

# Research on circuit experiment teaching reform based on open teaching mode

**Dong Huang**

*Guilin Institute of Information Technology, Guilin 541004, China*

**Abstract:** *This paper analyzes the common problems in the experimental teaching of digital logic circuit in Colleges and universities, mainly including outdated teaching materials and teaching contents, students' passive learning, insufficient embodiment of engineering skills and methods, less engineering training time and so on. It is proposed to reform the traditional teaching content and teaching methods with the support of the open experimental teaching platform to make them suitable for the open teaching mode. Circuit experiment is a very important practical link in circuit teaching. In view of the single teaching method of traditional experimental teaching and the lack of initiative of students. This paper analyzes the reform of circuit experiment teaching mode to achieve the purpose of cultivating high-quality applied talents. This experimental teaching mode takes students as the main body, grasps basic knowledge and improves comprehensive ability, and combines rich experimental contents with flexible experimental methods, effectively improving many drawbacks of the traditional experimental mode. At present, there are many problems in the experimental teaching of digital circuit, mainly due to the small number of class hours, unreasonable experimental design, many confirmatory experiments, lack of design and comprehensive experiments, coupled with the students' low attention to the experiment, the effect of the experiment is not very good, and the purpose of developing students' ability to put forward, solve problems and innovate is not achieved. In order to improve the effect of experimental teaching. The reform of digital circuit experiment teaching should start from the aspects of experiment design, experiment process, experiment platform and examination method.*

**Keywords:** *Digital circuit experiment; Reform in education; Reform in education*

## 1. Introduction

With the development of digital electronic technology, the application of digital circuits is becoming more and more extensive [1]. Under the new situation that the demand for high-quality innovative talents is constantly expanding in the era of knowledge economy, cultivating a large number of innovative talents with innovative spirit is an urgent requirement of social development for higher education. As required courses for students majoring in electrical engineering, the courses of Electrical and Electronic Practice, Circuit and Digital Logic Circuit Practice and Analog Electronic Circuit Practice are the most important professional experimental courses in all colleges and universities of electrical engineering, an important link to cultivate students' modern engineering ability, and the top priority of the teaching work of electrical and electronic experimental centers in all colleges and universities. There are many circuit experiment classes for electrical majors, so multiple experiments should be done, and the experimental mode of each experiment is fixed [3].

Before the experiment, students should preview the experimental instruction book. The experimental instruction book describes the use of experimental instruments, parameter testing methods and other steps in great detail. During the experiment, the teacher guides step by step, and each experimental student turns around the teacher [4]. This practice imprisons students' thinking and is not conducive to the cultivation of innovative talents [5]. At present, many colleges and universities are still using the traditional experimental mode, method and means of digital circuit experimental teaching, which is difficult to fully stimulate students' interest. Students don't pay attention to experimental classes, and the experimental effect is not obvious. The students trained lack innovative spirit, and it is difficult to adapt to the requirements of social development [6]. Experimental teaching is an important part of curriculum teaching in Colleges and universities. It plays an important role in cultivating "high-quality, high-level, diversified and creative" talents and improving college students' practical ability and scientific literacy [7]. We noticed that computer technology can not only be used in circuit analysis, design, simulation, but also in the management of circuit experiments, pre-class preview, experimental

teaching, teaching evaluation and other links. Integrating computer technology into circuit experiment teaching is beneficial to enable students to master circuit theory knowledge, to cultivate students' innovative consciousness, ability to analyze and solve problems, and to broaden students' knowledge.

## **2. Teaching reform ideas**

### ***2.1. The inevitability of experimental teaching reform***

The traditional experimental teaching focuses on confirmatory experiments with a single topic, and the experimental instruction has all the experimental purposes, contents, methods, steps and even record forms of each experiment without independent thinking. Students are in a passive position in the process of experimental teaching, which restricts the exertion of students' creative ability and seriously affects the formation and development of students' subjective initiative and innovative thinking. Experimental teaching has not really played a role in cultivating innovative ability [8]. In the past experimental teaching, the experimental instruction book gave a detailed description of the experimental principle, experimental content, wiring method and experimental steps. Observe and record experimental phenomena and results [9].

Experimental teaching reform is not only to implement education to fully meet the requirements of modernization for all kinds of talents training and improve the quality and efficiency of running schools, but also to follow the law of higher education and adapt to the development trend of modern higher education [10]. Establish a software and hardware platform for open teaching, including the construction of an all day open laboratory, a networked teaching auxiliary management system and a scientific management system. We should solve the problem of reasonable division of labor and connection between the three courses, solve the connection between theoretical courses and practical courses, solve the contradiction between teaching hours and actual demand hours, and complete a set of teaching materials that meet the characteristics of open teaching, meet the training requirements of the development of modern electronic technology for the practical ability of electrical and electronic engineering, and mobilize students' thinking by means of guidance and inspiration. At different stages of students' completion of experimental tasks, teachers should grasp the situation of students' experimental activities in time, and point out improvement and optimization strategies for students' next experiments. Feedback summary is the last link of the experimental class. As a teacher, this is the process of collecting feedback information and reflecting on teaching, so as to study and summarize the success and failure of experimental teaching; as a student, on the basis of communication, reflect on the process of experimental learning. The knowledge and skills acquired can be summarized and summarized, which is conducive to improvement and improvement.

### ***2.2. New ideas of experimental teaching reform***

Establish a student-centered, create a good experimental teaching environment, adhere to the experimental teaching concept of coordinated development of knowledge, ability and quality, pay attention to the cultivation of students' exploration spirit, scientific thinking, practical ability and innovative ability, fully understand and implement the important position of experimental teaching in the cultivation and teaching of high-quality innovative talents, and form the concept and atmosphere of overall coordination and healthy development of theoretical teaching and experimental teaching. For example, in the design of medium-scale combinational circuits, a lot of class hours were spent explaining the device structure and design methods in both theoretical and practical courses.

In the new arrangement, the theory course no longer explains the structures, functions, pins, etc. of various medium-sized devices, but only briefly introduces the design methods. Experiment is mainly to create a kind of teaching activity that is conducive to the development of students' thinking ability, so that they can improve their operation ability, tap their potential and improve their quality through practice. Therefore, the experimental content is divided into different levels, and a step-by-step approach is adopted, so that students can get exercise step by step from shallow to deep. The reform of experimental teaching should change from taking experimental teachers as the center to taking students as the main body and experimental teachers as the leader. Let students personally lead the experiment, stimulate students' experimental enthusiasm, fully mobilize students' initiative, and give each student the opportunity to think independently and do it in person. Experimental pre design is not only an important link to ensure the smooth progress of the experiment, but also an important means to train students' autonomous learning. The course team has developed a variety of teaching resources such as

experimental instructions and experimental teaching videos to help students learn. The course requires students to complete the corresponding circuit design according to the requirements of experimental tasks before class. The experimental items without pre design are recorded as zero points. The recording and analysis of experimental data requires students to correctly record the original experimental data, analyze and sort out the data, and the teacher will score according to the correctness of data recording and the rationality of analysis.

### 3. Multi-level and open experimental teaching mode

#### 3.1. Connotation of multi-level experimental teaching mode

In circuit experiment teaching, we pay attention to grasping the rules of the curriculum, insist on taking students as the main body, taking ability and quality training as the main line, taking quality education as the guide, focusing on practice and guiding innovation, and determined from basic to comprehensive, from design to innovation The multi-level experimental teaching mode. Circuit Experiment is an important technical basic course for engineering students, especially electrical students. It is a course to consolidate the knowledge of circuit theory and cultivate students' ability to analyze and solve problems. But traditional teaching methods. We believe that the electrician test bench should have the following functions: (1) It should have enough basic circuit components such as resistance, capacitance, inductance, diode and operational amplifier; (2) Provide DC power supply with adjustable amplitude, single-phase and three-phase AC power supply, sine wave, triangle wave, matrix wave and other signals required for the experiment; (3) It's easy to lap the experimental circuit and adjust the component parameters, which can be used for both the planned basic experiment and the design and open experiment.

After the experiment, students can submit the electronic experiment report to the teacher's computer and print server through LAN, and can also save or copy the experimental data on the student's computer to floppy disk. The experimental software is installed on the teacher machine and each student machine. CAI software mainly introduces the basic theory of measurement, the basic knowledge of components, the use of instruments and meters, and tutors the key and difficult points in teaching. It should be an organic combination of animation, graphics, sound and text, with strong interactivity and practicability. Considering the good support for transmitting multimedia information, experimental data and various files, more advanced computer network equipment and technology should be used to provide enough exclusive bandwidth for each computer in the local area network. According to the content and requirements of communication, the communication protocol between intelligent instrument and student computer and between student computer and teacher computer should be formulated. Fig. 1 is the network structure block diagram of the new circuit laboratory:

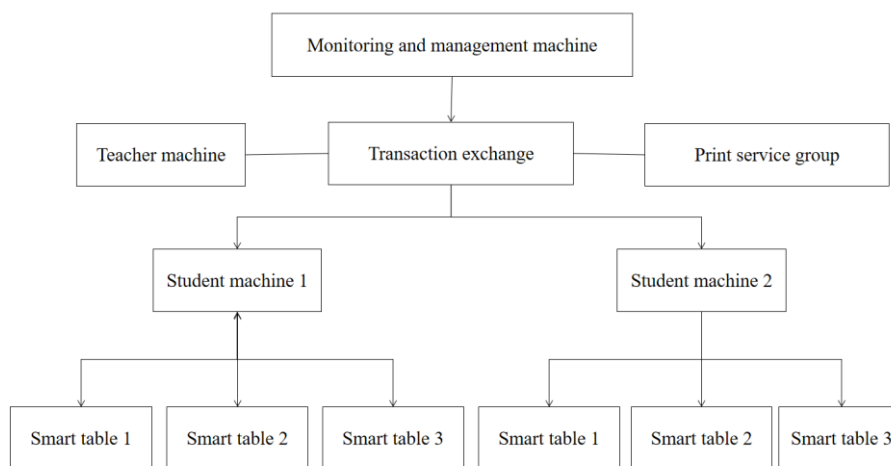


Figure 1: Network structure diagram of circuit laboratory

#### 3.2. Open experimental teaching mode

Opening the laboratory mainly includes two parts: opening the experimental time and opening the experimental content. Opening time means that the laboratory announces the opening time of the

laboratory to the students in the first week of each semester according to its own situation, on the premise of meeting the normal teaching and the arrangement of experimental teaching. On the first level (making up the gap), the opening of time is adopted, and students can continue to complete the necessary experiments in class during the opening hours of the laboratory; On the second level (promoting excellence), the openness in time and content is adopted. Students can freely choose experimental time and experimental projects for experimental research. It is best to adopt "task driven experiment", which can not only change these monotonous experiments into cultivating students' innovation ability and ability to analyze and solve problems independently, but also enable students to go deep from outside to inside, from perceptual knowledge to rational knowledge. The combination of theory and practice can gradually stimulate students' interest in learning and practice.

Optional items or extended functions are added in different learning stages such as usual experiments, stage tests, and comprehensive project evaluations, which can well encourage students to continue their in-depth study, encourage outstanding students to stand out, and can effectively distinguish students' academic levels. Students' autonomy will stimulate their subjective initiative and actively seek solutions to problems. For example, the experiment of three-phase AC circuit is practical and close to life, and many problems may be encountered in life, such as sudden voltage rise, asymmetric three-phase load, disconnection of fire phase, disconnection of neutral line, etc., resulting in the damage of electrical equipment, inconvenience to people's lives or heavy losses. In the teaching reform, we put forward the guiding ideology of reducing the number of experiments, enriching the content of each experiment, increasing the research depth of each experiment, and strictly requiring students to experiment in each link according to the standard of engineering research. Choose the most appropriate teaching contents and methods according to the different characteristics of students, give targeted individual guidance to students, and allow students to have man-machine dialogue with computer tutors in their own language. It has the best interactivity, so that teaching students in accordance with their aptitude can really be put into practice. The relationship between the concepts of intelligent teaching system is shown in Figure 2:

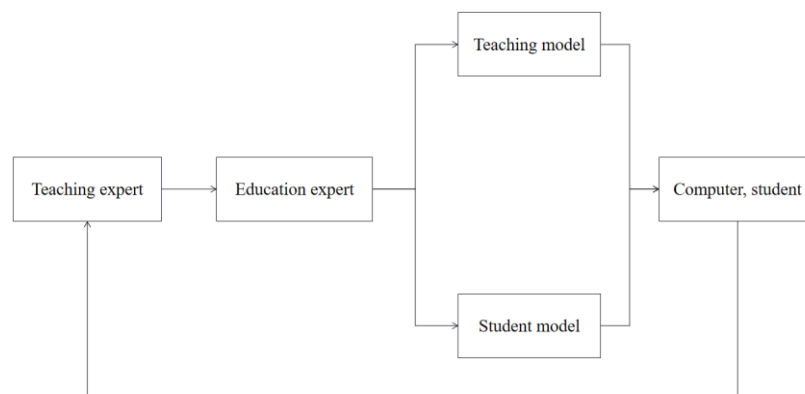


Figure 2: Relationship between the concepts of intelligent teaching system

#### 4. Conclusions

Through the analysis of the evaluation results of each link, the course group can also find the weak links of students' learning, reform the experimental teaching method in a targeted manner, and effectively improve the teaching quality. Taking ability training as the main line, building a multi-level experimental teaching mode not only consolidates and strengthens students' basic theoretical knowledge of circuits, but also improves students' enthusiasm for independent learning, students' self-learning ability, observation ability, experimental operation ability, knowledge acquisition ability and The ability of innovative thinking has been strengthened, and their practical ability, ability to analyze and solve problems has been improved, and the sense of cooperation and team spirit has been improved, which has the effect of broadening their horizons, broadening their thinking, inspiring inspiration, and improving their overall quality. What is really gratifying is that in the practical guidance, we can see that most students can quickly design the circuit required by the task book, skillfully use various instruments to debug and measure the circuit, and quickly find and eliminate the faults encountered in the experiment. It should be said that through the study in the pilot class, the engineering practice ability of most students has been greatly improved. In the experimental instruction book, the contents,

steps and methods of this kind of experiment are not listed, and the whole process of the experiment is completed by the students themselves. However, the teacher should carefully check the feasibility and operability of the students' design experiment, and the experiment can only be carried out after passing the examination. This has greatly stimulated students' enthusiasm for experiments, not only made them firmly master theoretical knowledge, but also improved their comprehensive ability in experimental operation skills.

## References

- [1] Cui Bin, Han Liang. Discussion on experimental teaching reform of digital electronic technology [J]. *Research on Laboratory Work in Colleges and Universities*, 2017(3):3.
- [2] Zhang Guoyu. Reform and practice of experimental teaching of digital electronic technology [J]. *Experimental Science and Technology*, 2018, 16(2): 4.
- [3] Gu Shipu, Sun Kexue. A Preliminary Exploration on the Teaching Reform of Digital Circuit Experiments in Retraining Classes [J]. *Laboratory Science*, 2018, 21(1): 3.
- [4] Ying Jun, Huang Peiyu, Luo Yijing. Reform and practice of digital circuit experiment teaching [J]. *Exam Weekly*, 2017(95): 1.
- [5] Zheng Xiaojing. Talking about the reform of digital electronic experiment teaching [J]. *Science and Technology Economics Guide*, 2019(32): 2.
- [6] Zeng Jurong. Teaching Reform of Digital Circuit Experiments [J]. *Curriculum Education Research: Research on Learning and Teaching Methods*, 2017(25):2.
- [7] Zhang Guoyu. Reform and practice of experimental teaching of digital electronic technology [J]. *Machinery Industry Press*, 2022(2).
- [8] Yan Xiaomei, Wang Zhishe, Gao Wenhua. "Online-Offline Mixed" Teaching Reform of "Digital Electronic Technology Experiment" [J]. *Journal of Electrical and Electronic Teaching*, 2021, 43(3): 3.
- [9] Chen Zhen. Exploration on the teaching reform of the experimental course of "Digital Electronic Circuits" [J]. *Journal of Wuhan Engineering Vocational and Technical College*, 2019(1):2.
- [10] Kaibinur Saidiai Hemat. Teaching Reform and Innovation of Digital Electronic Technology Experiment Course [J]. *China New Communication*, 2018, 020(023): 171-172.