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Construction of a Blended Theoretical Teaching Model for Pharmacogenomics Under the Background of Precision Medicine

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Abstract: The rapid development of precision medicine has put forward new requirements and challenges for pharmacogenomics teaching, and the traditional theoretical teaching model can no longer meet the needs of interdisciplinary integration and talent training goals. Based on this, this paper studies the construction of a blended theoretical teaching model for pharmacogenomics under the background of precision medicine, analyzes the current problems in teaching, expounds the application value of the blended theoretical teaching model in teaching, and proposes corresponding implementation countermeasures. The aim is to provide teaching reference for cultivating high-quality pharmaceutical talents meeting the development needs of precision medicine, and promote the reform and high-quality development of pharmacogenomics teaching.

Keywords: precision medicine; pharmacogenomics; blended teaching; theoretical teaching model; teaching reform

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1. Introduction

Precision medicine achieves the core goal of "personalized medicine" by accurately locating disease mechanisms and

optimizing diagnosis and treatment plans, and has become a global research hotspot and important direction in the medical field. As a core supporting discipline of precision medicine, pharmacogenomics focuses on the association between genetic polymorphism and drug efficacy and adverse reactions. Its teaching quality directly affects the core competitiveness of talents in pharmacy, clinical medicine and other majors. The blended teaching model integrates the flexibility and convenience of online teaching with the interactivity and pertinence of offline teaching. By optimizing the allocation of teaching resources and reconstructing the teaching process, it realizes the organic combination of "online independent learning + offline in-depth discussion", and has shown significant advantages in the teaching reform of multiple disciplines [1]. Therefore, exploring the construction of a blended theoretical teaching model for pharmacogenomics under the background of precision medicine is of great value.

2. Problems existing in pharmacogenomics teaching under the background of precision medicine

2.1. Disconnection from the development of precision medicine

At present, the theoretical teaching content of pharmacogenomics mainly includes classic cases of genetic polymorphism and basic experimental principles, with lagging cutting-edge developments, showing a phenomenon of "valuing basics while neglecting frontiers". The update cycle of textbook content is long, and many teaching contents of pharmacogenomics lag behind the technological breakthroughs and scientific research progress in the field of precision medicine. Cutting-edge contents such as multi-omics joint analysis, clinical application of gene sequencing technology in pharmacogenomics, and personalized medication guidance are difficult to integrate into teaching, resulting in students' lack of understanding of the disciplinary development trends [2]. The teaching process lacks the core concept of precision medicine. Most courses only involve pharmacogenomics theories, lacking the connection of links such as precise diagnosis, precise treatment, and precise prevention. It is difficult for students to establish an integrated thinking of "gene - drug - clinic", and thus hard to meet the practical requirements of pharmaceutical talents under the background of precision medicine.

2.2. Single teaching model

At present, most theoretical teaching of pharmacogenomics adopts the traditional classroom lecture model, with low teaching innovation and diversification. The current teaching model mostly adopts a one-way indoctrination model where teachers lecture and students receive, ignoring the dominant position and initiative of students, which is difficult to stimulate students' learning interest and exploration desire [3]. The traditional one-way teaching model can hardly fully mobilize students' initiative, easily leading to cognitive deviations of students on complex concepts such as genetic polymorphism and drug metabolism mechanisms, and also affecting the cultivation of students' logical thinking ability and problem-solving skills.

2.3. Imperfect teaching evaluation system

The current teaching evaluation system still has many limitations and cannot achieve the goal of comprehensive and integrated evaluation. The evaluation method is relatively single, only focusing on the assessment of memory of basic knowledge, while ignoring students' initiative and practical operation skills, resulting in the lack of channels to reflect comprehensive quality performance [4]. The evaluation content lacks pertinence. Without combining the disciplinary characteristics of pharmacogenomics under the background of precision medicine, the assessment of students' core abilities such as cutting-edge knowledge reserve and precise medication thinking is insufficient, leading to the failure of evaluation results to provide effective feedback for teaching improvement and talent training.

3. Application value of the blended theoretical teaching model for pharmacogenomics under the background of precision medicine

3.1. Conducive to connecting with disciplinary frontiers

The blended teaching model can integrate the latest cutting-edge scientific research achievements and technological progress in the field of precision medicine by virtue of the flexibility of online teaching platforms, making up for the defect of slow update of traditional textbooks. The online platform can timely upload materials related to precision medicine, guiding students to independently learn cutting-edge contents such as gene sequencing, multi-omics analysis, and artificial intelligence-assisted medication guidance, achieving synchronous resonance between teaching content and disciplinary development. At the same time, through the combined online and offline teaching, the core concept of precision medicine is fully infiltrated into all links of pharmacogenomics teaching, enabling students to clarify the internal connection between pharmacogenomics and precision medicine, and cultivating students' frontier thinking and interdisciplinary integration ability [5].

3.2. Conducive to optimizing the teaching process

The blended teaching model breaks the inherent limitations of traditional classrooms in time and space, and realizes the innovation of educational concepts and practical paths by establishing a three-stage framework system of "online independent preview + offline in-depth discussion + online consolidation and expansion". In the pre-learning link, students can watch videos at their own pace, complete pre-class tasks, and digest core knowledge points in advance. In the offline interaction link, key concepts are explored in depth to promote students' in-depth understanding of knowledge and development of application abilities. After class, the online education platform can use intelligent technology to push personalized exercises and resource expansion, helping students form an efficient learning model of "independent pre-learning - in-depth exploration - systematic integration", which can not only enhance students' sense of subject participation but also improve their independent inquiry ability and practical application ability [6].

3.3. Conducive to improving evaluation dimensions

The blended teaching model provides strong support for establishing a diversified and comprehensive evaluation system, breaking the limitations of traditional single evaluation methods. The various evaluation mechanisms cooperating with online and offline not only pay attention to the mastery of theoretical knowledge but also attach importance to the cultivation of independent inquiry spirit, team cooperation awareness, and innovative ability, realizing the organic integration of "formative assessment + summative assessment" and "disciplinary knowledge accumulation + practical skill improvement". This can more comprehensively and accurately reflect learning outcomes and development potential, promoting the continuous improvement of educational quality and meeting personalized needs [7].

4. Construction countermeasures of the blended theoretical teaching model for pharmacogenomics under the background of precision medicine

4.1. Integrate precision medicine resources and infiltrate blended learning theories

Under the background of precision medicine, in promoting blended teaching of pharmacogenomics courses in universities, it is necessary to build an online education platform integrating "precision medicine" and "pharmacogenomics", collect authoritative literature, classic cases, and technical manuals from home and abroad, comprehensively include the main theories, experimental methods, and latest achievements of pharmacogenomics, upload them according to disciplinary classification, and store the materials in a digital learning resource library. Thus, a diversified teaching system including preview materials, video explanations, extended reading, clinical case analysis, and interactive exercises is formed. Invite senior clinical pharmacists and relevant technical personnel to participate in the compilation work, select materials from actual diagnosis and treatment environments to improve the quality of materials, pay specific attention to disciplinary

frontier and practicality, and design curriculum modules suitable for students' learning and use, preferably specific application scenarios such as the setting of tumor targeted therapy plans and "individualized medication guidance for cardiovascular metabolic diseases". The curriculum system construction should promote students' knowledge transfer and be optimized in practice. Based on blended learning theories, clarify the functional scope of online and offline [8]. In the online part, focus on the push of basic teaching content and high-quality resources as well as the design of personalized assignments to promote students to independently construct knowledge systems; while in offline courses, focus on the interpretation and communication of key topics as well as practical operations. Through in-depth dialogue and special guidance, it can improve learners' mastery and promote skill transfer, achieving mutual support between the two.

4.2. Innovate curriculum teaching methods and implement three-stage blended teaching

In the teaching process, teachers should construct a three-stage blended teaching model of "pre-class online self-learning - in-class interactive exploration - post-class expansion and consolidation", and optimize the curriculum system planning. During preview, teachers upload learning packages including basic theory explanation videos, knowledge frameworks, and exercises on the online platform, encouraging students to systematically master the main concepts of pharmacogenomics and the basic principles of genetic polymorphism, and conduct preliminary discussions on the latest development of precision medicine. After students submit preview results, teachers and students jointly review and summarize opinions, and adjust the focus of offline teaching accordingly. In the in-class teaching process, teachers can adopt various methods such as case analysis, group cooperation, and scenario simulation to focus on discussing difficult problems and key knowledge points, improving students' cognitive level and operational ability [9]. For example, assign the theme of "Clopidogrel medication and CYP2C19 genetic polymorphism", carry out special seminars, and students analyze in groups the specific mechanisms by which differences in genotypes affect drug efficacy, formulate personalized treatment plans based on patients' clinical conditions, and simulate the consultation process that pharmacists encounter when facing patients in practice, thereby training students' critical thinking ability and comprehensive application ability. In the post-class link, teachers should submit extended resources through the digital system, such as key literature commentaries, typical case analyses, and similar exercises, guiding students to deeply understand the content and importance of the course, submit assignments online, and trigger independent research through the online evaluation system, so as to achieve a good integration model of online and offline [10,11].

4.3. Enrich offline theoretical teaching and enhance teaching interactivity

Offline teaching is the focus of blended teaching. Teachers can enrich the form and improve interactivity by using three teaching methods: case-driven teaching, problem-based learning (PBL), and team-based learning (TBL). Case teaching focuses on clinical scenarios of precision medicine, guiding students to disassemble clinical problems around cases such as clopidogrel medication and genetic polymorphism, and individualized drug administration for tumors, and establishing "gene - drug - efficacy" related thinking by linking theoretical knowledge. PBL teaching takes disciplinary difficult problems as the trigger, asking students how multi-omics analysis can optimize plans to trigger independent inquiry and problem-solving, and teachers can act as guides to sort out ideas and answer questions. TBL divides students into groups, which conduct division of labor and cooperation around a certain case or theme, deepen understanding through in-class presentations, peer evaluation, and in-depth discussions, and improve interaction efficiency through small-class teaching to ensure that everyone can fully participate in discussions and express their views. This method integrates a variety of teaching means, and while realizing the transformation from abstract theories to practical skills, establishes a system for cultivating core competencies of precise medication [12]. In addition, teachers can use virtual simulation technology to build a pharmacogenomics experimental platform, use digital tools to reproduce the main steps of genetic testing, pharmacokinetic analysis, and personalized treatment plan formulation, strengthen theoretical understanding and improve practical operation ability in a virtual immersive learning environment, so that each student can fully participate in interactive discussions, thereby improving the accuracy of classroom teaching [13].

4.4. Improve curriculum learning evaluation and form online-offline evaluation

To effectively improve the implementation effect of blended teaching, teachers should establish a multi-dimensional evaluation system integrating online and offline to comprehensively examine the development of students' comprehensive quality. In the online evaluation part, teachers use the data analysis function of the digital learning platform to focus on the implementation of preview tasks, the duration and progress distribution of video viewing, the quality of individual homework submission, and the degree of classroom interaction participation, comprehensively reflecting the results of individual independent cognitive ability improvement [14]. In the offline evaluation part, teachers focus on the in-class experience. In the physical classroom scenario, they focus on the frequency of teacher-student interaction, the intensity of group cooperation, the level of case analysis and literature writing, and the scores of phased assessments, while paying attention to the cultivation of critical thinking and the assessment of comprehensive application of multi-disciplinary knowledge [15]. In addition, teachers should add student self-evaluation and peer evaluation links. Students summarize and reflect on their own learning situation through the online platform, evaluate the cooperative performance and contribution of other members in the group, and incorporate the results of self-evaluation and peer evaluation into the comprehensive evaluation system, thereby enhancing the objectivity and fairness of the evaluation.

5. Conclusion

In summary, the rapid development of precision medicine provides an opportunity and puts forward higher requirements for the teaching reform of pharmacogenomics. As a new teaching model, the blended theoretical teaching model can effectively connect with disciplinary frontiers, optimize the teaching process, and improve the evaluation system, which is of great significance for improving teaching quality and cultivating professional talents meeting the development needs of precision medicine. In the teaching process, teachers should focus on integrating teaching resources, innovating teaching methods, enriching offline interaction, and improving the evaluation system to realize the in-depth integration of online and offline teaching. In subsequent teaching, teachers should continuously deepen teaching reform, promote the high-quality development of pharmacogenomics teaching, and cultivate more high-quality professional talents.

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Disclosure statement

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