Journal of Clinical and Nursing Research, 2025, Volume 9, Issue 9
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Innovation in the "Basic-Clinical" Connection Teaching Model of Biochemistry Course Empowered by AI Case-Guided Learning System

Yungang Shi, Meixia Jia, Changfeng Wang

Shijiazhuang Medical College, Shijiazhuang 050000, Hebei, China

Abstract: Against the background of the continuous reform in medical education, biochemistry, as a fundamental medical course, maintains a close connection with clinical practice. However, under the traditional teaching model, the effectiveness of the "basic-clinical" connection is relatively poor, which hinders the improvement of educational outcomes. In the practical teaching of higher vocational medical education, the integration of the AI Case-Guided Learning System can enhance students' enthusiasm for knowledge exploration and effectively improve teaching quality. Starting from the perspective of the "basic-clinical" connection teaching in the biochemistry course, this paper analyzes the application value of the AI Case-Guided Learning System and proposes specific application strategies, aiming to accumulate experience for the innovation of biochemistry teaching.

Keywords: AI Case-Guided Learning System; Biochemistry; Basic-clinical

Online publication: Oct 16, 2025

1. Introduction

Biochemistry plays a crucial role in medical teaching, as it provides theoretical support for clinical practice. Focusing on the chemical composition and properties of biological substances, biochemistry studies the laws of chemical changes occurring in life activities, which lays a foundation for subsequent learning of knowledge such as the pathogenesis of diseases, diagnostic methods, and therapeutic principles. With the development of artificial intelligence technology, the emergence of the AI Case-Guided Learning System aims to effectively improve teaching effects and promote the effective connection between "basic knowledge and clinical practice". The AI Case-Guided Learning System can integrate clinical case resources and facilitate the integration of biochemistry knowledge with clinical cases. By analyzing the innovation of the "basic-clinical" connection teaching model in the biochemistry course under the AI Case-Guided Learning System, medical education can be reformed effectively, feasible teaching models can be proposed to improve the quality of biochemistry teaching, and high-quality medical talents can be cultivated.

2. Application value of the AI case-guided learning system in the "basic-clinical" linkage teaching of biochemistry courses

2.1. Enhancing students' learning interest and initiative

In the biochemistry classrooms of higher vocational colleges, under the traditional teaching model, teachers often merely explain theoretical knowledge in class while students take notes mechanically. The entire teaching process is monotonous and boring, leading to students' lack of enthusiasm for learning knowledge [1]. The application of the AI case-guided learning system can promote the integration of biochemistry theories with clinical cases and present knowledge content to students through multimedia [2]. Real cases enable students to understand biochemistry knowledge, master the content of diagnosis and treatment, intuitively perceive the value of knowledge, and shift from passive learning to active learning, thereby enhancing their enthusiasm for knowledge exploration. For example, when teaching content related to glucose metabolism, the AI case-guided learning system can display cases of diabetic patients, such as patients' symptoms and blood glucose test results [3]. During the analysis of specific cases, students tend to actively participate in in-class knowledge exploration, understand knowledge such as the glucose metabolism process and the mechanism of insulin action, and analyze the causes of diabetes. By conducting knowledge learning through cases, students can learn knowledge in connection with problems, effectively improving learning quality and enhancing the effectiveness of education.

2.2. Strengthening students' ability to apply knowledge

Biochemistry knowledge is highly theoretical and abstract. In the process of learning professional knowledge, students often only memorize individual knowledge points and fail to grasp the specific application of such knowledge in clinical practice [4]. The application of the AI case-guided learning system can provide students with a high-quality knowledge learning platform, effectively transforming theories into practical skills. In the analysis of specific cases, students can combine the biochemistry knowledge they have learned with clinical problems to conduct in-depth analysis and judgment, thereby practically improving their ability to solve practical problems. For instance, when teaching content related to protein metabolism, the AI case-guided learning system can provide cases of relevant patients, such as those with liver cirrhosis [5]. Students can use knowledge about protein synthesis and decomposition to analyze the causes of the patients' symptoms and propose corresponding treatment suggestions based on specific symptom manifestations. Through the implementation of such training activities, students can better understand the specific clinical application of biochemistry knowledge and effectively enhance their knowledge application skills.

2.3. Optimizing the teaching process and improving teaching efficiency

The application of the AI case-guided learning system can provide personalized guidance based on students' specific situations, effectively achieving the goal of teaching students in accordance with their aptitudes. The system can record students' knowledge learning processes, analyze their mastery of knowledge points, identify their weak areas, and push relevant cases and learning materials, truly helping students make up for their knowledge gaps [6]. The implementation of personalized teaching can address the shortcomings of traditional teaching and enhance the targeting and effectiveness of teaching. Meanwhile, the system can automatically grade students' homework and case analysis reports, effectively reducing teachers' workload [7]. With the help of the system, teachers can devote more time and energy to activities such as case explanation and teaching design, thereby effectively improving teaching quality. In addition, the cases in the system can be reused, updated, and

improved, which effectively expands teaching resources and ensures the timeliness of content.

2.4. Promoting the integration of "basic-clinical" knowledge

In the traditional teaching activities of higher vocational medical education, basic medical courses and clinical medical courses are taught separately, resulting in a disconnect between students' theoretical knowledge and clinical practice knowledge. The AI case-guided learning system combines clinical cases to organically integrate biochemistry with clinical knowledge, which can effectively improve teaching effects [8]. In the process of analyzing specific cases, students can clearly recognize the application of basic theories in clinical practice, understand the inherent connection between the two, and truly achieve the integration of knowledge. For example, when teaching content related to nucleic acid metabolism, the system can present cases of cancer patients, covering biochemistry knowledge such as nucleic acid synthesis, decomposition, and gene expression, as well as clinical knowledge such as cancer diagnosis and treatment [9]. Students can analyze these cases to deepen their understanding of nucleic acid metabolism knowledge, clearly recognize the pathogenesis of cancer, and effectively integrate basic and clinical knowledge.

3. Practical strategies for the application of AI case-guided learning system in "basic-clinical" connection teaching of biochemistry course

3.1. Construction of case library

In the application of the AI case-guided learning system, higher vocational colleges need to attach importance to the construction of the case library, effectively collect real and typical cases, and strengthen the connection between these cases and biochemistry knowledge. During the specific case collection process, teachers should emphasize the authenticity and accuracy of cases, and incorporate cases covering different disease types and severity levels [10]. Meanwhile, it is also necessary to conduct strict screening and review based on the actual situation of cases to effectively ensure the quality of cases. The cases included in the case library must have a close connection with biochemistry knowledge, enabling students to engage in knowledge learning and effectively find relevant cases. Teachers can also classify and label cases according to the chapter knowledge of biochemistry, for example, dividing cases into carbohydrate metabolism-related cases, lipid metabolism-related cases and more. In addition, during the specific construction of the case library, it is necessary to add detailed key points, analysis, and reference answers to each case, helping students participate in knowledge learning and thus conduct case analysis more effectively [11].

To ensure the timeliness and advancement of the case library, teachers need to set a fixed schedule to update and improve it. By strengthening cooperation with hospitals and other medical institutions, they can continuously collect clinical cases, supplement them to the case library, and effectively expand teaching resources. At the same time, relevant cases can be revised and optimized based on teaching feedback and medical development achievements, truly making the case library meet teaching needs and improve the effectiveness of talent cultivation.

3.2. Design of teaching process

To smoothly apply the AI case-guided learning system, teachers need to pay attention to the optimization of the teaching process and design a reasonable one, including pre-class preview, in-class learning, and after-class review [12]. During the

pre-class knowledge preview stage, teachers can use the system to push relevant case learning materials, helping students understand the course-related content in advance. Teachers can independently conduct case analysis, identify the biochemistry knowledge involved, and guide students to actively carry out preview activities. Through pre-class preview, students can initially understand the course content, engage in professional knowledge learning based on related questions, and deepen their understanding of knowledge. In the in-class learning process, teachers can organize students to conduct knowledge exchanges based on the cases previewed before class and encourage them to share their learning ideas and achievements. Teachers can explain and provide guidance on biochemistry knowledge based on the students' knowledge discussion. They can also help students sort out their learning ideas and deepen their understanding of knowledge [13]. In the specific explanation of professional knowledge, teachers can use the system's multimedia resources, such as animations and pictures, to vividly and intuitively present the knowledge related to biochemistry courses and clinical cases. In the final after-class review stage, teachers can guide students to use the system to review the cases and knowledge explained in class and effectively complete the case analysis assignments assigned by the system. The system can automatically grade students' assignments and provide constructive feedback. Students can then identify gaps in their knowledge based on the feedback, deepen their understanding of the learned knowledge, and actively conduct case simulation exercises to effectively improve their skills in applying theoretical knowledge.

3.3. Transformation of teachers' roles

In the teaching model empowered by the AI Case-Guided Learning System, teachers' roles need to shift from knowledge transmitters to guides and organizers. Teachers are no longer the center of the classroom; instead, they should guide students to take the initiative in learning and organize discussions and exchanges among students. During the teaching process, teachers need to carefully design teaching plans, select appropriate cases and learning materials, and adjust teaching strategies in a timely manner based on students' learning progress. When students encounter difficulties in case analysis, teachers should provide appropriate hints and guidance to help them solve problems [14]. At the same time, teachers should encourage students to think actively, speak boldly, and foster their innovative thinking and teamwork spirit. In addition, teachers need to continuously learn and master knowledge related to AI technology to improve their ability to use the AI Case-Guided Learning System. They should also actively participate in the construction and update of the case database to provide high-quality teaching resources for the system. Only when teachers' role transformation is fully realized can the AI Case-Guided Learning System be fully utilized, and the innovation of the teaching model be achieved.

3.4. Improvement of the evaluation system

A sound evaluation system is an important guarantee for ensuring teaching quality. In the teaching model empowered by the AI Case-Guided Learning System, the evaluation system should focus more on assessing students' comprehensive abilities rather than merely testing their memory of knowledge points [15]. The evaluation content can include students' case analysis ability, knowledge application ability, teamwork ability, and innovative thinking ability. Diverse evaluation methods can be adopted, such as student self-evaluation, group peer evaluation, and teacher evaluation. In the evaluation process, full use should be made of the advantages of the AI Case-Guided Learning System: the system records students' learning processes and case analysis results, providing objective and accurate basis for evaluation.

Meanwhile, a timely feedback mechanism should be established to convey evaluation results to students

promptly, enabling them to understand their strengths and weaknesses and make improvements in future learning. Through a refined evaluation system, students can be motivated to learn actively and enhance their comprehensive abilities.

4. Conclusion

To sum up, in the teaching of biochemistry courses, the application of the AI Case-Guided Learning System can effectively carry out the "basic-clinical" connection teaching. The integration of AI and clinical cases helps to enhance students' enthusiasm for knowledge exploration, cultivate their knowledge application skills, and build a high-quality case resource database, laying a solid foundation for students to engage in course learning. With the deepening of artificial intelligence and medical education reform, the AI Case-Guided Learning System has broader application prospects, pointing out the correct development direction for the talent cultivation of higher vocational medical majors in the future.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Wang H, Li D, Wang L, et al., 2025, Reform of Biochemistry Experiment Teaching Oriented by Clinical Practical Ability Cultivation. Chemistry of Life, 45(01): 160–164.

[2] Wan L, Chen M, Lai Y, et al., 2024, Exploration on Teaching Design of Clinical Biochemistry Testing from the Perspective of Curriculum Ideology and Politics. Journal of Medical Theory and Practice, 37(15): 2685–2688.

[3] Chen C, Yang Y, Zhang T, et al., 2024, Exploration on the Reform of Curriculum Ideology and Politics in Clinical Biochemistry Testing Based on National First-Class Majors. China Continuing Medical Education, 16(13): 42–46.

[4] Zhang Y, Guo S, Zhang J, 2024, Exploration and Practice of Blended Teaching Mode Reform in Clinical Biochemistry Testing Course. The Science Education Article Collects, 2024(11): 108–111.

[5] Luo Y, Lu Q, Tang Y, et al., 2024, Research and Practice on Teaching Reform of Clinical Biochemistry Testing Course. Technology Wind, 2024(11): 133–135.

[6] Li Q, Liu L, 2024, Exploration on the Application Mode of Small-Class Teaching in Clinical Biochemistry Testing Technology Course for Medical Laboratory Technology Major. Medical Teaching in Universities (Electronic Edition), 14(02): 33–37.

[7] Pan Y, Xi J, Jin D, et al., 2024, Exploration of ChatGPT-Assisted Online Teaching of Clinical Biochemistry Testing Technology. Laboratory Medicine and Clinic, 21(09): 1341–1344.

[8] Liu Q, Guo H, Liu Q, 2024, Reform and Innovation of Biochemistry Course in Application-Oriented Undergraduate Universities Under the OBE Concept. Journal of Jilin Agricultural Science and Technology University, 33(01): 85–88.

[9] Xu K, Zhang L, Zhu Y, et al., 2024, Comparative Study of Cooperative Learning and Lecture-Based Teaching in Clinical Biochemistry Testing Course. Chemistry of Life, 44(02): 363–368.

[10] Wang R, Chen Q, Lin N, et al., 2023, Investigation and Analysis of the Implementation Effect of HICV Teaching Mode—Taking Clinical Biochemistry Testing Technology as an Example. Journal of Chengdu University of Traditional Chinese Medicine (Educational Science Edition), 25(04): 39–41.

[11] Liu D, Sun L, Yang M, et al., 2023, Exploration on the Reform of Clinical Biochemistry Testing Experiment Teaching. Medical Teaching in Universities (Electronic Edition), 13(06): 48–51.

[12] Tang W, Huang H, Lian C, et al., 2023, Practice and Summary of Mind Mapping in Biochemistry Teaching for Clinical Medicine Major. Journal of Bengbu Medical College, 48(11): 1604–1606 +1612.

[13] Du G, Zhou D, 2023, Exploration on Promoting Biochemistry Teaching Reform by Connecting Knowledge Points with Clinical Cases. Basic Medical Education, 25(10): 850–854.

[14] Ji S, Hu S, Bai P, et al., 2023, Exploration on the Construction of Curriculum Ideology and Politics in Clinical Biochemistry Testing Technology. Medical Education Research and Practice, 31(05): 598–602 + 612.

[15] Dai H, Bai S, Lu J, et al., 2023, Reform and Practice of Clinical Biochemistry Testing Training Teaching for Cultivating Comprehensive Practical Ability. Journal of Modern Medicine & Health, 39(15): 2670–2673.