

Teaching Reform and Application of Circuit Basic Experiments

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Abstract: In view of the problems existing in the traditional teaching of circuit basic experiment, the contents and methods of the teaching need reformed. In terms of teaching content, design experiment by Integrated Electronic Research and Development Platform is used to replace verification experiment teaching; in terms of teaching method, the "flipping classroom" is adopted to adjust the proportion of time inside and outside the classroom. Teaching reform of the circuit basic experiment not only cultivates design thinking, but also lays a solid foundation for the follow-up study of electrical experiment courses.

Keywords: Circuit basic experiment; Teaching reform; Flipping classroom.

In the traditional teaching mode, most of the content in circuit basic experiment[1] is to verify the theoretical course. The students can only repeat the experimental steps mechanically, but can not arouse the enthusiasm of design innovation. It is difficult for them to take the initiative to complete some design experiments. Ultimately, it leads to the disconnection between knowledge and the experience they need to master in their future work, and fails to cultivate professional talents in the electronic field, so the teaching reform[2] is imperative.

The integrated electronic development platform is a comprehensive electronic learning system, it has been applied and promoted more and more with its advantages of high efficiency, rich content, effective performance and security. It is great significance to apply in the circuit experiment. Because this comprehensive learning system can not only enable students to learn hardware knowledge, but also enable students to access the software system running on the hardware platform: In terms of hardware, this system includes the mainstream hardware resources, and ingeniously combines them to achieve complementary resources; In software, the system is equipped with standard and editable source code. Moreover, the study of the latest electronic technology and the application of intuitive circuits are not only conducive to enhancing the interest in learning, but also enable them to understand the application of circuits in practical work. In a relatively short time, students can enter the state of "electronic designer" and experience the application and operation of circuit in real life.

With the development and popularization of the Internet, students learn by themselves after class through abundant and high-quality teaching resources on the Internet. The teaching mode of "flipping classroom"[3-4] which aims at discussion with teacher gradually enters the university classroom. "Flip Classroom" was originally mentioned by MaureenLage and Glenn Platt and Michael Treglia in "Inverting the Classroom: A Gateway to Create an Inclusive Learning Environment"[5] in 2000, Then J. Wesley Baker mentioned it again in his paper "The classroom flip: Becoming the Guide by the side"[6] published at the 11th International Conference on University Teaching. Because the ultimate goal of teaching is not to teach but to learn, the "student-centered" flipped classroom just

solves this problem, so more and more universities in China carry out various forms of "flipped classroom" teaching practice, and have achieved good results.

2. EXISTING PROBLEMS IN CIRCUIT BASIC EXPERIMENTS COURSE

Circuit basic experiment course is an experimental course which cooperates with circuit basic theory course but has independent courses. Through the study and practice of circuit basic experiment course, students should not only master the basic theoretical knowledge and analysis methods of circuit, but also lay a practical foundation for learning circuit theory. At the same time, students should be able to grasp the basic skills of electrical related experiments and the ability of comprehensive practice. After the good experimental habits are formed, it also lays a solid foundation for the subsequent electrics-related experimental courses.

With the development of science and technology and the rapid internationalization of colleges and universities, knowledge updating is also changing with each passing day, so the basic circuit experiment course for all the students majoring in electrical engineering is increasingly unable to meet the requirements of development. At the same time, with the further development of teaching reform, there are usually two kinds of experiments in the new teaching mode: The first one is that only fixed experiments are provided in the experiment box, students can complete the experiment only by connecting the wires according to the graph and according to the requirements of the experiment guide, so the students can not really participate in the learning activities. The second is to make some actual experimental circuit boards or objects, and then design, test and debug them. The second mode greatly improves the practical ability, but the actual operation is limited by the number and variety of equipment, and time-consuming, occupying too much class time, consuming too much consumables and high cost, so it is only used in the digital circuit design course. Because the first teaching mode is usually used in the current circuit experiment course, there are mainly the following problems:

1) The old experimental equipment restricts the development of design thinking:

Traditional circuit basic experiment courses use experimental boxes designed to verify theoretical knowledge. A complex experiment requires a large number of connections. In this way, it is not only easy to make mistakes, but also can cause signal attenuation and affect the experimental results. With the rapid development of the electronic industry, the updating speed of mainstream devices is very fast, it is difficult for students to design experiments according to the mainstream design ideas by using "outdated" hardware devices for experimental operation

2) The content of traditional experimental courses is out of line:

The traditional experiment content is mainly demonstration and verification. The experiment content is too single, With the development of the electronic industry, the goal of experiment teaching and training is gradually disconnected. Students operate mechanically according to the given experimental steps, although this way can verify theoretical knowledge, it seriously limits the development of innovative thinking.

3) There are great limitations in the teaching methods of experimental courses:

Since the experimental class has much fewer hours than the theoretical class, if the verification experiment is turned into a design experiment, most students are difficult to complete the task in the classroom, and are easily discouraged and affect the teaching effect. Designing experiments requires a lot of time for students to absorb knowledge beyond theoretical classes, but students do not have the ability to effectively search for information after class, so they can only "look at the questions and sigh" in class. Through the analysis of the current situation, it is imperative to reform the teaching of circuit basic experiment course. We need to explore new experimental teaching methods to meet the rapid development. If the integrated electronic development platform can be applied to the experiment, students can not only be free from the limitation of equipment, but also master more new knowledge and skills.

3. THE TEACHING REFORM IN CIRCUIT BASIC EXPERIMENTS

In order to carry out the teaching reform of experimental courses, it is necessary not only to change the teaching equipment and content, but also to change the teaching method. In addition, the teaching reform should take full account of the balance among the three so as to make it more in line with the current teaching situation and future development.

3.1. Teaching Reform of The Experimental Content

Integrated electronic development platform is a comprehensive learning system, which includes the mainstream devices, and can achieve many basic functions. It is very suitable for students without foundation to learn. The system includes 8051、ARM、CPLD、FPGA、4.3 inch LCD、voltmeter channel、arbitrary wave generator and digital storage oscilloscope. In the process of design, students run through the idea of "everything proceeds from reality". They can learn the knowledge of electronic design from scratch. Not ignoring any details, from device packaging to software engineering management, from hardware circuit to instrument design, even students without circuit foundation have no obstacles to learning.

As a important task of this teaching reform, it mainly uses the full-function digital storage oscilloscope function of the system. This is because the oscilloscope is expensive and many beginners have no chance to contact with it deeply. Through the hardware, software and analysis of the design process of digital storage oscilloscope, students can not only remember, but also understand the basic principles of oscilloscope fundamentally. Through the study of digital storage oscilloscope, students can sense how a signal is displayed on the LCD screen through the principles and actual hardware circuits they have learned. Through the study of each part of the circuit realization, we can understand the basic knowledge of analog circuit and digital circuit. At the same time, the system is also applied to the important knowledge points involved in basic circuit teaching, such as AD sampling principle.

Through the study and application of the system, teachers can build a bridge from theory teaching to engineering practice, so that students can master more professional skills, lay a good foundation for the subsequent electricity related experimental courses, and be more able to assist the teaching of theory courses, so that students can quickly enter the electronic industry after graduation.

3.2. Teaching Reform of The Experimental Method

The design of basic circuit experiments is task-driven, under the requirement of constructing the teaching content of knowledge and experience independently, students as the main part of designing experiments can complete the tasks from consulting and analyzing data、planning project design scheme、implementing task plan and writing summary report under the guidance of teachers timely and appropriate. Teachers are no longer the inculcators of knowledge, but the organizers、instructors and evaluators of experimental tasks. It is mainly responsible for assigning tasks, timely guiding and answering questions, and assessing the completion of tasks. All these conform to the "student-centered" teaching mode of "flip classroom". With the introduction of the "student-centered" teaching mode of "flip classroom", it is particularly important, this teaching practice can effectively give full play to the initiative of students, improve the teaching efficiency in the limited time of the classroom and achieve satisfactory teaching results.

The teaching reform method of circuit basic experiment course requires that all teaching plans of this semester、including teaching objectives、teaching contents、teaching methods、teaching activities and teaching evaluation methods be sent to students in the first class, and students are randomly grouped to cultivate their teamwork spirit. After the first class, students can use the extra-curricular time to organize the information and design ideas through the learning materials provided by teachers. And each group of students is required to talk about the design process and the problems encountered in the next class. Classroom teaching is mainly based on questions and interaction. Teacher according to feedback and the effect of pre-class preview, focus on important knowledge points and expand the knowledge. Through inspiration and discussion、classroom demonstration、case practice、simulation operation and other teaching activities, the ability of the students to actively explore learning and research learning is enhanced.

4. APPLICATION OF TEACHING REFORM

In the practical application of teaching, we should pay attention to the balance of teaching content and teaching methods, otherwise we will achieve half the result with twice the effort. The actual teaching reform can be divided into three stages:

- 1) In the first class, the students are randomly divided into groups, assigning the teaching tasks of this semester to the students. The pre-made PPT and related learning materials are put on the server for the students to study after class. The related online resources are introduced so that the students can learn by themselves while the students need them. Complete the preview report of related tasks and record the problems encountered.
- 2) In class, students are asked questions randomly by interactive software, and the experimental reports are checked. According to the preview effect of students and the completion of classroom experiments, the score of each experiment are given.
- 3) The final score is made up of pre-report (10%)、seminar (10%)、experiment (40%) and final grade (40%). At the same time, we should actively participate in the discussion of the course, pay attention to the quality of participation, and get appropriate points for students who have special contributions to the course.

Through teaching, students can master basic experimental knowledge and expand circuit-related knowledge. The teaching mode of "flip classroom" has realized the transformation from teacher-centered teaching mode to student-centered teaching mode, thus giving full play to subjective initiative of the students and laying a good foundation for the follow-up courses.

5. CONCLUSION

This paper explores and practices the teaching reform of the course "Circuit Basic Experiment". The content and method of the teaching reform has achieved good teaching results. From the aspects of teaching contents, teaching methods, performance and evaluation, the results of teaching reform have achieved satisfactory results. At the same time, as a new teaching method, the "flip classroom" strengthens teaching based on "student-centered", promotes the training of teaching quality and ability, and improves the effect of experimental teaching. Such exploration of teaching reform plays an important role in cultivating practical ability and innovative consciousness of students, and lays a good foundation for future study.

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