ISSN: 2664-9640

# Exploration and Practice of Digital Logic Stepped Experimental Teaching Oriented to Output.

Liwen Dong

Liaoning University of Science and Technology, China

## Abstract

**In view of the problems and current situation in the teaching of Digital Logic for computer majors in colleges and universities, guided by the concept of output of results, the teaching methods are improved, teachers' guidance is strengthened, and "learning by doing, learning by doing" is promoted, which can enhance students' interest in learning computer hardware courses and help students improve their ability to design digital electronic systems, thus achieving better teaching results.It lays a foundation for the follow-up courses of computer composition principles and provides power for students to adapt to the development trend of computers.**

## Keywords

**Digital logic; outcome output; teaching mode; experimental teaching.**

## 1. The Question Is Raised

As an important course of computer hardware structure, the course of logic plays an important role in teaching. As a prerequisite course, digital logic should prepare corresponding logic circuit design knowledge, analysis and design techniques for the subsequent "Principles of Computer Composition". How to carry out more accurate and specific digital logic teaching,It is an urgent and important task to better integrate the knowledge of computer hardware courses and software courses and improve students' comprehensive design ability of digital systems. In the current teaching reform research, it is necessary to lay a good learning foundation for subsequent courses.

By analyzing the current situation of the digital logic and its experimental course of the undergraduate major of Computer Science and Technology in our college, there are mainly the following outstanding problems:

(a) the shortcomings of the traditional teaching model.

The logic course is taught in the way of "teacher explanation+multimedia teaching+exercise". In the whole classroom teaching process, students are more likely to act as listeners, follow the teacher's train of thought to understand and memorize relevant knowledge points, and students' "learning" is completely carried out around the teacher's "teaching", which is the traditional mode of teachers' active "teaching".It can only bring students the dilemma of passive "learning". Undeniably, the traditional teaching method has a remarkable effect on students' quick mastery of course knowledge points, but its limitations are also very obvious. Multimedia teaching demonstration is convenient, but the theoretical knowledge demonstrated is not vivid and concrete enough. After class, the exercises are completed by students themselves, corrected and solved by teachers' explanation.Without a more vivid supplement to the knowledge points, students are easily bored and bored, which leads to the serious phenomenon of copying homework.

(b) the allocation of experimental resources is insufficient, and the form is single or too simple.

Due to the limitation of site construction time, no special hardware teaching laboratory has been set up, and the experimental teaching has used the form of "simulation experiment", that

ISSN: 2664-9640

is, using simulation software and VHDL language to simulate the working process of the chip on a desktop computer, and using software to view the working waveform of the chip (as shown in Figure 1). This form of teaching,It is not obvious to understand the teaching process more concretely and vividly.

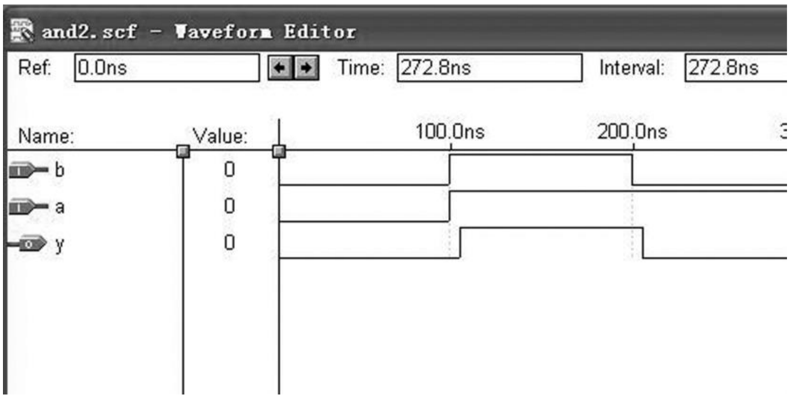


Figure 1 waveform display of experimental results

Figure 2 Digital circuit experiment box

After the coordination of relevant teachers, the course adopts the experiment box (as shown in Figure 2). Students do not need to design and make chips by themselves, but only need to connect wires to design the required circuits, which has a very intuitive effect on enabling students to quickly verify and master the knowledge of theoretical courses.

However, the teaching method of experimental course is mainly to simply verify the theoretical teaching. Generally, students only operate according to the existing experimental contents and steps in the experimental instruction book, which does not stimulate students' learning enthusiasm for this course, on the contrary, it also reduces students' learning interest in experimental courses. Therefore, how to improve the interest and depth of experimental teaching,It is worthy of further study to make the theoretical teaching better verified and supported.

(c) guidance methods and evaluation mechanisms are limited.

Due to the lack of equipment and the limitation of teaching space and time, not only students, but also teachers themselves can't design and make more complex and interesting experiments with experimental equipment, and can't provide better guidance for students. The evaluation method of experimental results is to take two students as a group, and submit the experimental report mainly in the form of electronic documents.Teachers will give feedback to students after correcting. All the existing experiments are basic verification and simple design experiments, which are easy to get results, and teachers will not easily evaluate students as unqualified

ISSN: 2664-9640

scores. In this situation, it is impossible to accurately judge whether all the students in the group have achieved the expected learning effect.Are there lazy "hitchhiking" students? If we can't find out the gaps and problems among students, we can't stimulate students' interest in learning.

## 2. The Design And Implementation Of Curriculum Content

(a) The teaching philosophy of output.

Output is a classic model of engineering education in Massachusetts Institute of Technology. It aims to guide students to learn engineering in an active, practical and organically linked way among courses. It is a set of educational models that conform to the growth rules and characteristics of engineering and technical talents, and aims to cultivate innovative engineering and technical talents with all-round development.

(b) The improvement of the experimental form and content of digital logic.

In order to promote students' interest in learning and improve their ability to design circuits and analyze practical projects, the teaching reform project team plans to build a teaching mode of digital logic and its experimental course based on the teaching philosophy of results output.

The research contents of this project mainly include the following aspects:

1. The improvement of teaching and experimental content.

According to students' reality, the content of multimedia courseware should be improved, and students should preview, watch teaching videos, design by themselves, etc., so as to dilute the leading role of teachers' "full explanation", strengthen guidance and guidance, and encourage students' interest in learning digital electronic technology.

With the support of experimental equipment, improving the contents of the experimental syllabus is not only a basic verification experiment, a simple circuit design experiment, but also a complex comprehensive curriculum design experiment, which examines students' comprehensive application of software and hardware knowledge, and is of great help to the improvement of students' practical ability.

2. Improvement of experimental learning form and examination form.

Actively guide students to think actively, and teachers only give necessary guidance in the experiment. After giving the experimental tasks and requirements, the teacher only tells the students how to analyze, but does not explain the experimental tasks in detail. Teachers only play a guiding role in the experiment, which makes students less dependent on teachers and enhances their independence.

Increase the proportion of comprehensive design experiments in the examination results, so as to open up the gap, find out the students who have outstanding achievements and are more interested in the in-depth study of modern electronic technology, and make preparations for the construction of excellent courses of digital logic.

(c) The specific measures in the implementation of teaching.

1). Questionnaires were conducted among the old students.

A questionnaire survey is conducted among senior students who have studied the course of digital logic to find out their mastery of the course and the knowledge points they are interested in, and the teaching plan of junior students is revised through the survey contents. The questionnaire includes the following aspects:Students' mastery of course knowledge points, students' feedback on existing teaching situation, students' interest in learning and willingness to implement, and so on. By summarizing these aspects, we can observe whether the teaching effect is improved.

2). Make experimental videos and revise teaching courseware and experimental plans.

ISSN: 2664-9640

Find some old students who are more interested in digital circuit courses and have comprehensive knowledge points, and make digital circuit videos. In the process of making and using multimedia courseware, attention should be paid to the application of aesthetic knowledge in classroom teaching through multimedia courseware, so as to make dull teaching contents vivid.It is beneficial to arouse students' learning enthusiasm. At the same time, in the teaching plan, the link of playing video first and previewing by students is added, and then teachers explain the precautions after the experiment. In this way, students can pay more attention to the knowledge points of the course, which makes the experiment link more interesting and has better learning effect.

3). Modification and refinement of assessment methods.

Reduce the proportion of exercises in homework after class, and reduce the number of theoretical questions and improve the authenticity of homework. Guide students to actively think, preview and complete the experiment independently during the teaching, and add more detailed descriptions of the experimental process and conclusions to the experimental report.To understand the specific situation of mastering the knowledge points related to experiments, and to observe whether their ability to summarize and express the knowledge points of courses is improved.

## 3. Summary Of Research Results And Contents

(a) The production of experimental teaching video.

Among the students in Grade 2017, 8 students were contacted to make experimental videos of digital logic experiments. The experimental equipment used was the "Digital Circuit Experimental Box" purchased by the project funds. The videos of 8 students were from the basic use of the experimental box, the verification of chips, the design and implementation of combinational circuits, and the design and implementation of sequential circuits.Several complete digital logic experiments are described in detail (as shown in Figure 3).

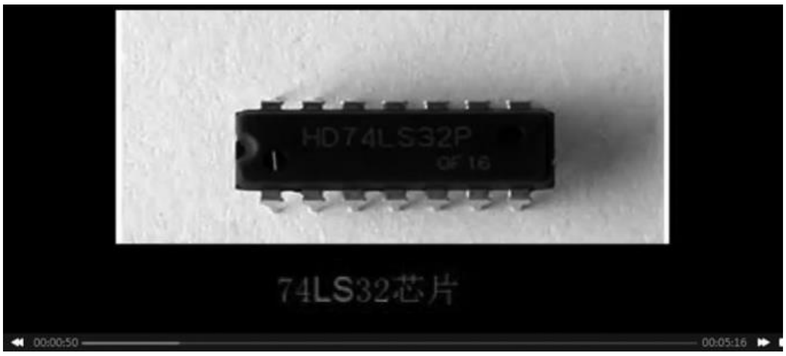


Figure 3 Video screenshot of experimental teaching

Based on the concept of output, guided by the thought of "learning by doing, learning by doing", after making videos, the students of Grade 14 expressed that they had made some progress in mastering the knowledge of digital logic and improving the ability of language organization.

(b) The improvement of the experimental outline and content.

At the end of the course, 45 students from Grade 17 and Grade 18 were collected and counted. According to the feedback from Grade 17 students, the experimental content was adjusted, and the simulation experiment was changed to classroom demonstration. Some adjustments were made to the experimental content of Grade 18, and the experiment of designing arbitrary combinational circuits with self-selected chips was modified.

Grade 17 students have some fear of difficulties in teaching, they feel difficult to learn difficult chapters such as "combinational logic circuit" and "sequential logic circuit", and they have difficulty in understanding the experimental contents. The number of people who have achieved good results in the experiment is relatively small, and many people have the phenomenon of "hitchhiking". One of the students with strong ability in the group is mainly responsible for completing the experiment.Others are only responsible for recording the experimental results, but do not seek a solution.

After summing up the problems in Grade 17, the experimental teaching in Grade 18 has improved. After summing up the learning situation of Grade 18, Grade 19 follows the experimental outline of Grade 18, but the experimental steps and descriptions are refined in terms of experimental requirements. The experimental preparation, chip preparation, experimental process description and experimental experience narration are all more detailed than Grade 18, and the completion quality is better.

(C) Overview: students' progress and existing problems and deficiencies.

After learning, the students independently completed the production of the experimental video, and the teachers used the experimental video, which made some progress in teaching effect.

Through preview and active preparation in advance, students have a deeper understanding of the experimental chip, the understanding of the experimental process and the summary of the experimental report. According to the students' completion of the experimental report, analyzing its completion quality can be roughly divided into the following three indicators:

1). Timely completion: whether the experimental report can be submitted within the specified time;

2). Accurate description: Can you prepare to describe the experimental steps and results?

3). Accurate summary: whether to write the experimental experience correctly, describe the problems and solutions encountered in the experiment, and summarize the learned knowledge points.

According to the above indicators, the following lists the comparison of experimental teaching effects between the traditional mode and the output mode of students in grades 17-19. The experimental results show that there is no obvious difference between the experimental results of different classes in the traditional mode of teachers' full-course guidance. For complex experiments, under the guidance of teachers, the number of students who have completed high quality is relatively small.However, under the teaching of results-based output mode, students are slightly unsuitable in preview at first, and then gradually adapt to and surpass the traditional mode. In later complicated experiments, the completion ratio is better than previous ones, and better results have been achieved.

Applying the concept of output to digital logic experiment teaching has improved students' practical ability and project design ability, enhanced students' interest in hardware courses, and initially cultivated students' innovative consciousness and team cooperation spirit, with good teaching effect.

Problems and shortcomings: The opening hours of experimental equipment and laboratories are short, resulting in insufficient time for understanding and in-depth study of experiments, and the design of more complex digital systems has not been completed. In the future teaching, we will continue to improve and explore.

Due to the limitation of experimental hours and venues, there are still problems in the connection between digital logic and the course "Principles of Computer Composition". Students have difficulty in understanding when studying "combinational logic circuits" and "sequential logic circuits", and they will have insufficient understanding and fear of difficulties in the subsequent experiments of designing ALU and CPU. In order to solve the phenomenon of "learning to ride a car",It is suggested to increase the arrangement of experimental hours and venues.

The two courses are taught by different teachers, and teachers have different understandings and grasps of the courses. There may be some problems in the focus of the experiment, which leads to the disconnection of teaching contents. If possible, the two courses should be taught by the same teacher.

## 4. Conclusion

In the future teaching, we should constantly sum up experience, correct shortcomings, cultivate students' interest in learning computer hardware courses according to the characteristics of computer major courses, and constantly strengthen students' ability of learning and designing digital electronic systems. In the experimental teaching, we emphasize the teaching ideas of self-preview, teachers' guidance and strengthening study, and the close connection between the front and back courses. Improve the teaching effect and adapt to the development trend of computer science in the future.

## Acknowledgements

(Supported by the Experimental Teaching Reform Project of Liaoning University of Science and Technology in 2021, ProjectNo. SYJG202113).

## References

[1] virtual reality technology in the "tour guide business" course experimental teaching reform application analysis [J]. Zhan yi. intelligence.2020 (01).
[2] Experimental teaching reform and practice of Soft Drink Technology [J]. Yuan Ze. Science and Technology Wind .2020 (08).
[3] Research on experimental teaching reform of the course Principle and Application of Single Chip Microcomputer [J]. zhangxin, Zhu Danfeng, Zeng Bixin. Examination Weekly .2017 (08).
[4] Experimental teaching reform and practice of mechanical courses [J]. Qian Cheng. Technology and Market .2014 (08).
[5] Discussion on experimental teaching reform of specialized courses in colleges and universities [J]. Qiu Huidong. China Metallurgical Education .2008 (06).
[6] Experimental teaching reform and planning of microcomputer principle and interface technology course [J]. Tan Yue, Deng Shuguang, Li Wenguo. Fujian Computer.2014 (06).
[7] Exploration and Practice of Experimental Teaching of Robotics Course [J]. Zheng Minghui. Automotive Practical Technology .2020 (23).
[8] "Furniture Design" experimental teaching reform and exploration [J]. Bao Yiling. Popular Literature and Art.2016 (23).
[9] Analysis on Experimental Teaching of Composition Courses of Planning and Design Specialty [J]. Xiao Qing, Xiao Xin, Zhang Yuanbing. Journal of Lanzhou Institute of Education .2017 (01).
[10] experimental teaching status and reform of mechanical testing technology course [J]. Wang Xingxing, Zhuang Liyang, Lu Shuaishuai. Science and Technology Information.2017 (05).