The Application Research of Project Teaching Method Based on the CDIO Concept in Analog Circuit Course

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Abstract. The CDIO concept has been widely used in the teaching reform of higher education. The teaching method based on project conforms to the concept of the CDIO, which is focusing on the development of students' practical ability. In the paper, we mainly discuss the application of project teaching method based on CDIO in analog circuit teaching. Using the method may give full play to the initiative of students, mobilize the enthusiasm of students, improve the learning efficiency of students and achieve good teaching results.

1. Introduction

With the continuous development of electronic information science and technology, the employment problem of electronic specialty is becoming more and more serious. Because the traditional mode of personnel training often only pays attention to the theory and neglects students' practice and innovation, emphasizes knowledge and ignores students' learning ability, now comprehensive quality of many graduates is low and the actual work ability is poor. They are unable to adapt to the social or professional needs. The CDIO concept[1-3] is a new international engineering education model researched by Massachusetts institute of Technology and Sweden Chalmers University of technology. It uses concept, design, implementation and operation. The project teaching method refers that the whole process of the project management is carried out by the students under the guidance of the teacher. The most notable features of the method are: "the project as the main line, the teacher as the guide, the students as the main body". The teaching method can fully embody the teaching idea of CDIO focusing on the cultivation of students' practical ability. We introduce the project teaching method based on the CDIO concept into the teaching of analog circuits, thus the efficiency of classroom teaching and the practical ability of students can be effectively improved.

2. "Analog Circuit" Course Characteristics and Teaching Situation

The "Analog circuit" course is a basic course of many specialties such as electrical and information engineering, communication engineering and electronic science and technology. It is a very practical course. It is a necessary course mastered by practical talents with the ability of using electronic products, design, analysis, commissioning and production. The talents are engaged in electromechanical, communication, measure, use and development of electronic products. The course also plays an important role in the cultivation of students' professional ability and quality. The course between prerequisites "circuit analysis basis" and follow-up course "digital circuit" has a connecting role. At the same time, "analog circuit "course contains multitudinous knowledge and less practice content. Its contents are abstract. Because the basic concept of course is too much, the students are difficult to learn. In the traditional teaching process, teachers usually adopt the traditional teaching method. They have emphasized to teach the principles of semiconductor devices and their
components, which are usually highly theoretical. Because the students have difficulty understanding, they are weary of studying and afraid of difficulty emotion. At the same time in the traditional teaching process, the making method of an actual circuit has been less involved. The content is lack of connection with the actual daily circuit. It is difficult for students to understand the key and difficult points of the course and link the course with the application of the daily life. The teaching can only rest on the study of written content. It can’t achieve the effect of learning in order to practice. The experiment is mainly set up some validation experiments, lack of innovative experimental training. The students often rely on the experimental box excessively. In the experimentation, the teacher demonstrates and the students follow to do, so the training of the students' independent ability is less. Assessment method is single; the total score is mainly based on the final exam results.

3. Thinking of Project Teaching Method Based on CDIO Idea

In the CDIO method[4-6], we advocate "learning by doing" and "project-based learning". In the teaching process, we have taken the project as the driving force and taken the case as the basis. At the same time, we have simulated classroom teaching environment into the engineering education environment under the CDIO mode. The project teaching method refers to a set of teaching project, in which students under the guidance of teachers independent or team complete the whole process of the project, including: processing division, coordination and team cooperation, information search, demonstration, design and implementation of the project, project acceptance etc. The most significant characteristics of the project teaching method are taking the project as the main line and students as the main body. The method has changed the past passive teaching mode of "teachers talk, students listen", which has let students actively participate in the teaching process. The initiative and enthusiasm of the students can at utmost be developed.

3.1 Reform ideas of teaching content.

With the development of modern electronic technology, the teaching content of the existing analog circuit has been unable to meet the needs of social development, such as the teaching contents of the traditional analog circuit are focused on theoretical analysis, ignored the engineering and practice course. Moreover the analog circuit course has taken up fewer hours and covered wider range. Its basic concept is abstract. When students learn this course, their ordinary reaction is that the content is difficult and the knowledge can’t be applied. The result is that learning effect is poor and learning enthusiasm is not high. So we select the content of courses to remove the some contents of abstract, difficult to understand and not closely linked with practice. And we pay more attention to the characteristics of the device itself, parameters and its application in the actual circuit. The teaching process is reflected the CDIO engineering education ideas[7-8] and focused on the practicality and engineering content. Thus the students’ ability of understand to basic knowledge, engineering thinking, engineering practice, problem solving and team cooperation have been significantly improved.

3.2 Reform ideas of teaching method.

We can be adopted the project teaching methods based on the CDIO concept. The method has weakened the working principle of the device and paid attention to the practicality and engineering of teaching content. It has completed the transformation from the teacher leading traditionally to the student centering. The knowledge points will be provided to students in the form of engineering projects to stimulate students' sense of independent inquiry. In the teaching process of the analog circuit, the CDIO engineering education model is always carried out. The concept of CDIO engineering education is flexibly run through the teaching activities. The method is taken the project as the main line, constructed the project covering the main content of curriculum knowledge system to carry out the teaching process. So that students can use the form of completing the project task to complete the learning of the knowledge.
4. Implementation of Project Teaching Method Based on CDIO

The analog circuit is arranged in the first semester of sophomore year. It is the second basic courses for students. The students have not been established the basic concept of the actual analog circuit, so we should not only talk about the theory and the experimental development of the project. However, we should explain some simple, basic, easy to understand content and the content of the actual application development. We should avoid to introduce too much contents to the students, such as amplifying circuits, signal processing circuits, signal generating circuits, power supply circuits, integrated circuits, analog switch and control circuits, photoelectric isolation circuit, etc.. The students can only learn some fur instead. Some key contents should be selected to teach students, such as basic semiconductor devices, power amplifier circuits, integrated circuits, signal generation circuits, etc.. The overall course contents are designed for four projects, there are respectively project one a LED melody lamp, project two a DC regulated power supply, project three an active soccer sound, project four a simple signal generator. The design of the project follows the principle from simple to complex, from imitation to independence, from single skill training to comprehensive application. The block diagram of the project is shown in Fig. 1.

![Block diagram of the project](image)

Figure 1. Block diagram of the project.

Item one is a LED melody lamp. The teaching content of this project contains common components, semiconductor components and instruments.

The tasks of this project are as follows:
1. the detection and identification of common electronic components. 2. the identification and detection of the diode. 3. the identification and detection of the triode. 4. the installation and debugging of the LED melody lamp.

Students are required to achieve the knowledge objectives are as follows:
1. the identification, testing and selection methods of electronic components. 2, technical requirements for welding and assembly of electronic product.

Technical goals are:
1. learning to correctly identify, detect and select all kinds of common electronic components. 2, completing the installation and commissioning of the LED melody lamp.

Item two is a DC regulated power supply. The teaching content of this project includes rectifier circuit, filter circuit and voltage regulator circuit.

The tasks of this project are as follows:
1. the installing and debugging of the rectifier circuit. 2. the installing and debugging of the filter circuit. 3. the installing and debugging of the voltage regulator circuit. 4. the fabrication and debugging of DC voltage regulator circuit.

Students are required to achieve the knowledge objectives are as follows:
1. mastering the composition and working principle of the DC power supply. 2. mastering the using methods of multimeter, millivoltmeter and oscilloscope.

Technical objectives are:
1. learning the DC regulated power circuit designed method, component parameter calculation method and component selection method. 2. installing and debugging DC voltage regulator circuit independently.

Item three is an active football sound. The teaching content of this project includes the amplifying circuit, the multilevel amplifier circuit, the power amplifier circuit, the integrated operational amplifier and application feedback.

The tasks of this project are as follows:
1. the installing and debugging of the basic amplifier circuit. 2. the installing and debugging of feedback amplifier circuit. 3. the application of integrated operational amplifier. 4. the installing and debugging of power amplifier circuit. 5. the installing and debugging of active football sound.

Students are required to achieve the knowledge objectives are as follows:
1. composition, working principle and analysis method of the basic amplifying circuit. 2. understanding coupling mode and characteristics of the multi-level amplifier circuit. 3. mastering the relevant knowledge of feedback. 4. understanding the internal structure, the functions and characteristics of each part of integrated operational amplifier. 5. mastering composition, performance analysis and testing methods of the power amplifier circuit.

Technical objectives are:
1. learning the installing and debugging methods of the amplifier circuit. 2. the making and debugging of active football audio independently.

Item four is a simple signal generator. The teaching content of this project includes the RC and LC oscillator circuit.

The tasks of this project are as follows:
1. installing and debugging of RC oscillation circuit. 2. installing and debugging of LC oscillation circuit. 3. installing and debugging of sine wave signal generator circuit.

Students are required to achieve the knowledge objectives are as follows:
1. mastering the composition and the basic conditions of the sine wave oscillator circuit. 2. mastering the working principle of RC and LC sine wave oscillator circuit.

Technical objectives are:
1. designing a simple sine signal generator according to the requirements. 2. installing and debugging of sine wave signal generator circuit independently.

The implementation of the project includes the task introduction, the task analysis, the task implementation, the evaluation and task summary. In the introduction stage of task, some practical examples are given by the teacher to stimulate the students' interest in learning, to enhance the students' perceptual knowledge, and to bring out the tasks to be completed. In the analysis stage of task, the teachers guide students to analysis task step by step. Firstly, they should analysis the principle of the designed circuit theoretically, tell the students the required theoretical knowledge to complete the task, arrange students to learn the related content, encourage students to discuss with each other and answer common problems uniformly. Then they help students learn the method of installing some basic circuits. In the implementation stage of task, the students discuss in groups, analysis the circuit structure and signal flow under the guidance of teachers, clarify the circuit connection, draw the designed circuit using simulation software to simulate and test. In the actual production process, the team members should be required to work, discuss and solve problems
together, thus improve the ability of analyzing and solving problems. In the exhibition and evaluation stage, the students’ production will be shown. Through self-assessment, peer assessment and teacher evaluation, students can understand the industry standards, make the correct evaluation to the products of ourselves and others in accordance with industry standards and make a correct assessment to their own knowledge and skills. In the summary stage of task, let the students summarize the problems and solutions in the process of task implementation, the aspects of needing pay more attention to in the actual work process, the mastering knowledge and skills in order to cultivate students’ ability of analysis, generalization and reflection.

5. Conclusion

The paper is based on the CDIO concept. The project teaching method, which focuses on active inquiry, is introduced into the teaching of analog circuits. The combination of the abstract content and the specific project is conducive to play the initiative of students and cultivate their spirit of exploration, to mobilize the enthusiasm of students, to improve the learning efficiency. The introduction of this method will lay a good foundation for the future development of students.

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7. References