Research on the Teaching Reform of the Course of Medical Electronics Foundation Based on Online Open Course

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Abstract: In view of the deficiency of current basic teaching of medical electronics, a new teaching model of open online courses is proposed. This paper has made some changes in the course of teaching goals, content, teaching methods, and evaluation criteria. This kind of online open course has formed the teaching concept from the center of curriculum to the center of students, and improved students' self-learning ability. It is of great significance to train innovative talents to meet the needs of the society.

Keywords: Open online courses; Fundamentals of medical electronics; Teaching reform

1. Course teaching status and reform content

1.1 Analysis of the current situation of the course teaching

The Fundamentals of Medical Electronics is an important basic course in the fields of medical inspection technology and medical imaging technology. This course is mainly for students majoring in medical imaging. It is based on theoretical knowledge such as suppression of interference from digital circuits, analog circuits and medical instruments, which strengthens students' study of the basic theories and basic knowledge of medical electronics [1]. This is an important course that provides the basis for the follow-up skills learning of the students. It is also the main course for cultivating students' comprehensive ability, basic operation ability of instruments and equipment, and solving the common problems of medical instruments. It is the beginning of a deep understanding of the development and application of imaging equipment technology for students [2].

The "Medical Electronics Foundation" course plays a leading role in medical imaging and other related majors. It has a strong sense of theoretical, abstract, professional and comprehensive. Therefore, learning the course requires the guidance of the teacher in the class and the review and discussion of the students. However, in the process of students' absorption and digestion, many problems can’t be solved in time. The knowledge points that teachers speak in class are easily missed, which causes students to fail to make up the leaks in time, and which affects students' enthusiasm for learning [3]. Throughout the offline teaching feedback of the major universities of Medical Electronics Foundation, there are three main problems:

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(1) The knowledge that the teacher said is easy to forget after class. The university course is tight and the progress is fast. When students are not careful in class, they will miss a few important points of knowledge. It is easy to cause confusion and incomprehension when reviewing notes. If the teacher is talking too much in class, it will be easy to forget after class.

(2) The problem analysis does not correspond to individuals. The biggest advantage of on-site teaching is that it can be arranged according to the student's absorption situation. However, each student's problem is different. The teacher can only explain in detail the problems that everyone concentrates on, but can't do one-to-one correspondence.

(3) There is no timely feedback at the end of the course. The problems encountered by students in class can't be timely feedback to the teacher, which is a vicious circle. The knowledge points are scattered, and many contents cannot be linked together. So the overall ability of students has not improved.

1.2 Content and status of online open curriculum reform

The online open course is a popular video teaching method. The universities have put forward the teaching videos recorded in advance by the teaching and research section through the online platform. Students can arrange their own learning progress according to their own learning conditions [4]. The electrical engineering course team of Henan University of Science and Technology proposed to follow the combination of learning and practice, practice and evaluation, communication and answering questions, online and offline, process and results, foundation and promotion combined online teaching mode and concept. This emphasizes that college students should learn professional knowledge in a self-learning and practical way, and high-quality, comprehensive and innovative talents should be cultivated to meet the needs of society. The teaching experience of reforms in China has shown that the teaching philosophy and model of "open online courses" are effective and feasible. Xi'an Jiaotong University, Henan University of Science and Technology, Huazhong University of Science and Technology and other universities have already conducted online open courses.

Based on the continuous development of online open courses, this paper puts forward the teaching reform mode of Medical Electronics Foundation, which combines student interaction, teaching evaluation, knowledge feedback and problem solving with video teaching as the main body. The video teaching content is based on the teaching materials, and the key points of teaching are consistent with the teaching materials. Questions can be inserted into the video to interact with the students to mobilize the enthusiasm of the students and create a safe and effective learning platform and environment for the students. Online teaching should abandon the shortcomings of on-site teaching, extract its advantages, and ensure the quality of teaching.

2. Overall design of the course

The online open course is based on the learning theories of cognition, relevance and constructivism, and is a thematic inquiry around a specific topic. Online open courses are not only the innovation of educational technology, but also the innovation of learning methods and educational models. The online open courses' arrival has brought about tremendous changes in the education system, teaching methods and personnel training process, which will drive the integration of China's education and information technology industry [5][6]. Medical Electronics Foundation is an emerging discipline with strong practicality and applicability, which can provide a powerful reference for medical imaging professionals and clinical medical workers.

By viewing data and web search, there is currently no online open course on Medical Electronics Foundation. Therefore, this paper proposes a practice design of flipped classroom teaching based on online open courses.

2.1 The design concept of the course

With the goal of improving students' hands-on ability, communication skills, teamwork ability, independent problem-solving and problem-analysis skills, based on the online open curriculum and flipped classroom mode, the teacher plays the role of a guide, allowing students to learn independently and then build their own knowledge system to continuously enhance their interest in learning.

2.2 Course design ideas

2.2.1 Teaching objectives

Through the course study, students will master the relevant knowledge of "Medical Electronics Foundation", correctly operate electronic instruments, judge the quality of components and solve common problems in the use of instruments.

2.2.2 Reform of course content

Medical Electronics Basics is based on circuit, combined with the practical application of imaging equipment and the development of technology, focusing on amplifiers, oscillating circuits, high-frequency circuits, DC power supplies and gates, etc. The content of the course is connected with the actual, and it plays an important role for the students' practical ability. The textbook "Medical Electronics Foundation" used by the medical imaging major of the School of Biomedical Engineering of Xinxiang Medical University has certain limitations. It pays more attention to the integrity of the knowledge system, while the practical application content is relatively less [7]. This leads to a disconnection between teaching and practice, which has a negative impact on the quality of teaching.

In response to the deficiencies in the textbooks, the course content mainly made the following reforms:

(1)The content of the multi-stage amplifying circuit of the differential amplifying circuit is deleted. Medical electronics is mainly based on the amplifying circuit, and the integrated circuit such as the differential amplifying circuit only needs to understand its basic principle. It is undoubtedly the best choice to cut down the content of the differential circuit in a limited time.

(2)Make the teaching materials more suitable for self-study. Taking into account the needs of the school and the professional training of talents, the textbooks will become more accessible and easy to understand. The method is to increase the length of the text, mainly to increase the number of examples and analysis of the examples, to achieve gradual progress, easy to difficult, inspire students' thinking, and cultivate students' self-learning ability.

(3)Teachers should pay more attention to the experiment in the teaching process. The experimental operation is the key to improve the students' ability to do it. It is necessary to make the theory and practice fit in the process of teaching [8].

2.2.3 Reform of teaching methods

Based on the online open curriculum and flipped classroom, the hybrid teaching mode of online video teaching and offline classroom teaching is adopted. Students are required to study offline at least one-third of the total hours of class study, and no less than five times' meeting classes, no less than one hour each time. Its teaching mode is shown in Figure 1:

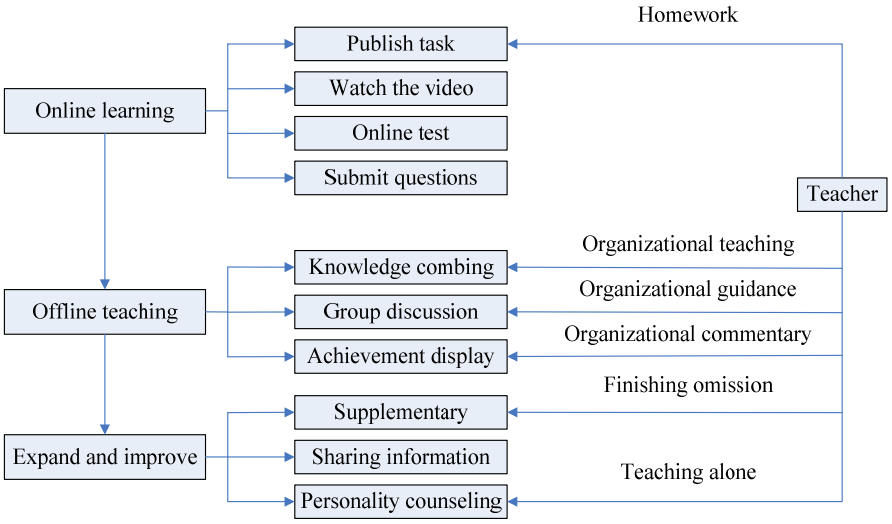

Figure 1 Online and offline teaching mode diagram

Online video teaching and offline classroom teaching mode are mainly carried out from the following aspects:

(1) First of all, the teacher has to produce high-quality micro-course videos. The content needs to deeply reflect the syllabus. Teachers should also adopt scientific and reasonable teaching strategies, take into account the logic, accuracy, knowledge and forward-looking, optimize the knowledge points of the curriculum, carefully design each micro-course script to strive to make the main line clear, and the introduction is clear. Teachers should upload the 10-20 minutes micro-course for each section at least two weeks in advance and design 3-5 exercises at the same time.

(2) Learning groups should be organized according to the actual situation of the students. Each group leader is responsible for organizing the members of the group to learn relevant micro-curriculum and to count the problems encountered by students in the process of self-learning. This prepares for offline classroom teaching.

(3) After the teaching content is taught to students online, the offline classroom needs more high-quality learning. In the face-to-face teaching process, the teacher will make a general review of the knowledge points of this lesson. The students will focus on the issues summarized by the group leader. The teacher will summarize the problems left by the students after discussion, and solve the difficult and important problems in class.

(4) According to the problems in the classroom, the teacher pushes the solution to the micro-course in the next section to consolidate the knowledge points of the section. And the teacher will arrange after-school study according to the specific situation of each group.

2.3 Assessment criteria for the course

The course assessment adopts a combination of usual grades and test scores, and the corresponding ratio is 4:6. The original assessment method based on written test results is cancelled, and then the objectivity and authenticity of the evaluation are enhanced. The usual results mainly refer to the student's online learning progress, homework completion, attendance, classroom enthusiasm, etc. The test scores are divided into two parts: written test results and experimental operation results, which is more objectively and scientifically to measure students' learning effects. Its evaluation plan is shown in Figure 2:

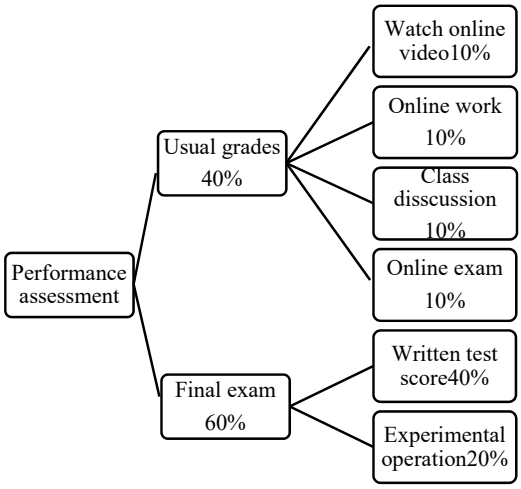

Figure 2 Scheme for course assessment

3. Implementation of teaching activities based on online open courses

The reform of teaching should fully improves students' independent study and thinking ability, so as to cultivate comprehensive talents with comprehensive development of knowledge, ability and quality. The online course mainly includes the student's learning resources, which is measured by the learner's learning effect. Therefore, online teaching should build a quality course platform. The course arrangement and course introduction of this course are shown in Table 1:

Table 1 Teaching Arrangement of "Basic Medical Electronics"

Course team	Department of Medical Electronic Instruments
Course Introduction	Course Title: Medical Electronics Foundation
	School: Xinxiang Medical University
Class schedule	Start time: March 5th
	Ending time: June 24th
	Class time setting(hour): theoretical time 32, experimental time 30
Teaching Evaluation	Set discussion area, student message

The teaching team should prepare all the video resources in advance, and the PPT in the video is required to be concise and clear. The teaching content is based on the textbook, and the teaching ideas are clear and easy to understand. The difficulties and key points of the chapter should be highlighted. The length of a video is about ten minutes. The videos will be released at least two weeks in advance according to the course schedule. In conjunction with the video, there are also classroom exercises and teaching documents. After the teacher finishes the content of a certain section, 3~5 classroom exercises can be set up, which can be filled in with blanks and multiple-choice questions. The purpose is to test the students' absorption and strengthen the students' learning content. The teaching document contains the main content of the teacher's video explanation, and students can simplify it into their own class notes according to the teaching document. After the end of each chapter, relevant unit tests and assignments can be arranged, and a fixed answer time can be set. Only after the students submit the test paper can the answers be issued. After students correct the mistakes, students can exchange ideas between the classmates in

the discussion area or consult the teacher in the message area. The teacher answers a few questions in the message area. For most questions, the teacher will give a key explanation in the class. The online open course is an extension and expansion of classroom teaching. It has the characteristics of large amount of information, vivid image and diversified forms of teaching content [9]. It is a new form and means of teaching materials. This teaching mode improves students' learning initiative, which is of great significance for cultivating innovative talents. Both students and teachers have great expectations.

4. In conclusion

The online open course is a new educational model, which is based on short videos and allows students to watch it repeatedly. The online open course aims to improve students' self-learning, develop students' ability to solve practical problems, and stimulate students' enthusiasm for learning. The Medical Electronics Foundation teaching model based on online open courses is still in the stage of practical exploration, but it has brought a big challenge to traditional teaching mode. In this paper, aiming at the teaching status of Medical Electronics Foundation, and improving the overall quality of students, the author combines online video teaching with offline classroom teaching to improve students' enthusiasm and ability to learn. This kind of reform provides a reference for the construction of Medical Electronics Foundation related courses.

References:

[1] Xie Xiang, Zhang Chun, Wang Zhihua. Development of Biomedical Electronics[J]. Electronic Products World, 2002(11): 53-55.

[2] Cui Dong, Zhang Guangyu, Guo Yongxin, et al. Research and practice of electronic experiment teaching reform in biomedical engineering specialty[J]. Chinese Journal of Medical Physics, 2012, 29(3): 3452-3454.

[3] Xing Juan, Yan Peng, Li Xiangmin, et al. Exploration of experimental teaching reform of medical electronics based on the introduction of formative evaluation in the whole process[J]. China Higher Medical Education, 2017(5): 65-66.

[4] Zhang Yanli, Liu Xiaomin, Cui Jiren, et al. Research on “Online Open Course Construction and Teaching Application” [J]. Guangdong Chemical Industry, 2017, 44(5): 192-192.

[5] Shen Ling. Research on hybrid teaching design based on online open course[J]. Science & Technology Information, 2017(33): 143-143.

[6] Pei Lei, Zhang Jun, Wan Xiaopeng. Bringing into play the effectiveness of online open courses and promoting the reform of the “student-centered” teaching model [J]. China University Teaching, 2017(6): 54-55.

[7] Zhang Lin, Deng Tianping. Discussion on the Reform of Teaching Contents of "Simulated Electronic Technology" Course[J]. Journal of Electric and Electronic Education, 2015(2): 14-16.

[8] Cui Dong, Zhang Guangyu, Guo Yongxin, et al. Research and practice of electronic experiment teaching reform in biomedical engineering[J]. Chinese Journal of Medical Physics, 2012, 29(3): 3452-3454.

[9] Ma Shangang, Yu Yujie. Related Terms and Their Relationships in Online Open Courses[J]. Journal of Electric and Electronic Education, 2017(6), 39(6):1-4.