The Application of Blended Teaching in Medical Biochemistry and Molecular Biology Course

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Abstract. The objective of this study was to explore the application of blended teaching in medical biochemistry and molecular biology course for clinical medical students. Using the Zhihuishu platform and the Test Database of Chinese Medical Education by People's Medical Publishing House as online educational materials, combined with traditional place-based classroom methods, to explore the transformation of teaching mode which is suitable for medical education and teaching characteristics in the information technology era. It provides experience for the teaching reform of biochemistry and molecular biology course, and will help to improve teaching effect, improve teaching theory and construct new teaching models.

Introduction

Biochemistry and molecular biology is a basic subject of life science and basic medicine science. This course is mainly deals with the molecular basis and regulation of molecular structure and function, metabolism and regulation of organisms, and inheritance of genetic information. Biochemistry and molecular biology courses are mainly taught by traditional classroom methods. It is difficult to stimulate students' interests in learning, because this is a strong theoretical specialized course and its content is too abstract to understand and memorize [1]. With the development of Internet and information technology, Massive Open Online Course (MOOC) is a large-scale open online course, and has been applied in the process of teaching English, computer, law and other courses in many universities. MOOCs feature traditional course materials including videos, readings, and problem sets. MOOCs also provide interactive user forums that should help build a community [2]. MOOCs use recorded video lectures and discussion forums to engage students. It provides a learning experience that embodied the attributes of the Internet: open, accessible, networked, distributed and participative. Online learning affords the use of games, tutorials, videos, and such that can support learning at different levels and for students with specific needs [3]. But the dropout rate is high, only 10-20\% of students complete the courses by learning the online courses in MOOCs [4]. Blended teaching which combined the web-based online learning with the traditional face-to-face instruction has been widely applied in many courses. The approach combines the benefits afforded by both face-to-face and online learning mode of instructions, it reduces online transactional distance and increases the interaction between teachers and their students, offers flexibility, pedagogical richness, ensures value interaction and learning engagement [5]. At present, the contents of biochemistry courses in MOOC resources of colleges and universities are increasing, but these courses lack systematic analysis and research, and are seldom used in practice [6]. Qiqihar Medical University worked online education as an important strategy of school development since 2017, and biochemistry and molecular biology is designed for the pilot course of blended teaching. This study introduced the experience of application of blended teaching in medical biochemistry and molecular biology course, in order to provide experience for the teaching reform of biochemistry and molecular biology course, and help to improve teaching effect, improve teaching theory and construct new teaching models.
Blended Teaching Course Design

Course Objectives

The first step in the blended course design process was to focus on the objectives of the course. By the end of this course, the students should master the structures, functions and their chemical reactions of some biological molecules in living organisms, basic concepts and mechanism of biochemical processes, students should have a systematic and comprehensive understanding of the basic rules of gene activity at the molecular level. In this course, the students would establish scientific and clinical thinking by the clinical case.

Resource Preparation

Before the start of the course, we collected the curriculum resources of Biochemistry and molecular biology on the main MOOC platform, and fully used the existing excellent resources such as videos, pictures, cases and PPT for reference. Before class, teachers with rich teaching experience shall record learning videos according to teaching knowledge points. Each video shall explain 1-3 knowledge points in 5-15 minutes. It is convenient for students to watch the video content selectively in fragmented time and they can repeat learning until they fully understand and master the knowledge points.

Running the Course

Before the theoretical course is taught, teachers release learning information through the Zhihuishu platform (https://coursehome.zhihuishu.com/) and students are required to learn independently on the online platform. Teachers can check the students to complete the task list and student feedback problems that students encounter the difficulties in the learning process, and design rational teaching plan in advance, in order to help students understand and master in the classroom. Students find problems before class, so that students can study in the classroom and improve the learning effect. Students are encouraged to leave comments and discuss in the forums of Zhihuishu platform. Students can communicate with each other on questions, and teachers can answer students' questions in time through replies.

Analysis of Clinical Cases

The online courses of Biochemistry and molecular biology are divided into four parts: protein chemistry, nucleic acid chemistry, metabolism and energy, and genetic information transmission. Combined with clinical knowledge, set 6-8 cases for each part, and release the cases and related problems on Zhihuishu platform during the learning of relevant content. Each class is divided into 4-5 case analysis groups to discuss and analyze the cases in groups. The students rush to answer the questions related to each case in groups. The teacher conducts case analysis and knowledge summary in the form of question discussion and group analysis, etc. to complete the flipped classroom, which fully mobilizes the students' enthusiasm for learning and improves the students' independent learning ability.

Achievement Evaluation

The performance assessment is divided into final assessment (60%) and formative performance assessment (40%). The final examination is in the form of closed-book examination. The examination papers are randomly selected from the Test Database of Chinese Medical Education by People's Medical Publishing House to carry out the final examination. Formative performance assessment is divided into online performance (15%) and offline performance (25%). Online scores include: A. video watching progress: once at the end of each part, the watching progress of corresponding content is greater than 95%; B. chapter test: complete corresponding test questions after each chapter section, and allow to answer questions twice repeatedly, and get the final score; C. online final test: complete online final examination within a fixed time after online course learning, with a total of 40 multiple-choice questions, full score of 100, those who fail the exam have a chance to make up. Offline scores include: A. case analysis test: in the course of clinical analysis
class, count the classroom performance of each group of students, score the enthusiasm and accuracy of answering the case questions, and take the form of closed-book test before the end of the term. Each class randomly selects the cases and questions in the case analysis course to answer; B. experimental class: according to the students’ practical operation ability in the experimental class and the experimental report give a score. C. Attendance: according to the attendance, late and early leave of students. The score evaluation distribution is shown in Fig. 1.

![Figure 1. The Score Evaluation Distribution.](image)

**Problems and Feedback**

In order to better implement and improve the blended teaching, and improve students’ interest in biochemistry and molecular biology and their ability of independent learning, a course rating survey was set up on the Zhihuishu platform. Including the knowledge acquisition, learning satisfaction, online course video quality evaluation, case analysis and learning effect evaluation of face-to-face class, and teacher guidance situation evaluation, online forum and satisfaction of Q&A exchange. At the same time, students are invited to put forward opinions and suggestions on the course through the Zhihuishu platform.

**Discussion**

After four semesters operation of the blended teaching in biochemistry and molecular biology course, 5209 students from 17 universities and colleges participated in the course. Education resources are completely open, learners are not restricted by region, economy and culture, every one's learning desire has the opportunity to be satisfied, which is conducive to the realization of education equity. Blended teaching promotes the interaction between teachers and students. In this course, teachers and students interact more than 75-80% of the time, which cannot be achieved in traditional teaching methods. At the same time, through online data statistics and exchange interaction, teachers can track and grasp the characteristics of students' learning, which is conducive to teachers' individualized teaching and improve the quality of teaching. The application of blended teaching has greatly improved students' learning interest and autonomous learning ability. The traditional classroom teaching procedure is that teachers take classes according to the lesson plan prepared before, and students are in a passive state of acceptance, which leads to the brain unable to be excited, the class atmosphere is dull, and the classroom efficiency is relatively low; while the blended teaching procedure is more flexible, not immutable, not a unified class teaching system, and students can choose the learning time and progress of each class. Students can adjust according to their actual needs, and the teaching procedure is alive, which is conducive to students’ active
thinking activities in a relaxed and pleasant environment. The blended teaching mode can make the change from teacher centered to learner centered, from teaching centered to learning centered, guide the students to carry out problem-based learning, cooperative learning, and from knowledge transfer to ability and quality cultivation.

The application of the blended teaching mode in biochemistry and molecular biology courses highlights the characteristics of the course and cultivates students’ scientific thinking and rigorous scientific attitude, so as to help students establish a preliminary clinical thinking mode. Based on clinical cases, the flipped classroom in the face-to-face course enables students to truly understand the importance of medical biochemistry and molecular biology knowledge to clinical work, increases the interest of learning, and trains students in the process of explaining the pathogenesis of diseases by using the knowledge of biochemistry and molecular biology through the scientific analysis of symptoms and detection indicators in clinical cases. In order to provide guidance for disease prevention, diagnosis and treatment, we have fostered clinical thinking mode, scientific thinking and rigorous scientific attitude of students.

The application of the blended teaching mode in biochemistry and molecular biology course optimizes the examination and evaluation mode, and more objectively evaluates the mastery and application ability of students’ knowledge. The learning effect of students in blended teaching activities should be evaluated from multiple dimensions, including the formative assessment of online course video learning content and chapter test completion, as well as offline meeting course attendance, classroom performance, experimental course completion formative assessment and final assessment of final test results [7]. By properly increasing the proportion of formative assessment in the final score, students can be encouraged to take the initiative in online learning and self-learning. It not only corrects the habit of students not learning at ordinary times, but also puts the learning of biochemistry into the process of self-learning at ordinary times, rather than just obtaining the short-term memory of biochemistry by surprise before the examination [8]. Through the analysis of the questionnaire and the final examination papers, it is found that the blended teaching can effectively improve students’ interest in learning, help students to understand the key points and difficulties of the learning content comprehensively, improve the ability of learning summary and induction, and improve their academic performance.

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