

## Teaching exploration and practice of medical laboratory instrument course in Biomedical Engineering

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**Abstract.** Medical laboratory instruments have become an important means of clinical diagnosis in modern medicine. They play an important role in disease diagnosis, disease monitoring, health evaluation and so on. Therefore, there are more and more employees in medical laboratory equipment, and the requirements are higher and higher. The course of Medical Laboratory Instruments can be offered in biomedical engineering (BME) and medical laboratory technology, but the requirements of the course are different because of their different training objectives. Through exploring the special position and teaching reform method of Medical Laboratory Instruments in BME, it has important guiding significance for the teaching and students' development of Biomedical Engineering specialty.

### 1. Introduction

With the continuous development of electronic technology and computer technology, the performance of medical laboratory instruments has been greatly improved. Medical laboratory has become an important basis for clinical diagnosis, so the correct use and maintenance of laboratory instruments is very important. At present, the course of Medical Laboratory Instruments, which is offered by medical laboratory specialty, focuses on medical basis, but neglects the maintenance and operation of the instruments. It is difficult to meet the social requirements for the talents of new medical laboratory instruments. [1][2]

For the undergraduate medical colleges and universities which mainly cultivate application-oriented talents, one of the specialties of biomedical engineering (BME) is to cultivate students' ability of instrument operation and maintenance, which is conducive to cultivating new type of instrument personnel who are better at instrument maintenance and equipment management. Therefore, it is very important to set up the course of medical laboratory instruments in BME.

Based on the teaching practice, this paper first analyzes the characteristics of the course Medical Laboratory Instruments, then analyzes the problems existing in the teaching of Medical Laboratory Instruments in BME, and puts forward corresponding countermeasures to provide reference for improving the teaching of clinical laboratory instruments.

### 2. characteristics of medical laboratory instruments and problems in Teaching

#### 2.1 Characteristics of medical laboratory instruments

##### (1) teaching objectives

The functions of modern medical laboratory instruments are becoming more and more complex, the degree of intelligence is becoming higher and higher, the sensitivity is becoming stronger and stronger, and a large number of new instruments and equipment are constantly emerging and put into practice. At the same time, modern medicine has become more and more dependent on medical laboratory instruments, which requires more and more professional workers. The purpose of the

course is to cultivate and improve the students' ability to master and use modern medical laboratory instruments, so that they can better use medical laboratory instruments and provide support for disease diagnosis and treatment. It is necessary for students to master the performance, usage, working principle, troubleshooting and calculation techniques of medical laboratory instruments.[3]

#### (2) analysis of curriculum characteristics

At present, most medical laboratory instruments are used in the detection of the existence, composition, structure and characteristics of tissues and cells. High-precision qualitative or quantitative analysis results are needed. Any error may lead to a misdiagnosis and evaluation. The course of medical laboratory instruments is a course aimed at improving students' practical ability in the application of medical laboratory instruments. [3]

Modern medical laboratory instruments usually consist of light, electricity and machine. They have many kinds, complex functions, increasing automation and intelligence, and more and more complicated structures, such as separation and analysis, spectral analysis, visual inspection, cell and molecular biology testing, routine clinical examination and non-routine clinical examination instruments. Medical laboratory instruments usually involve optics, electronics, computers, materials, sensors, biochemistry, radiology and other technical fields, in addition to the need to understand the use of instruments and equipment, but also need to constantly master new materials, new devices, new test and analysis methods.[4]

## **2.2 Problems in Curriculum Teaching**

Medical laboratory instrument is a multi-cross integration course, which is a challenge to both teachers and students. Thus, there are some difficulties in teaching. After several years of exploration and practice, the problems existing in the teaching process of laboratory instruments for biomedical engineering specialty were analyzed.[5]

### *2.2.1 Theoretical teaching is too boring and difficult, and students lack enthusiasm for learning.*

Although students majoring in BME have a solid foundation in electronic technology, mathematical statistics and computer applications, their understanding of medical knowledge is not deep enough, leading to students' understanding of instrument principles is often half-understood. As for the content of the instrument, the current domestic textbooks on "medical laboratory instruments" are decoupled from the current relatively new instrument knowledge. Many contents, especially the introduction of typical test instruments, are rather outdated. They are not closely related to the testing principles, operation and maintenance of instruments on the market at present. The introduction of optical and electrical contents (such as electronic components, photoelectric sensors, etc.) is very few, and it is often difficult to stimulate students' learning. Interest in the course. [3]

### *2.2.2 Laboratory instruments are limited.*

Practice course is an important part of the teaching of laboratory instruments for biomedical engineering, which mainly focuses on training maintenance engineers. Due to the lack of attention to the course of medical laboratory instruments and the limitation of funds, the hardware equipment cannot keep up with the pace of teaching, which seriously affects the students' practical training, and then affects the teaching effect.

### *2.2.3 Lack of teachers and single teaching methods.*

On the one hand, because there are very few laboratory instruments courses offered in BME, few teachers (especially young teachers) of BME come from laboratory instruments, which affects the teaching effect. On the other hand, the current teaching method is mainly based on the traditional LBL method, which is characterized by "transmission - acceptance" and only pays attention to imparting knowledge, not to develop ability, which is not conducive to the cultivation of students' innovative thinking and innovative ability.[5]

### **3. Curriculum reform measures**

#### **3.1 Pay attention to the course contents and the diversification of teaching methods**

Aiming at the aim of training maintenance engineers of inspection instruments, we should select the textbooks and contents carefully, and combine them with practice, with emphasis, with wide knowledge and with difficulty. Through literature research and visits to Shanghai, Zhejiang and other hospitals, it was found that the equipment needed to be frequently repaired and maintained in clinic included blood cell analyzer, blood coagulation analyzer, semi-automatic urine analyzer, urine sediment analyzer, biochemical analyzer, enzyme labeling analyzer, bacterial identification analyzer, immunoluminescence analyzer, etc. Select the content of this kind of instrument. In addition to the basic theory and principle of testing instruments, the course also includes the basic circuits, structural functions, operating methods, fault detection and removal, maintenance steps and so on.

In addition to the traditional teaching method, teaching methods should be taught in a variety of ways. Classroom teaching should also be properly supplemented with Department equipment pictures, multimedia animation, video, and so on, vividly expound the operation, installation, failure analysis of the instrument process, can play a better effect, but also to complement the lack of laboratory equipment, students cannot operate the instrument by hand defects; can also try to guide teaching, focusing on Besides lecturing by teachers, some thinking questions are designed for the teaching content. Students are required to consult materials, make courseware and give speeches, set up discussion and teacher comments, and urge students to learn and master.[4]

With the rapid development of science and technology, more and more new technologies, new methods and new equipment are constantly used in medical laboratory. If only confined to the content of teaching materials, it will inevitably cause the relative lag of basic knowledge, unable to adapt to the development of science. Therefore, in the teaching of basic theoretical knowledge, we should not only confine ourselves to teaching materials, but also make full use of all kinds of materials, such as newspapers, periodicals, network and other media, to expand the teaching content, expand the scope of students' knowledge, so as to make them more quickly and better adapt to the future clinical laboratory work. At the same time, only boring instrument knowledge teaching will be extremely boring, in teaching should also try to use physical objects and multimedia demonstration, so that students can intuitively and clearly understand the structure of equipment, performance, principles and other knowledge, stimulate the enthusiasm of students to learn.

#### **3.2 Attaching importance to practice and improving students' ability to operate**

The practice content of medical laboratory instrument course can be divided into five aspects: course experiment, class internship, graduation practice, graduation design and social practice. These five ways should be applied comprehensively in teaching to provide students with ample opportunities for practical operation training and to enable students to master various kinds of medical examination through practical operation training. The application methods, evaluation methods, calculation strategies, routine maintenance and troubleshooting of medical laboratory instruments should be clarified. On the one hand, it can consolidate students' basic theoretical knowledge and lay a solid foundation for their future work and research; on the other hand, it can improve students' practical ability and help students adapt to the needs of work practice faster.[4]

We should properly increase the experimental courses, according to the characteristics of different instruments, curriculum content, existing equipment resources, elaborate design of experimental operation courses, so that each student can be skilled in the use and maintenance of commonly used medical laboratory instruments.

#### **3.3 Strengthening school enterprise cooperation**

We should strengthen cooperation with laboratory instrument companies and establish practice bases for medical laboratory instruments. It is an effective way to promote the students' learning effect and help them to follow the principle of "maintenance engineer" in the future. At the same time, we can invite out-of-school maintenance engineers to hold lectures to bring students examples and

experience of hospital equipment maintenance, so that students can better understand and grasp the key points of laboratory equipment maintenance.[5]

#### 4. Summary

In this paper, the characteristics and existing problems of medical laboratory instruments course for biomedical engineering specialty are studied. Through practice, it is concluded that the teaching quality can be improved by choosing reasonable teaching contents and teaching forms, paying attention to practical training, strengthening cooperation between schools and enterprises, and paying attention to the cultivation of students' comprehensive quality.

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