

Visualization Analysis and Reflection on Research Hotspots and Trends in Pathophysiology Teaching

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ABSTRACT

Pathophysiology is a science that deeply explores the occurrence and development of diseases, studies the mechanisms behind the final results, and integrates knowledge from multiple disciplines such as physiology, biochemistry, and immunology. The core lies in revealing the pathological and physiological changes during the disease process and analyzing the fundamental principles. In the medical education system, pathophysiology is an integral part of the foundational curriculum, serving as a bridge between basic medicine and clinical medicine. By studying pathophysiology, students can comprehensively understand the initial causes of diseases, pathological processes, and functional metabolic changes of the body under disease conditions. This discipline is also committed to cultivating students' systematic thinking, critical analysis skills, and problem-solving abilities, comprehensively enhancing their overall quality, making them more competitive and adaptable in the medical field.

1. Introduction

Against the backdrop of rapid medical development, the teaching strategies and content of pathophysiology are constantly being updated and improved. Medical education is facing unprecedented challenges and opportunities, and how to cultivate medical talents with innovative consciousness and practical ability has become a focus of attention in the education industry. The rapid development of information technology, multimedia, network platforms, and virtual reality technology provides new paths for innovative teaching models in pathophysiology. The integration of pathophysiology with other disciplines is becoming increasingly close, and curriculum integration has become an important direction for teaching reform. Breaking down disciplinary barriers and organically integrating knowledge from pathophysiology and related dis-

ciplines enables students to establish a complete knowledge framework and improve learning outcomes during the learning process. Systematically analyze the current focus and trends in pathophysiology teaching research, provide direction for future teaching innovation and curriculum system construction, improve education quality, and cultivate excellent medical professionals.

2. Analysis of the Current Status of Teaching and Research in Pathophysiology

2.1 Evolution of teaching methods and models

In recent years, the teaching methods of pathophysiology have changed to cater to the rapid development of medical education and meet the diverse needs of students. In traditional teaching, the focus of pathophysiology is

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on classroom lectures and textbook learning. While rote learning ensures systematic knowledge transmission, it neglects students' initiative and innovative potential. With the continuous updating of educational concepts, educators in pathophysiology have begun to explore diverse teaching strategies^[1]. Especially with the rapid development of information technology, the teaching mode of online platforms has become increasingly popular, breaking the traditional limitations of time and space and increasing students' autonomy in learning. Through online platforms, teachers can easily publish teaching resources and assign homework, while students can independently arrange their study time, submit homework, participate in discussions, and provide feedback on their learning experience, improving teaching efficiency and enhancing students' self-learning and teamwork abilities. Emerging teaching models such as flipped classrooms and micro courses are gradually being applied in the teaching of pathophysiology. Flipped classroom moves classroom lectures to before class, encouraging students to self-study through videos and literature. In class, it focuses on interactive discussions and case analysis, improving students' participation and learning effectiveness. Micro courses are presented in the form of short videos, providing in-depth explanations of specific knowledge points for students to quickly master. Blended learning is a new attempt to combine online and offline teaching, providing teachers with accurate teaching feedback and flexible adjustment of teaching strategies through real-time interaction and data analysis^[2].

2.2 Quantitative analysis of teaching research literature

With the deepening of medical education reform, the research on pathophysiology teaching has attracted the attention of scholars, and related research results continue to emerge. Enrich the teaching theory of pathophysiology and provide reference for practical teaching. The research involves multiple aspects such as teaching methods, teaching models, and teaching evaluations, optimizing traditional teaching methods and exploring new teaching models based on problems, case studies, and simulation teaching. Teaching evaluation has also become a new focus of research, by establishing a scientific and comprehensive evaluation system to objectively evaluate the teaching achievements of pathophysiology^[3]. It is worth noting that research on pathophysiology teaching has expanded from internal research within a single school or institution to cross school and cross regional cooperation and exchange, promoting in-depth research on pathophysiology teaching and facilitating the sharing and optimization

of teaching resources^[4].

2.3 Hotspot clustering networks and trends in teaching research

Through cluster analysis of research hotspots in pathophysiology teaching, it can be foreseen that with the continuous development of information technology and the updating of educational concepts, researchers will continue to explore more efficient, flexible, and diverse teaching methods and models to adapt to the rapid development of medical education and the diversification of student needs. With the improvement of the quality of medical education and the improvement of the evaluation system, teaching evaluation and feedback will be given more attention, and teaching strategies will be adjusted in a timely manner to meet students' learning needs and achieve the goal of improving teaching quality. Interdisciplinary integration and cross disciplinary research have also become new trends in the teaching and research of pathophysiology. With the close integration of medicine with other disciplines, the teaching of pathophysiology will also undergo in-depth interdisciplinary research, expanding students' knowledge horizons and achieving the goal of cultivating comprehensive qualities and innovative abilities^[5].

3. Hot spot analysis of teaching and research in pathophysiology

3.1 Application of flipped classroom and micro lessons

Flipped classroom subverts the traditional teaching process, characterized by transferring classroom lectures to pre class, allowing students to learn independently through watching videos and reading materials. In the teaching of pathophysiology, the application of flipped classroom helps students deepen their understanding of complex pathophysiological processes, enhance their learning enthusiasm and participation. Not only does it enhance students' self-learning ability, but it also exercises teamwork and communication skills, laying the foundation for continuing education. Micro courses, as concise instructional videos, focus on explaining specific knowledge points or skills, presented in a clear and concise manner. In the study of pathophysiology, micro courses provide students with convenient and efficient learning resources, allowing them to choose appropriate content based on their personal progress and interests, and deepen their understanding of pathophysiology knowledge^[6]. Micro courses also provide teachers with rich teaching materials to help design and implement more targeted teaching plans.

3.2 Integration of Rain Classroom and Ideological and Political Education

Rain Classroom, as a blended learning model combining online and offline teaching, provides teachers with accurate teaching feedback and improves the teaching effectiveness of pathophysiology through real-time interaction and data analysis. Rain Classroom simplifies the teaching management process, such as homework release and grade statistics, to reduce the workload of teachers. Integrating ideological and political education into the teaching of pathophysiology, cultivating students' correct values and professional ethics^[7]. By combining the professional knowledge of pathophysiology with ideological and political education content, teachers can guide students to explore issues such as medical ethics and humanistic care, enhance their sense of social responsibility and professional ethics. Improving students' comprehensive quality also injects new vitality and depth into medical education.

3.3 Development and Teaching Application of Pathological Techniques

Modern pathological techniques include multiple fields such as conventional pathology, immunohistochemistry, molecular pathology, etc., providing support for accurate diagnosis, treatment, and prognosis evaluation of diseases. Introducing the latest pathological technology research results in the teaching process of pathophysiology can help students gain a deeper understanding of the pathological and physiological mechanisms of diseases. By combining experimental teaching with case analysis, teachers can guide students to master the pathogenesis and clinical manifestations of diseases, improve experimental skills and clinical thinking. The innovation of pathological technology has also brought new teaching methods for pathophysiology teaching, such as virtual simulation experiments, remote teaching, etc., enriching teaching content, enhancing students' learning interest and teaching effectiveness^[8].

4. Exploration of the Trends in Teaching and Research of Pathophysiology

4.1 Cross school cooperation and resource sharing

In the wave of globalization, the richness of educational resources is increasing day by day, and cooperation and resource sharing among different universities also exist in the field of teaching and research in pathophysiology. Accelerating the sharing of high-quality teaching resources, including an excellent team of teachers, advanced teaching facilities, and diverse teaching cases, not only

improves the teaching level, but also deepens academic exchanges and research cooperation, providing impetus for the deep exploration and sustainable development of the discipline of pathophysiology. In terms of resource exchange, the application of digital technology provides strong technical support for cross university cooperation. By establishing a pathological physiology teaching resource database and online teaching platform, digital, networked, and intelligent management of resources can be achieved, facilitating teachers and students to access the required teaching resources anytime and anywhere^[9], and providing interactive communication, online Q&A, and homework submission functions, enriching teaching methods and learning experiences.

4.2 Personalized teaching and precision teaching

With the updating of educational concepts and the rapid advancement of technology, personalized and precise teaching strategies have been valued in the research of pathophysiology teaching. Personalized teaching focuses on students' individual needs and learning differences, tailoring teaching plans to fully stimulate students' learning enthusiasm and potential. In the teaching of pathophysiology, teachers can develop personalized teaching plans and provide targeted guidance based on students' learning styles, interests, and basic knowledge. Precision teaching is based on personalized teaching, using technologies such as big data and artificial intelligence to monitor and evaluate students' learning process in real time, accurately grasp students' learning status and effectiveness, help teachers identify and solve students' learning problems in a timely manner, flexibly adjust teaching strategies, and ensure that each student can achieve the best learning outcomes^[10].

4.3 The combination of pathophysiology and artificial intelligence

The rapid development of artificial intelligence technology has brought new opportunities and challenges to the teaching of pathophysiology. Pathophysiology teaching is entering a new era of greater intelligence, efficiency, and precision through the combination of artificial intelligence technology. Constructing a knowledge graph of pathophysiology provides students with more comprehensive and systematic learning resources. Using artificial intelligence for remote teaching and online Q&A breaks through traditional time and space limitations, providing teachers and students with more convenient and flexible learning paths. The combination of pathophysiology and artificial intelligence promotes in-depth research in

pathophysiology. Through the analysis and mining of big data, new disease mechanisms and treatment methods are revealed, making important contributions to the progress of medical science. Artificial intelligence technology also provides an intelligent evaluation system for teaching pathophysiology, helping teachers objectively and comprehensively evaluate students' learning outcomes.

5. Trends and prospects

5.1 Summarize the hotspots and trends in teaching and research of pathophysiology

With the continuous development of biological science, computer science, and image processing technology, emerging technologies such as digital pathology, optical coherence tomography (OCT), and molecular pathology are gradually integrating into the field of pathological examination to improve the accuracy and efficiency of pathological diagnosis. The application of artificial intelligence in the fields of pathology and physiology is becoming increasingly widespread, especially in the field of pathological image recognition technology. By intelligently analyzing digital slice images, it provides accurate diagnostic assistance for doctors. In terms of personalized medicine within hospitals, pathophysiology provides theoretical support for predicting disease progression and developing personalized treatment plans through in-depth research on the mechanisms of disease formation and progression. Molecular pathology plays an indispensable role in tumor treatment. For example, HER-2 gene amplification plays a guiding role in targeted treatment of breast cancer and gastric cancer, laying a solid foundation for precision medicine. The interdisciplinary cooperation between pathophysiology, basic medicine, clinical medicine, and other disciplines is becoming increasingly close, jointly promoting the progress of medical science. In the fields of disease prevention and control, as well as new drug development, cooperation between pathophysiology and public health, pharmacy, and other areas is becoming increasingly common. The combination of pathophysiology and artificial intelligence is not only to meet future educational needs, but also to construct effective educational methods.

5.2 Suggestions for future teaching reform in pathophysiology

The teaching content of pathophysiology should keep up with the forefront of disciplinary development, constantly update and expand, including cellular and molecular pathophysiology, the latest diagnostic technologies, etc. We need to increase the reform of experimental courses

and exercise students' abilities in scientific research exploration and innovative thinking through practical operations. Encourage students to actively participate in scientific research and closely integrate theoretical knowledge with practical operations. Using digital technologies such as virtual reality (VR) and augmented reality (AR), create a pathological simulation environment to help students intuitively understand the structure and function of human pathology. Establish an online learning platform and resource library, providing flexible and diverse learning methods. Teachers can set up interactive activities in the classroom, such as real-time testing, online discussions, etc., to enhance students' classroom participation. Establish an effective learning feedback mechanism, timely understand students' learning status, and adjust teaching strategies in a timely manner.

6. Conclusion

In today's rapidly developing information technology, pathophysiology teaching will place greater emphasis on technology driven teaching innovation, utilizing technologies such as big data and artificial intelligence to optimize teaching processes and evaluation systems. Through international exchanges and cooperation, advanced teaching concepts and methods are introduced to comprehensively improve the teaching level of pathophysiology in China. In the future, pathophysiology teaching will pay more attention to meeting students' personalized and customized learning needs. By analyzing students' learning data and preferences, customized learning paths and resources will be provided for each student. Pathophysiology teaching will also strengthen the cross integration with disciplines such as public health, pharmacy, biotechnology, etc., to jointly promote innovation in the medical field. Looking ahead, the teaching of pathophysiology will demonstrate trends such as technological integration, personalized medicine, and interdisciplinary collaboration. In the face of these trends and challenges, it is necessary to maintain mastery of new knowledge and technologies to adapt to the constantly changing environment and enhance one's competitiveness.

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