

# Research on hybrid teaching of Medical Electronics

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**Abstract.** Medical electronics is a basic course for the combination of medicine and engineering. The course features a wide range of knowledge but not deep, focusing on the basic theories concepts and methods. However, due to the wide range of knowledge, shallow student foundation and short course hours, the teaching effect of this course is not satisfactory. With the development of modern educational technology, we introduce a new educational model of online and offline mixed teaching, which integrates the advantages of online education with the advantages of traditional classroom teaching, improves students' autonomous learning ability and cultivates innovation ability from three links: before class, in class and after class. Teaching practice has proved that the hybrid teaching mode can fully explore the convenience of online teaching at the forefront of disciplines, make use of the efficiency of offline classroom teaching knowledge, complete discipline intersection and promote medical engineering integration, so as to improve teaching quality and talent training quality.

**Keywords:** Hybrid teaching, Online and Offline, Medical electronics, Combination of medical and Engineering.

## 1. Introduction

Medical electronics is an interdisciplinary course. To teach students with medical background the basic knowledge of electronics, the course construction must always pay attention to the basic characteristics of "integration of medicine and industry" and cultivate compound talents. Today, with the rapid development of information technology, we can build a more effective online and offline hybrid teaching platform with the help of information technology, and use network technology to assist teaching, so as to improve classroom efficiency and teaching quality.

## 2. Academic situation analysis

### 2.1 The contradiction of wide range of knowledge and relatively few class-hours

The medical electronics course covers the basic knowledge of analog electronics, amplifier theory and digital circuit, with a "wide range" of knowledge. At the same time, the depth of knowledge involved in the course is relatively shallow, focusing on the cultivation of basic knowledge, basic concepts and basic skills, and less involving advanced theories. Compared with the electronics course learned by the electronics major, the difficulty of the course is obviously shallow. The knowledge is broad and shallow, which is mainly determined by the professional nature [1].

On the other hand, medical electronics, as a basic course, is allocated 54 class hours. Except for the 18 class hours occupied by experiments, the theoretical course is only 36 class hours. Compressing such a wide range of knowledge within 36 class hours puts great pressure on teachers and students.

### 2.2 The contradiction between the strong theoretical and practical characteristics and the weak foundation of students

The electronics course is highly theoretical, involving several theorems and laws in DC circuit, amplification principle of amplification circuit, relevant theoretical derivation of amplification circuit, and relevant derivation in digital circuit; At the same time, the curriculum supporting

experiments have strong practical requirements for circuit connection, fault analysis and so on. However, students' basic circuit knowledge only stays in the high school stage, and there is no circuit principle learned by other electronic majors as the foundation. Although the knowledge of the course is relatively shallow, students still generally reflect that the course is difficult.

### **2.3 The combination of doctors and workers is not enough, and there is a lack of innovative training mode**

Subject to the school running environment and teacher conditions, most biomedical engineering majors try to give consideration to medical and engineering disciplines when arranging courses for specific professional directions, but each discipline is relatively independent, there is less integration between medical and engineering disciplines, and the integration quality is poor, so it is difficult to produce the effect of " $1 + 1 > 2$ ".

## **3. Advantages of Hybrid Teaching**

### **3.1 Diversification of teaching resources construction helps the teaching process**

Under the mixed teaching mode, the construction of teaching resources is rich and diverse in form [2]. In addition to the traditional offline learning behaviors such as face-to-face teaching in class, after-school homework, tutoring and Q & A, hybrid teaching makes full use of modern network technology to dig online resources, such as micro courses, MOOC, professional website forums, special knowledge lectures, etc., and integrates the knowledge on the hybrid learning platform for teaching [3]. In addition, in the mixed teaching mode, the content of teaching resources is closer to reality and application scenarios. Relying on network resources, hybrid teaching can draw on the strengths of many families as needed for my use. It has great advantages in depth and breadth of knowledge and helps the integration of doctors and workers [4]. In particular, due to the multi-disciplinary integration nature of the major, it often needs a combination of multiple methods to solve a problem. In terms of knowledge accumulation, it is not enough to rely only on the courses offered by the school. It also needs to use the Internet for self-study, especially the excellent open courses offered by other schools (such as MOOC, wisdom tree and other open course platforms), Take it as a powerful supplement to this course.

### **3.2 Teaching method reform and diversified evaluation system**

Under the mixed teaching mode, it breaks through the face-to-face teaching mode in the traditional classroom and adopts a new online + offline mode. This teaching method focuses on cultivating students' innovative ability and improving students' autonomous learning and innovative creative ability. Hybrid teaching emphasizes the multiple interaction between teachers, students and students, and promotes the improvement of students' ability of cooperation and communication. Hybrid teaching reasonably selects and effectively uses resources to meet the needs of the development of information society. It is not only conducive to students' expansion of knowledge and thinking space, but also conducive to students' cooperation and communication ability to improve their scientific exploration ability [5]. In the current information society, almost everyone has a smart phone, and there is basically no problem in hardware support. Students can log in to the course platform with the help of campus network, timely understand the relevant information of the course, and submit homework on mobile phone, which is convenient and fast.

In terms of evaluation system, the differentiated evaluation standards, diversified evaluation subjects, diversified evaluation methods, comprehensive evaluation contents, dynamic evaluation process and beneficial evaluation results of mixed teaching not only improve students' enthusiasm for active learning and change "want me to learn" into "I want to learn", but also improve teachers' Teaching level, Guide teachers to adjust teaching plans in real time and try their best to achieve better teaching results. Under the new evaluation system, auxiliary teaching can be carried out with

the help of the rush to answer, time limit and other functions provided by the learning platform, which will help to activate the classroom atmosphere and form a good learning atmosphere.

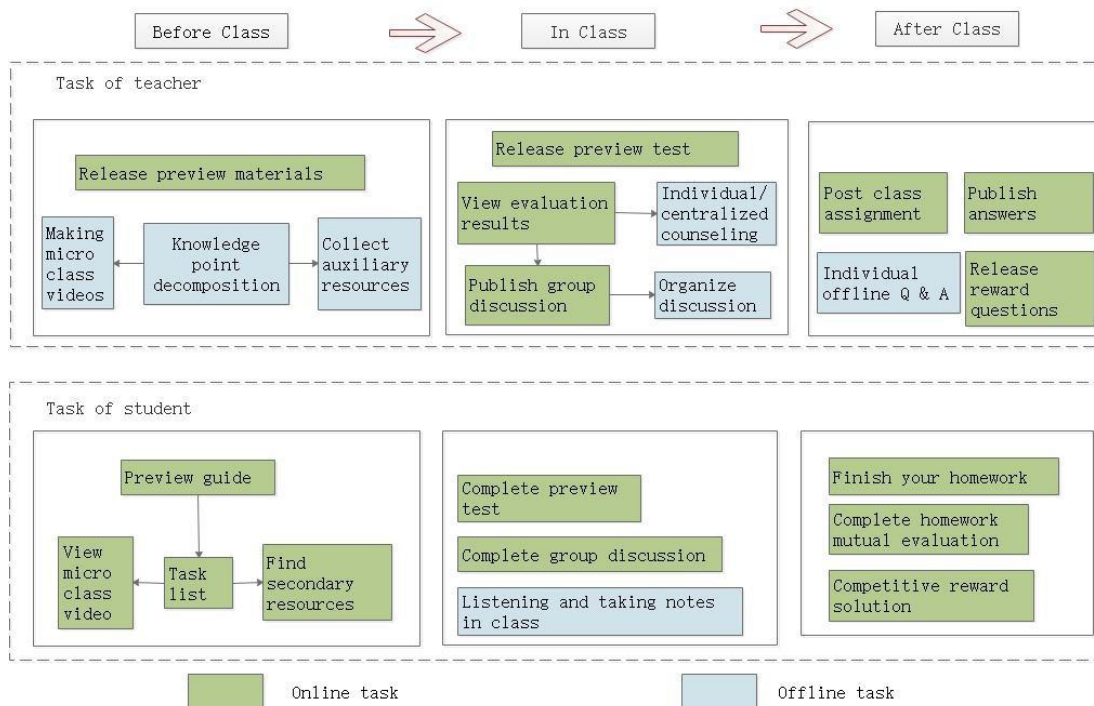
#### 4. Application of Hybrid Teaching in Medical Electronics Teaching

To implement the hybrid teaching mode, we must organically combine the advantages of online teaching and traditional classroom teaching, and give full play to the advantages of the two teaching methods. Therefore, the development of hybrid teaching needs to focus on the combination of online and offline teaching methods [6].

##### 4.1 Organizational form of online and offline hybrid teaching mode

After studying the development process of mixed teaching, based on the flipped classroom teaching mode, the mixed teaching is gradually carried out according to the three stages before class, in class and after class [7]. The main implementation process in teaching practice is shown in Figure 1 below.

Before class, teachers release corresponding preview materials according to the teaching content of this course, such as pre-made micro class videos, auxiliary teaching materials, etc. Students complete the preview tasks item by item according to the task list, so as to carry out targeted preview, which is helpful to improve the efficiency of follow-up classroom teaching.



**Figure 1.** Online and offline mixed teaching organization mode.

In class teaching, we generally need to check the preview of students in this class first to know well. The main test method is classroom preview evaluation, such as more basic choice questions, so as to master students' Preview. Then, according to the preview situation, flexibly formulate teaching strategies, such as giving a brief introduction to the generally mastered knowledge points, and giving a detailed introduction to the knowledge points with high error rate. On the basis of centralized auxiliary guidance, the group discussion can be flexibly released according to the teaching content, which can be the relevant content of the knowledge points of this class or the extension of classroom knowledge. Group discussion mainly tests students' flexible use of knowledge and exercises students' thinking. Generally speaking, in order to achieve a good effect of classroom discussion, it needs the real-time guidance of multiple teachers. On average, each teacher

guides about 30 students, and too much will affect the quality of group discussion to a certain extent [8].

In the after-school stage, the teacher needs to release an appropriate amount of after-school homework according to the learning content in this class, so as to consolidate the knowledge learned. Teachers know the students' mastery in time through their homework, so as to properly adjust the teaching progress or deal with the weak links. Due to the large number of students, this link generally involves a large workload. It is suggested to take more forms of homework such as judgment and filling in the blank, which can make full use of the automatic processing function of the learning platform, so as to reduce teachers' workload and improve work efficiency. For a small number of students with poor foundation, individual offline Q & A can be conducted in this link, so as to improve the overall quality.

#### **4.2 Establishment of teaching team**

Mixed teaching is inseparable from the construction of teaching team. In addition to the course leader, the person in charge of teaching and research office and the person in charge of course experiment, the person in charge of relevant professional courses can also be invited to join the teaching team according to the mixed nature of the course, regularly carry out teaching discussions, and extend outward from the knowledge points involved in the course chapters and sections. Specifically, it can be extended from medicine to the engineering method to solve medical related problems, or from the engineering problem to the medical problem that can be solved by the engineering method. In terms of organizational form, the teaching team of cross teaching and research departments can be established with the help of online and offline mixed teaching platform. On the one hand, the implementation form is convenient without disturbing the actual teaching preparation of the school, and on the other hand, it is convenient for discussion. You can join the course discussion and student counseling at any time as needed.

#### **4.3 Construction of teaching resources**

In hybrid teaching, teaching resources cover a wide range, including books and teaching materials, supporting exercise books, problem sets, micro videos and micro courseware made by teachers, as well as some cases, tutorials, learning guidance and web discussion collected by course teachers on the Internet. The construction of teaching resources must be related to the teaching content. On the basis of Medicine / engineering, according to the interdisciplinary attribute of Biomedical Engineering, we should train students' interdisciplinary and integrated thinking in a planned way, solve medical problems with engineering methods, or implement engineering methods combined with medical problems into specific applications. In terms of the mixing of teaching resources, the online and offline hybrid teaching platform can play an important role as a bridge and platform [9].

#### **4.4 Mixed teaching evaluation system in medical engineering**

Mixed teaching is a new teaching concept. In order to help student adapt to it, it is necessary to establish a new teaching evaluation system. Based on the full study of relevant educational theories, the teaching evaluation system should establish the concept of learning achievement orientation, learn from collaborative learning theory and hybrid teaching theory, realize the differentiation of evaluation standards, strive to diversify the evaluation subjects and cooperate with the diversification of evaluation methods.

Specifically, we should strengthen the proportion of process evaluation in the overall evaluation system, such as online learning time, online test effect, online discussion, online problem-solving methods, etc. For offline assessment methods, we must emphasize independent completion, so as to achieve the purpose of real detection.

#### **4.5 Curriculum thought and Politics in mixed teaching**

Under the current educational background, the ideological and political elements of the curriculum should be properly reflected in the curriculum teaching [9]. How to embody ideological and political education in mixed teaching is a problem worthy of discussion. On the one hand, teachers can introduce curriculum thought and politics through appropriate guidance in the process of offline discussion; On the other hand, online teaching resources can be enriched by adding ideological and political content related to this course to online teaching. Moreover, online course Ideological and political resources have a wide range of sources and various forms, which can achieve good course Ideological and political effects.

#### **4.6 Optimization of practical teaching in mixed teaching**

The combination of medicine and engineering specialty pays special attention to the integration of disciplines, hands-on on the basis of mastering certain theories, applies the engineering method to the medical field, and emphasizes the link of practical teaching. Especially under the background that mixed teaching attaches importance to the process and the requirements of first-class specialty construction, the proportion of practical teaching has raised a new level. In the actual teaching operation, we must make full use of the hybrid teaching platform to pave the way for the further optimization of practical teaching links.

Based on information technology, hybrid teaching platform can better serve practical teaching. Specifically, before practical teaching, relevant practical teaching tasks, as well as relevant videos, texts, web pages and other resources can be released through the learning platform to guide the development of practical teaching. Secondly, hybrid teaching can use its convenient network services to provide practical teaching with preview report correction, experimental report collection, correction and scoring, phenomenon discussion in the experimental process, research and discussion of experimental results, etc.

#### **4.7 Several key issues**

According to the general requirements of mixed teaching, considering the limitations of schools and teaching and research offices on teachers and the objective situation of students in the foundation of engineering courses, the following problems should be paid attention to in the specific implementation of mixed teaching:

##### **(1) Effective test of preview effect before class**

Online preview can only know whether students preview and the time spent through the learning progress, but the preview effect is unknown. Online testing must be carried out in the classroom to understand the actual mastery of students, so as to be targeted, so as to grasp the key and difficult points of the classroom, use the limited valuable time of offline classroom for answering questions and solving doubts, and strive to enable more students to truly master the knowledge points of this chapter [10].

##### **(2) Effective development of classroom discussion**

Offline classroom discussion is the core link of hybrid teaching. On the one hand, it can actually test students' preview before class, on the other hand, it can help students apply their knowledge to the actual scene and cultivate students' interdisciplinary thinking [11].

### **5. Conclusion**

To carry out Hybrid Teaching in medical engineering courses, we need to fully consider the interdisciplinary attribute of medical engineering specialty, and fully explore the advantages of hybrid teaching mode and its teaching platform in teaching elements such as curriculum design, resource construction, curriculum development, curriculum thought and politics, so as to serve interdisciplinary and improve teaching quality.

## Acknowledgments

This work was financially supported by the First-Class Discipline Construction Fund of North Sichuan Medical College.

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