

## Application of CDIO Model for "Microcomputer Principle" at Technology University

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### Abstract

CDIO Model, the trend of education at present, was introduced to the course of "Microcomputer Principle". CDIO teaching is the teaching activities of teachers and students together to complete several entire projects. The CDIO education model embodies the teaching philosophy that teachers are guiders, students are subject, the combination of works and studies and "Learning by Doing". It improves teaching effectiveness and teaching quality.

**Index Terms:** CDIO; Microcomputer Principle; Teaching Model

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### 1. Introduction

In our Institute, the course of "Microcomputer Principle" is an important professional basic course to the professionals of electrical automation technology, computer application technology, etc. It plays a huge role for students in the future development and design of computer hardware and the follow-up courses of study. Its main task is to make students understand the working principle of the computer system, master assembly language programming and master interface chips commonly used in industrial application <sup>[1]</sup>.

### 2. The Problems in "Microcomputer Principle" teaching

#### 2.1. Analysis and solving of students problem

Vocational college is different from other undergraduate colleges. Its students mainly come from general secondary schools and vocational high schools, whose college entrance examination admission is relatively low. So the basis of these students are relatively poor.

Although students come from high school have some good in math and English, but because of "Microcomputer Principle" is their first contact, they are generally considered it more abstract and difficult to understand; for students come from vocational high school, this course is relatively simple because they have contact with some professional course previously. But English, mathematics and other basic course is difficult for them. Under this circumstance, we can take small classes, and develop different training program to meet the different students.

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Their common advantage is their practical ability is good. We should make full use of this advantage to mobilize the enthusiasm of students and train the students to be successful high-skilled personnel.

## 2.2. Problems in teaching content

The course of "Microcomputer Principle" is a theoretical and practical course, while a lot of institutions put emphasis on theory and ignore the practice. In theory, we mainly discuss working principle of the computer's internal structure, often-used instructions, assembly language, common interface, etc. In practice, we mainly do some confirmatory testing through the microcontroller. As the time is too little for doing experiment, the general experiments for students are practiced step by step in accordance with relevant reference books, which reduce the process for students to think and don't meet the requirement that train students' capabilities of analyzing and solving problem. When they've finished the course, they even do not understand why learn this course and what's the use in the future work. Of course the learning effect is minimal.

This is because that in the teaching process, we overlooked a very important issue - interest, so how to mobilize the students' learning interest is the key. Then we need to reform the teaching content and teaching methods based on the actual situation of the school.

## 3. The reform based on CDIO

### 3.1 CDIO educational philosophy

CDIO engineering education mode is the latest achievement of international engineering education reform in recent years, engineering education developing toward the internationalization is inevitable. Training Chinese engineers with international standards is the fundamental task of engineering education. Engineering education should focus on solving the problems such as putting more emphasis on theory than practice, more emphasis on individual academic ability than the spirit of teamwork, more emphasis on knowledge learning than the cultivation of innovation to enhance personal development skills, interpersonal communication skills, design ability<sup>[2-3]</sup>.

CDIO stands for Conceive – Design – Implement – Operate, and is teaching theories and educational mode of today's engineering education. It is a masterly generalization and abstract of "learning by doing" and "product teaching".

### 3.2 CDIO application status at home and abroad

CDIO engineering education mode is the latest results for international engineering education reform in recent years. It is initiated by Massachusetts Institute of Technology, Sweden Chalmers Institute of Technology, Linköping University of Sweden and the Swedish Royal Institute of Technology and participated by 23 universities in the world in 2000. After exploration and study of four years, an international organization named CDIO were set up in 2004, and the CDIO engineering education philosophy was founded. So far, dozens of The world-renowned universities have joined in the CDIO international organizations, these universities use CDIO engineering education philosophy and curriculum to carry out teaching practice, and they have achieved good results. In particularly, students trained by CDIO model are welcomed by the community and businesses.

College Engineering of Shantou University became the first member of CDIO International Cooperation in early 2006. Combining with China's reality and basing on the CDIO, they creatively put forward the EIP-CDIO training mode, which focused on ethics, integrity and professionalism which were integrated by the idea of Conceive - Design - Implement – Operate and emphasized the combination of life and work. Through comprehensive reforms and explorations, they had made a series of experiences and achievements<sup>[4]</sup>.

### 3.3 CEC-CDIO Reform of Teaching Mode

Since we started the construction projects for the State model of high vocational colleges, we have reformed the related curriculum. Combining with the actual situation in our institute, we cooperated with China Railway Construction Corporation, Shijiazhuang Haitian Computer Engineering Co., Ltd and other enterprises in the teaching process. According to the training objectives of vocational colleges, regarding the deeply integration of college-enterprise as the base platform, and docking with the CDIO philosophy of engineering education, we proposed CEC-CEIO training model for highly skilled person. That is, on the basis of college-enterprise cooperation, we focus on training students in manufacturing capacity, engineering construction capability and the capability of construction technology innovation, and take into account the conceiving, designing and operating of construction technology to train the craftsmen with the construction of innovation and teamwork skills. After nearly three years implementation, we have achieved initial results.

## 4. Reform of Teaching Method

According to course content and student's characteristics, we flexibly use multiply appropriate methods such as project-driven teaching, case teaching, group discussion teaching and the integration of teaching • learning • doing to carry out teaching activities, which effectively mobilizes the enthusiasm of students and guides students to think and practice, enhancing self-learning effects and the capacity of learning.

### 4.1 The project-driven teaching

The project-driven teaching is that teacher and students jointly implement a complete project work to carry out the educational activities. It uses the mode of "asking questions, analyzing and solving problems" to teach points of knowledge. This mode is a student-centered teaching method. Teacher assigns the tasks to students basing on analyzing and demonstrating tasks, and students firstly group, divide labor according to the form of tasks and then advice and study to determine the implementation of the program and develop work plans. The practical ability of student can be improved in process of implementation of task.

So before teaching, the teacher should develop practical projects according to the situation of students, teaching contents and teaching goals. Project selection is critical. If the project selected are too difficult for students to make out, it will make students lose interest in learning; while if projects are too simple for students to learn, it will make them feel uninteresting. According to the actual situation and the a large number of researches to Shijiazhuang Haitian Computer Engineering Co., Ltd, we explored three projects for the course of "Microcomputer Principle" and implemented them: completing a simple "students score management system" to learn the basic principles and assembly language; completing "the driver card of package" to learn the chip 8255,8251 and other important chips; completing "keyboard design" to learn the chip of 8253 and assembly language.

In the teaching process, teachers firstly propose the task of the project and determine the functions of projects, which will make students have a clear purpose to gain knowledge and effectively reduce blindness in learning; then as the project started, the teachers teach the needed knowledge. In this process, teachers play the roles of guidance, regulatory, advisory and monitor. At last, the teachers evaluate the final results of students learning<sup>[5-6]</sup>.

### 4.2 Case Teaching

This course is to theoretical, so students do not know the use of it and just learn passively for passing test. Through using actual instances we can greatly raise the learning interests of students, change passive learning to active learning and mobilize the enthusiasm of learning.

### 4.3 Group Discussion Teaching

Content in this course is very abstract, so it is easy to make students feel dull. In order to stimulate enthusiasm for learning, promote students' problems analyzing and solving ability, group discussion teaching can be used in teaching process. Before the project start, 3-5 students compose one project group; in the project, the group members can discuss and jointly resolve the problems encountered in the project. Using discussion method can exercise students' speculative capacity, while in the process of teaching we encourage students to challenge and guide students to access literature or do independent experiments after school, summarize scientific conclusions, which can expand the academic perspective, train the initial research and teamwork capacity.

### 4.4 The Integration of Teaching • Learning • Doing

Learn by teaching and learn by doing. Knowledge and skills are simultaneously increased. In the project of "Students' score management system", students learn theoretical knowledge while programming on computer. Problems can be encountered in this process, then group members or the teacher can discuss with each other; in the project of "Driver card for package", students design, weld and test the circuit board, which enhances the practical abilities of students and allows students to acquire knowledge in practice; in the project of "keyboard design", students not only learn the basic principles and the internal structure of 8253 but also consolidate the learning of assembly language. The integration of Teaching • Learning • Doing is the teaching method that combines works and study. Teachers and students do while teaching and learn while doing in the training room, learn by teaching and learn, so that knowledge and skills can be simultaneously increased.

## 5. Conclusions

In summary, using the project-driven teaching can stimulate students interest in learning, change the attitude towards learning, improve students' learning enthusiasm and initiative, improve their practical ability of analyzing and solving problems; using the collaborative group has trained students' teamwork consciousness. The project-driven teaching mode partly solves the problem of the department from theory to practice, emphasize the comprehensive abilities of students. Through one year of practice, we have achieved good teaching results, which show that this teaching method is suitable for vocational education.

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