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Artificial intelligence empowers pharmacological experimental teaching for overseas students: transformation and prospects

Xiulan Yang. Yang Yu
Experimental Teaching Center, Medical Department, Yangtze University, Jingzhou, Hubei, 421003, China

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Abstract

Driven by the dual forces of educational informatization and internationalization of medical education, integrating artificial intelligence (AI) into pharmacological experimental teaching for international students has become a key path to enhance teaching quality and cultivate international medical talents. This article delves into the current challenges faced by pharmacological experimental teaching for international students, and elucidates the unique advantages and application strategies of AI in optimizing teaching resources, innovating teaching modes, and improving evaluation systems. The aim is to refine teaching strategies, enhance teaching quality, stimulate students' learning enthusiasm, and provide theoretical support and practical references for constructing an efficient and intelligent new paradigm of pharmacological experimental teaching.

Keywords

Artificial Intelligence; International Student Education; Pharmacology Experimental Teaching; Teaching Reform

1. Introduction

Pharmacology experiments, as a core component of medical education, are crucial for international students to understand drug mechanisms, master experimental skills, and cultivate scientific thinking. However, traditional teaching models face challenges due to language barriers, cultural differences, and uneven knowledge foundations, resulting in ineffective teaching outcomes. AI technology, with its powerful data analysis capabilities, intelligent interaction, and simulation/emulation functions, offers new opportunities to address pharmacology experiment teaching challenges among international students. It has the potential to redefine teaching processes and enhance educational effectiveness.

2. Existing Challenges in Pharmacology Experiment Teaching for International Students

2.1. Language and Communication Barriers

Purported to be conducted in English, but international students exhibit uneven English proficiency, struggling with professional terminology comprehension (e.g., "pharmacokinetics", "pharmacodynamics"), resulting in operational instruction reception discrepancies and disordered experimental report writing, severely impacting information transmission and feedback.

2.2. Cultural Differences and Learning Habit

Conflicts Significant disparities exist between educational cultures and learning habits across countries. Some international students originating from systems emphasizing individual freedom exploration struggle to adapt to China's traditional "teacher-led, student-following" experimental teaching model. In team collaborative experiments, conflicts may arise due to differing communication styles and responsibility perceptions, reducing experimental efficiency and team cohesion.

2.3. Mismatch Between Teaching Resources and Personalized Needs

Traditional pharmacology experiment teaching resources (e.g., experiment textbooks, instructional videos) remain relatively fixed and lack specificity, failing to meet diverse knowledge backgrounds and learning progress requirements of international students. Students with weak foundations struggle to keep up with teaching pace, while those with strong foundations remain unsatisfied, limiting overall teaching effectiveness.

3. Advantages and Application Strategies of AI-empowered Pharmacology Experimental Instruction for International Students

3.1. Intelligent Language Assistance to Break Communication Barriers Leverage

AI translation tools (e.g., Youdao AI, Baidu Translate AI version) to real-time translate experimental guidelines and instructor explanations into the native language of international students, achieving seamless language alignment. Utilize speech recognition and synthesis technologies to enable international students to ask questions and receive guidance through voice, overcoming written expression difficulties and improving communication efficiency. For complex professional terms, employ visual aids such as images, animations, and case studies to illustrate concepts—e.g., using animations to demonstrate "drug transmembrane transport mechanisms"—enhancing understanding of abstract concepts.

3.2. Virtual Simulations to Resolve Cultural and Habitual Conflicts

Implement VR and AR technologies to create virtual pharmacology laboratories (e.g., "Virtual Drug Synthesis Laboratory," "Virtual Animal Experimentation Platform"), allowing international students to freely explore and repeatedly practice experiments in virtual environments without constraints of traditional laboratory facilities, equipment, or safety protocols. This approach also mitigates conflicts arising from cultural differences during collaborative experiments, enabling students to conduct experiments at their own pace and according to their habitual preferences.

3.3. Personalized Learning Support, Adapt to Diverse Needs

The AI analyzes data such as entrance exams, class performance, and homework completion to assess knowledge level and learning capacity, establishing personalized learning paths for each international student. For those with weak foundations, it arranges more fundamental knowledge reinforcement experiments and tutoring courses; for capable students, it recommends cutting-edge research extension experiments and academic literature. Based on learning paths and real-time progress, the AI automatically pushes tailored learning resources including experimental videos, e-books, academic papers, and exercises. For example, during an "antibiotic pharmac experiments" session, it provides the latest antibiotic research findings and clinical application cases to broaden knowledge horizons.

3.4. Multi-Dimensional Evaluation Feedback, Optimize Teaching Quality

AI has established a diversified evaluation system that comprehensively assesses multiple indicators including the standardization of experimental operations, quality of experimental reports, performance in team collaboration, and depth of knowledge understanding. Through real-time data collection and analysis, it not only focuses on final outcomes but also emphasizes learning processes, thereby comprehensively and objectively reflecting international students' learning status in pharmacology experiments. Additionally, AI supports peer evaluation and self-assessment mechanisms to encourage students to learn from each other, reflect on their growth, enhance their learning initiative and self-management skills, and further optimize the teaching quality of pharmacology experiments.

4. Challenges and Strategies

4.1. Technical Application Threshold and Teacher Training

The application of AI technology requires high information technology capabilities from teachers, with some exhibiting reluctance. Schools should implement systematic AI teaching training, including regular lectures and workshops on AI technology applications, expert-led guidance, and encouraging teachers to engage in AI teaching

project practices to improve their proficiency in applying AI technology in education.

4.2. Data Security and Privacy Protection

Student learning data generated during teaching processes involves privacy and carries risks of leakage. Schools must establish strict data security management systems, adopt technical measures such as encrypted storage and access control, to ensure data security; while simultaneously strengthening data security education for both teachers and students to enhance data protection awareness.

4.3. Integration of AI-assisted Teaching and Humanistic Education

Excessive reliance on AI may lead to the neglect of humanistic care in teaching. Teachers should emphasize emotional communication and value guidance with international students, such as guiding them to reflect on the social responsibilities and ethical considerations of pharmaceutical research during experimental discussions, thereby cultivating their humanistic literacy and professional spirit.

5. Conclusion

AI injects new vitality into pharmacology experimental teaching for international students, demonstrating significant potential in addressing teaching challenges and enhancing educational quality. Through applications such as intelligent language assistance, virtual simulation experiments, personalized learning support, and intelligent evaluation feedback, it aims to cultivate medical talents with solid pharmacological knowledge, innovative experimental capabilities, and global perspectives. Although facing challenges in technology, data management, and humanistic integration, collaborative efforts from schools, teachers, and students will surely achieve deep integration of AI with pharmacology experimental teaching, creating new prospects for international medical education.

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