Application of Constructive Learning Theory in Digital Electronic Technology Experimental Teaching

Yu-Xin LIAN1,a,*  Bo-Ya HOU1  Yun-Peng HOU1, Yan Li1, Jian-Qiang WU1

1Department of Electrical Engineer Harbin Institute of Technology
Harbin, Heilongjiang, China
aLianyx@hit.edu.cn
*Corresponding author

Keywords: Constructive learning theory, Digital electronic technology, Experimental teaching.

Abstract. The ideology of the constructive learning theory is student-centered, emphasizing students’ active exploration, discovery and construction of knowledge meaning. This paper discusses the possibility and specific application example in which the ideology of the constructive learning theory is applied to experimental teaching of Digital Electronic Technology Experiment course. The experimental teaching reform full mobilize the enthusiasm and initiative of students, cultivate their operating abilities, autonomous learning abilities, analyzing and solving problem abilities. The reform effectively improves the teaching quality of the experimental course and the effect of experimental teaching.

Introduction

Digital Electronic Technology Experiment is the core basic course required by the students major in electricity in universities of science and engineering. It is not only the practice and application of the theory of digital electronic technology, but also laid the foundation for the following courses. Digital electronic technology experimental course can train the students’ basic experimental skills, engineering consciousness, innovation ability, and improve the overall quality of students. In recent years, with the emergence of various types of new programmable devices, such as FPGA, CPLD, ISP and EDA based simulation software [1]. Therefore, the digital electronic technology experiment has to reform with the times. Many scholars at home and abroad put forward a lot of ideas and methods of teaching reform. For example, there are teaching methods from the experimental content and experimental system, experimental teaching methods and the introduction of advanced EDA design simulation technology. There is also a project teaching method based project learning to improve students’ hands-on ability and cultivate students’ innovative awareness and innovative ability. In addition, some scholars have put forward the students as the center of the autonomous learning mode of teaching and according to the progressive level of the experimental teaching method and so on. Based on the theory of constructivism, this paper discusses how to apply this theory to the experiment of digital electronic technology, in order to achieve a better teaching effect.
Constructive Learning Theory

The constructivist learning theory was founded on the basis of the theory of the Swiss psychologist J. Piaget. Constructive learning theory is the further development of structuralism theory, and it is a new learning theory [2]. According to Piaget's point of view, he believes that knowledge is neither from main body, nor from the object, but the interaction processes between the subject and object construction. On the one hand, the new experience to get the meaning must be in the principle of experience. On the other hand, new experience new will make the original experience some change to make it get rich, adjustment or transformation. This is a two-way construction process [3].

The basic content of the constructive learning theory includes two aspects: the meaning of learning and the way of learning. On the meaning of learning, constructive learning theory holds that knowledge is not taught by teachers. However, knowledge is obtained by learner under certain circumstances by means of meaning construction with help of other people, such as teacher or cooperative partner. About learning methods, the constructive learning theory promotes that learning is up on learner-centered environments with instruction of teacher. The four elements of the learning environment are the "situation", "cooperation", "discussion" and "meaning construction" [4]. That is to say, it not only emphasizes the cognitive subject of the learners, but also does not ignore the teacher's guiding role. The teacher is to help the construction of meaning, facilitator, rather than knowledge and indoctrination. Students are the main body of information processing and the active construction of meaning, rather than the passive recipient of external stimulation and the object of being implanted.

The Feasibility Analysis of Constructive Learning Theory

Digital electronic technology experiment is a very important experimental course in our university's national elaborate course and national elaborate resource sharing course "electrical and electronic experiment series". The digital electronic technology experiment includes the basic verification experiment, the integrated design experiment and the independent design experiment. Some experiments are based on 74 series chip, and some EDA simulation experiments are based on FPGA and simulation software.

According to the constructive learning theory, textbook knowledge is an objective and reliable explanation of some phenomenon, which is not an absolute reference to the real world [5]. The primary stage of learning is to know some important theoretical knowledge and facts. In the experiment, the knowledge learned is reproduced in the original. For example, the basic verification experiment is the primary stage of learning. For the design experiment of digital electronic technology experiment, it usually has a certain comprehensive, covering more knowledge of digital electronic technology. These experiments are a little system with a certain degree of difficulty that is regarded as the advanced stage of learning process. In this stage, students are required to grasp the importance of the concept, and can be widely and flexible to be applied to the specific situation.

In the teaching process of digital electronic technology experiment, the traditional mode of students' passive acceptance of knowledge is changed. The new mode requires students to actively carry out independent learning, through constant communication and cooperation with others, the real situation in the construction of information. This learning process is not simply
to absorb knowledge, but to the students on the basis of the original knowledge system, the process of the construction of the external information. Students are no longer the passive recipients of knowledge, but the center of the learning process. Therefore, the teaching process of digital electronic technology experiment is a learning mode based on the students as the center and the teacher as the guide. This model is in good agreement with the constructivist learning theory, so the constructive learning theory can be applied to the teaching process of digital electronic technology experiment.

Application of Constructive Learning Theory in Digital Electronic Technology Experiment

Construction of Constructive Learning Environment

Constructive learning theory advocates the student centered learning under the guidance of teachers and the pursuit of teaching and learning. The theory emphasizes the creation of real situation, the creation of context as a necessary prerequisite for "meaning construction". The course teaching team takes the following measures to build a constructive learning environment for students.

Modular digital electronic technology experiment platform. As to traditional digital electronic technology experiment box, the layout has been determined and the function module has been installed in the experimental box. Students only need to connect to complete the digital electronic technology experiment. In order to facilitate students to actively construct the experimental circuit, we use a modular digital electronic technology experimental platform. This platform includes power supply module, chip module, indicator, data switch, clock, digital tube, potentiometer, resistor, capacitor and other modules. Each function module is independent of each other. According to the design requirements, students choose their own devices, layout, connection, debugging, and ultimately to achieve the function of the circuit in the experimental platform. This is equivalent to the students in a piece of paper, to construct their own personalized digital circuits.

Fully open experimental teaching mode. In order to create a constructive learning environment, we implement fully open experimental teaching mode. This teaching model is mainly embodied in: the open class, the open class, the experimental time is open, the experiment site is open, the experimental component is open and the experiment content is open. Students can be in their own time to do the experiment, after the completion of the basic experiment, but also according to the interests of their choice to do some other content of the experiment.

Network information teaching platform. The center has built a very comprehensive network of experimental teaching information platform for digital electronic technology experiment. The platform includes: center Introduction; the center of teaching documents; laboratory introduction; experimental course introduction; experimental preview information; experimental course information; experimental teaching materials; online course selection, etc. In this platform, students can understand or get a variety of information and information about the teaching of experiment. At present, the platform has provided the center of the production of all the experimental course CAI teaching courseware, experimental teaching center of all instruments and meters using the method of video courseware. Platform also has performance management, course selection system, as well as online real-time interactive communication of
teachers and students. A complete network of information exchange platform and a wealth of experimental teaching resources, in order to create a constructivist learning environment provides a convenient condition.

**The Concrete Application of Constructive Learning Theory**

Based on the constructivism learning theory, the traditional digital electronic technology experiment teaching content and method are improved. Which the most representative is the combination of autonomous teaching mode and designed experiment, independent design type experiments are presented, greatly improving the student's study enthusiasm, stimulate the potential of students, more conducive to the cultivation of students' innovative spirit.

Independent design experiment requires students to independently conceive, plan, arrange, complete and summarize the whole process of a scientific experiment, the purpose is to cultivate students' ability to independently carry out scientific experiments.

**Preparation for experiment.** The student is the center of the learning process and the active constructor of knowledge. Prior to the specific experimental operation, students should master the relevant chapters of the theoretical courses, see the relevant materials and reference materials, and according to their own interests and expertise, the independent design of selected experimental topics. Students develop their own experimental programs and experimental steps according to the experimental requirements. The preparation work of the experiment needs to consider all kinds of factors and the various problems that may arise in the course of the experiment. Therefore, the students take their own as the center of the whole process of the experiment, rather than the mechanical to complete an experimental process. The careful design, reasonable arrangement of the experimental process before the experiment can effectively improve the efficiency of the experiment.

For example, students designed the experimental subject for responder circuit. Students must draw the schematic diagram before experiment shown in figure 1. Then refer to the relevant theoretical knowledge and reference materials, select components, and then determine the experimental circuit. Device selection is different, followed by the experimental programs and steps are not the same. In this process, students need to complete the construction of new knowledge on the basis of the original cognitive structure, so as to become the active construction of knowledge.

![Figure 1. Diagram of responder circuit.](image-url)
**Process of experiment.** Constructivism holds that learning is a social one, that is, knowledge is not only a personal one, but also a society as a medium. Learning problems can be understood in two general levels. On the one hand, in the interactive level, the interaction between learners and the interaction with people more rich than their knowledge. On the other hand, it is in the community level including the social process of public system knowledge and the mechanism of these systems.

In the course of the experiment, the students carry out the experiment in the lab according to their own time arrangement and carry the student card to the laboratory. If the student can not complete the experiment, he can come to the laboratory for testing at a later time. If there are special requirements, students can apply for all night to do the experiment in the laboratory. We encourage exchanges between students and learn from each other to improve together. This will not only improve the students' knowledge level, but also train the students' ability to communicate and increase the interest in learning. Teachers in the process create an independent learning environment for students and become students’ active helper and guider to construct knowledge for student. In addition, teachers should arouse students' interest in learning, guide and keep students' learning motivation.

**Summary of experiment.** Students become independent learners and learn to sum up and reflect on. After designing the experiment, the students should independently complete the independent design experiment report in time. Students should pay attention to the format of experimental report, concise, coherent, clear results. Data processing and expressing are used in the form of chart. Because of the difference between theory and practice, students are required to sum up the reasons for the inconsistency between the results of the simulation analysis and the actual experiment results. Furthermore, students reflect on the preparation of the experiment and the implementation process of the problem, to further revise the learning strategy, to achieve a better learning effect.

By taking these measures, the digital electronic technology experiment course has achieved good teaching effect. Students can be more comprehensive and profound understanding of the basic concepts of the curriculum, the working principle of digital electronic circuits and debugging process. This is conducive to improving the comprehensive quality and innovative ability of students.

**Summary**

Based on the constructive learning theory, this paper explores the reform of the experimental content and teaching methods of digital electronic technology experiment course. These improved measures in the experimental teaching mobilize the enthusiasm of the students and the subjective initiative and effectively improve the teaching quality of the experimental course receiving a good teaching effect. In addition, it cultivates students' ability of practice ability, analysis and problem solving, and it is beneficial to the students' creativity. However, the experiment of digital electronic technology covers a wide range, and the content is rich. With the development of digital technology and the emergence of new devices and products, the experiment content need to constantly be improved in order to help student actively carry out effective construction of new knowledge on the basis of the structure of existing knowledge.
References


