Course Design of Digital Electronic Technology Based on CDIO

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Abstract. Digital electronic technology is a course with strong engineering practicality. This paper mainly focuses on the curriculum design of digital electronic technology based on CDIO. Through the innovation of teaching mode, it drives the innovation of curriculum content and practice form, improves learning initiative, cultivates engineering design practice ability and innovation ability, and provides reference and reference for the cultivation of excellent engineering talents.

Keywords: CDIO · Course Design · BOPPPS

1 Introduction

In recent years, information technology is developing rapidly all over the world, and the demand for engineering and scientific talents in the information industry is also increasing [1]. Not only need to have a solid theoretical foundation, but also have strong engineering ability and innovation consciousness. Previously, engineering practice ability was mostly gradually produced through the training of work posts, and college education focused on the teaching of general theoretical knowledge [2]. However, this talent training model has been difficult to meet the growing demand of jobs for talents' engineering ability.

Curriculum is the basic carrier of professional practice and talent training. Digital electronic technology courses are offered in the second academic year in most colleges and universities. It is a core compulsory course for electronic information majors. Most of the courses that students study in the early stage take theoretical learning as the main body, and the role of the practical courses they participate in is usually to assist the understanding of theoretical knowledge. Digital electronic technology has established a bridge from theoretical thinking to engineering thinking. It is a key course for students to grow into excellent engineers [3].

In order to better meet the construction of emerging majors in Colleges and universities and the talent demand of emerging industries in society, and reduce the general gap between college education and the ability requirements of specific posts for college graduates, engineering education has gradually attracted the attention of various colleges and universities. Based on the above background, MIT began to promote the CDIO education reform plan, which aims to improve students' teamwork ability, critical thinking

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Table 1. Problems in digital electronic technology.

Problems in courses	Problem type
The course content is not updated in time	curriculum content
	curriculum architecture
The traditional practice teaching mode is single	curriculum architecture
	practical projects
Lack of innovation environment	engineering application

ability and comprehensive thinking and problem-solving awareness. CDIO represents conception, design, implementation and operation [4].

Although CDIO Engineering Education model is the latest achievement of international engineering education reform, it is a more universal education model. For students with different majors and backgrounds, different courses in the talent training program need to be designed according to the actual characteristics of students and the basis of talent training.

Therefore, how to improve students' engineering ability in the course teaching of digital electronic technology, cultivate students' innovative thinking, and further combine the course content with talent needs has become one of the focuses of colleges and universities. In view of the above problems, this paper puts forward the curriculum design mode based on CDIO and introduces it into the teaching of digital electronic technology, which is discussed from three parts: curriculum architecture, curriculum content and practical projects.

2 Existing Problems

For the digital electronic technology course, the integration and updating of course content is the first element to ensure the teaching quality and create a "golden course, which is also the development trend. Although some colleges and universities have launched the curriculum reform of digital electronic technology, at present, most domestic colleges and universities still use the traditional teaching mode in the teaching of relevant courses, and there are more or less the following problems, as shown in Table 1.

1. The course content is not updated in time

   The digital electronic technology courses offered by most colleges and universities mainly introduce the methods of classical digital system analysis and design, and spend a lot of time in the introduction and use of medium-sized devices.
2. The traditional practice teaching mode is single

   Because the focus of the theoretical course is on the traditional content, the practical teaching is mainly centralized teaching, mainly including the understanding of electronic components, circuit design and assembly, problem detection and troubleshooting, etc. As the core of engineering practice course, it is difficult to cultivate students' design ability and innovative thinking.

3. Lack of innovation environment

The knowledge of digital electronic technology courses is relatively scattered, and students often have the problem of what they can do to learn these knowledge. Students can't use their knowledge flexibly, which makes it more difficult to solve practical problems. In the process of electronic design competition, it is often difficult for students to put forward specific plans when facing scheme design and problem-solving.

3 Curriculum Design Mode Based on CDIO

3.1 Curriculum Architecture Based on CDIO + BOPPPS

CDIO teaching philosophy focuses on universality. In the actual teaching practice, BOPPPS model is usually used to organize the teaching process [5].

BOPPPS model is a teaching model based on constructivism [6]. It is famous for effective teaching design. It highlights participatory learning, emphasizes the active role of learners in the classroom, and makes timely adjustments through constant feedback on teaching and learning [7]. The model was first created by Canadian ISW and has been introduced and adopted by more than 30 countries around the world. The application practice shows that the use of BOPPPS model can promote students to actively participate in classroom learning, enable students to maintain their focus on the classroom, and improve the effectiveness of classroom teaching.

The BOPPPS model divides the classroom teaching process into six stages: Bridge in, Objective, Pre-assessment, Participatory Learning, Post-assessment and Summary [8].

As shown in Table 2, it is necessary to clarify the functions and processing strategies of the six stages in the teaching process.

We find that CDIO and BOPPPS can be combined organically to organize the teaching process through BOPPPS to achieve CDIO engineering education mode. The corresponding relationships between the four stages of CDIO teaching concepts and the six elements of the BOPPPS model are shown in Table 3.

Through the integration of CDIO and BOPPPS, the unification of theoretical explanation and engineering practice classroom organization in digital electronic technology course is achieved, which lays a foundation for improving the effect of Engineering teaching.

3.2 Reconstruction of Course Content

Transfer the teaching content from the traditional medium-scale device use to the hardware description language, and reconstruct it, with emphasis on the content of the two chapters of combinational logic circuit and sequential logic circuit.

With the introduction of Electronic Design Automation (EDA) technology and Hardware Description Language HDL, Programmable Logic Devices, Verilog language and Programmable Logic Device Programming Software Quartus II, students can fully master the design method of electronic design automation.

Table 2. BOPPPS model.

Stage	Function	Strategy
Bridge in	Attract students' attention, arouse students' thinking, and help students focus on or understand the content to be learned.	Play video, play games, case analysis
Objective	The function of learning objectives is to let students clearly grasp the learning direction.	Cognition, emotion and skills
Pre-assessment	Understand students' interests and abilities, and make students understand their mastery of knowledge	Questions, quizzes, group discussions
Participatory Learning	Improve students' participation and enhance the interaction between teachers and students	Group discussion, debate and scenario simulation
Post-assessment	Understand what students have learned and whether they have achieved their learning goals	Choice Questions, Checklists, Writing Experiences
Summary	Summarize classroom content, help students integrate learning, guide students to reflect on content	Content Review, Mutual Comment

Table 3. Mapping of CDIO and BOPPPS.

CDIO	BOPPPS
Conceive	Bridge in
	Objective
Design	Pre-assessment
Implement	Participatory Learning
Operate	Post-assessment
	Summary

3.3 Innovative Practice Project

Promote the subject competition through the practice teaching and improve the training ability of applied innovative talents. Engineering-oriented experimental teaching cases, such as signal processing, controller design, microprocessor design, are built based on subject competitions.

On the basis of scientific research projects and subject contest topics, the project group introduces CDIO mode, which embeds course learning into practical projects,

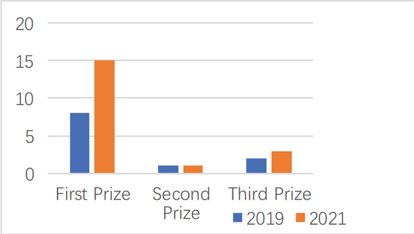

Fig. 1. This caption has one line so it is centered.

and improves the engineering practice ability of College students. It realizes the close combination of the knowledge and ability elements in the course teaching, practice teaching and subject competition, and systematically improves the innovative ability of College students.

Currently, the main content of the course is the medium-scale device use. The transformation from theory to engineering combined with the electronic design contest reorganizes the original course content and experimental course system, reduces the introduction of the basic characteristics of medium-scale devices, and changes it to make students independent. Change the homework from exam-taking to project design.

4 Curriculum Design Mode Based on CDIO

To verify the effectiveness of the teaching model and the teaching reform, we observed and compared the learning conditions of different grades in the same major. The result shows that the grade examination result of the course design of digital electronic technology based on CDIO has been improved.

We compared the awards of students participating in provincial electronic design competitions before and after the implementation of teaching reform. The results are shown in Fig. 1. From the results, the number of first prizes has increased significantly, with an increase rate of 87.5%. However, the number of second and third prizes in the two competitions has basically remained unchanged. This shows that the teaching mode we put forward has improved the overall quality of students.

5 Conclusions

According to the needs of Engineering Education in curriculum design, this paper puts forward the curriculum design of digital electronic technology based on CDIO, and makes research and innovation in three aspects: curriculum organization form, theoretical teaching content and practical teaching mode. Through comparative observation and practice, students' learning initiative has been significantly improved, and students' ability to solve practical problems, engineering design practice and comprehensive application innovation have been cultivated. Of course, in the process of practice, we also encounter the increase of teachers' workload and less topics from enterprises. In the next research, we will further explore how to optimize the teaching mode of CDIO.

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