

# The Ways to Achieve the Objectives of Single-Chip Computer Course

Yuan Liu<sup>1,\*</sup>, Yanan Zeng<sup>1</sup>, Haiyun Wu<sup>1</sup> and Guimei Dong<sup>1</sup>

<sup>1</sup> College of Engineering and Technology, Tianjin Agricultural University, Tianjin China

\*Corresponding author. Email: ynzeng@tju.edu.cn

## ABSTRACT

Due to the lags in the training mode of college students' learning and practical ability and the unsymmetrical situations between the teaching content and curriculum practice system and the training objectives of applied talents, the outcome-based education theory was applied in the teaching design of single-chip microcomputer to assist students to achieve the curriculum objectives. In the process of teaching implementation, students act as the center, and project teaching is the method. By means of action-oriented project organization, project implementation of students' main body, competency based project design and competency core project evaluation, the ways to achieve curriculum objectives were explored.

**Keywords:** *Outcome-Based Education Theory, Single-Chip Microcomputer, Achievement Degree of Course Objectives*

## 1. INTRODUCTION

With the rapid development of higher education reform in China, engineering education has become the focus of the reform [1]. Professional accreditation of engineering education is a mechanism to measure the level of teaching, meanwhile, the achievement degree of curriculum teaching objectives is the core of the evaluation [2]. However, as a major basic course for automatic control specialty, the teaching design and teaching methods for the principle and application of single-chip microcomputer (SCM) can not meet the requirements of applied talents cultivation in Engineering. Therefore, it is imperative to reform teaching mode by means of using outcome-based education(OBE) theory, referring to professional certification standards of engineering education, as well as exploring advanced teaching means and methods [3].

### 1.1. OBE Theory

To solve those problems above and meet the requirements of engineering education for training application-oriented talents, we integrated OBE educational concept into project teaching in SCM experimental courses.

The OBE theory of achievement-oriented education is a kind of teaching theory which is designed and implemented with students as the center and teachers as the auxiliary, emphasizing students' active learning and continuous feedback, focusing on what abilities students can acquire and what tasks they can accomplish after being trained[4]. The required teaching activities and teaching process are carried out around the expected learning results, trying to maximize the ability of students to achieve their learning results after learning through the

educational process. The teaching and learning process is an activation process of sustainable improvement.

### 1.2. Project Teaching and Target of the Teaching of SCM

Project driven method is a kind of teaching method based on OBE theory, which is characterized by "taking project as the mainline, teachers as guidance and students as the main body", and changes the passive teaching mode of "teachers speak and students listen", meanwhile, creates a teaching mode of students' active participation, independent cooperation and exploration and innovation. In the process of completing the task, students are placed in a complete process environment, which enables them to show their abilities of thinking, questioning, researching, deciding and presenting, and cultivate their abilities of creative thinking, analyzing and synthesizing information, planning and organizing[5]. It is the target of the teaching of SCM course that teaches students theoretical knowledge and operation skills, improves their professional ability and professional quality cultivates students' learning ability of accepting new knowledge and social ability of cooperation and communication with others, especially students' future sustainable development ability.

## 2. PROBLEMS IN TEACHING OF SCM

(1) The formulation of syllabus fails to reflect the degree of achievement of learners' professional level in various learning links.

The syllabus has always reflected the direction and goal. However, the basic requirements are non-specific, and the ways to achieve the goal (main teaching links), knowledge

points and methods are not exhibited in them. Therefore, the implementation process cannot be monitored and evaluated specifically to ensure the teaching quality.

(2) Scientific orientation is adopted in teaching, with a single teaching mode and insufficient practice.

It is precise because of the scientific orientation of theory, curriculum and teaching implementation, students are in passive learning so that they are not interested in learning, while teachers are not enthusiastic in teaching. In addition, the fact that students are the main body of teaching is neglected, as well as practice teaching. Students' ability to solve practical engineering problems, exploration and innovation are seriously lacking, and the teaching effect is getting worse and worse.

(3) The evaluation of teaching effect is not scientific enough.

To reflect the degree of students' mastery of knowledge, the assessment methods such as doing homework, writing experimental reports and examination papers are usually adopted, which can not reflect the degree of students' mastery of practical knowledge. At the same time, the problems such as students' engineering design ability, practical ability and innovation and entrepreneurship ability are also covered up.

(4) The examination and evaluation of students' non-professional technical factors are ignored.

Modern engineers are "social people" with social responsibility. However, the current teaching does not reflect the cultivation of students' comprehensive quality, the consciousness of sustainable development, cultural communication ability and cooperative spirit, and the ability of teamwork is poor.

### **3. WAYS TO ACHIEVE THE TARGET OF CURRICULUM**

In order to solve the problems existing in the teaching of SCM and improve the degree of achievement of the course objectives, the ways to achieve the course targets are explored.

#### ***3.1. Teaching Design***

Student-centered engineering education requires that the whole teaching design and teaching implementation should be closely focused on promoting students to achieve learning outcomes (graduation requirements). Project teaching aims at "teaching students to learn", teaching students to "enjoy learning", "be able to learn" and "learn to master". Among them, "be able to learn" is the core, namely learning by themselves, learning during practice and thinking. The implementation of the project should follow the principle of 1346. That is, one core target: all students should achieve the required results. "Three" refers to two key premises and one final target. Two key premises: one is to establish a clear learning achievement structure to determine the ability structure

that students should achieve at graduation; the other is to create a successful environment to provide suitable conditions and opportunities for students to achieve the expected results. A final goal (final learning achievement or peak achievement) is taken as the starting point to reverse the curriculum design, carry out teaching activities, and construct teaching links, teaching methods and ways to achieve the goal. Four implementation measures: action oriented project organization, student-centered project implementation, competency based project design and competency core project evaluation. Six general abilities: the ability to discover and solve complex problems, design and innovation, self-learning, self-management and self-development, teamwork and communication.

#### ***3.2. Teaching Methods and Measures Adopted***

##### ***3.2.1. Project design based on ability***

The design of the project title should reflect the general ability requirements of students, meet the cultivation of students' vocational ability for employment, and reflect the ability requirements of students' career sustainable development[6]. The teacher divided the students into 13 project groups in groups of three. In order to stimulate students' interest in learning, the teacher provides 13 project topics from daily life (such as the design of simulated washing machine, design of the intelligent door, design of analog taximeter, design of simulated elevator, design of password lock, etc.) for students' reference. The topics are determined through negotiation and cannot be repeated. Students can choose one of them according to their abilities, add or subtract functions, or set up other projects according to their interests. In the process of completing the project, students' professional ability and general ability can be developed.

##### ***3.2.2. Project organization based on action-oriented***

Based on the advantages of action-oriented task implementation, the project implementation process is divided into four stages: knowledge reservation, project implementation guarantee, project task implementation, induction and improvement, to implement the project task truly realize the combination of work and learning and the integration of theory and practice.

###### ***3.2.2.1. Knowledge reservation***

In order to improve the students' learning initiative, the teaching method is tried in SCM course. The main content of this course will be arranged for students in the way of MOOC and quality courses before class, and they will be required to study by themselves. In class, the teacher

explained the key technologies and knowledge points to be mastered and asked questions in the form of projects. Students discussed in groups of 3-4 and submitted answers. The teacher organized the discussion and made comments. This way of learning enhanced students' interest in learning and awareness of participation.

In the teaching process, we can find that some students do well in exams, but their practical ability is poor, some students do well in writing, but not in present, some students are not good at self-learning, but good at imitating. To solve these problems, a single microcomputer is developed in groups. Students were required to complete the basic functions according to the project requirements and encouraged innovation to expand the functions. The development process (hardware and software) was required for video. The video content should reflect the work of each student in the team. In the video, the design of software and hardware should be explained, the operation result should be presented, and the innovating points and problems should be summarized. By these measures above, the enthusiasm of students to study and explore was aroused.

SCM experiment course was composed of skill training and project implementation. In the skill training class, students should complete the basic operation of software and hardware according to the experimental requirements. Teachers corrected and guided.

### 3.2.2.2. Assurance of the project's implementation

Teachers are responsible for guiding and answering questions in the experimental class and after class, opening the laboratory and applying for self-study room to provide development environment for students, and providing experimental equipment and devices according to the implementation plan of students' projects.

### 3.2.2.3. Implementation of project task

Implementation of project task is student-oriented. The implementation process values the success of each student. Each student in the project team is required to participate in the project from the aspects of topic setting, data checking, design scheme determination, function realization and achievement display. Each student is responsible for one part in the project. The working process of each student is recorded by video. Students can refer to the course courseware, quality course and related materials to get the basic design principles and methods. If students have difficulties, students can ask for help from teachers (contacting via QQ at any time), classmates and the Internet. This kind of design highlights the students' main body, self-organized project design, autonomous learning and mutual learning, cooperative communication and expression, and independent realization. It solves the problems that students only attach importance to theory and poor practical ability, and improves their ability in the

implementation process and cultivates their innovation consciousness.

### 3.2.2.4. Induction and improvement

The learning results were checked by project discussion and debate after the project is completed. In the discussion and debate, each member of the project team elaborated the implementation method, the main problems solved, the innovations and the demonstration results around their own work in the project. After the presentation of one group, the members of other groups raised questions, and the reply group member answered them. Finally, teachers give comments and exchanges.

### *3.2.3. Project evaluation based on ability oriented*

The key link to teaching design is the evaluation mechanism of project implementation. Learning from the British BTEC hierarchical process teaching evaluation, problems that the current teaching and evaluation links disconnect can be solved.

The assessment and communication are conducted in the way of the seminar. The assessment scores include project difficulty, project completion, project description, defense, team cooperation, project writing, etc. The assessment reflects the actual degree of graduation requirements and ability requirements.

## **4. ACHIEVEMENTS OF THE TEACHING REFORM**

The practical application of project teaching method in measurement and control, agricultural machinery, electrical and other majors has broken the traditional teaching theory, teaching thinking and teaching method. It adopts the OBE results-oriented education philosophy and the action-oriented project teaching mode, and cultivates a large number of applied talents needed by the society.

(1) Students' professional skills were improved rapidly.

Students' professional skills were improved rapidly by applying project teaching. The application of the project teaching method makes students' professional and technical level improve rapidly. The pass rate of vocational training certificate, such as Single-chip engineers, programmable controllers, CAD and other vocational training, reached 100%.

(2) Students' comprehensive ability was improved significantly. The application of the project teaching method stimulates students' interest in autonomous learning and promotes the development of students' subjective initiative and creative potential. Through the project of "students as the main body, teachers as the guide", the ability of students' autonomous learning, independent thinking, exploration, innovation and

teamwork has been enhanced, and a series of teaching achievements have been achieved. In the past five years, 130 undergraduate students have applied for and obtained patents in the field of measurement and control technology and instrument alone. A total of 34 papers have been published by undergraduates, among which 27 papers have been published in academic journals and international conferences. 32 innovation and entrepreneurship projects were approved. Students have participated in 34 teacher research projects. Students have won 104 prizes in national and provincial electronic competitions.

(3) The students' learning effect was well received by professionals inside and outside the school.

Electronic competitions for college students were held. The professional level of our students has been well received by the organizing committee and experts. The innovative series of works controlled by SCM have been praised by the headmaster, teachers and students of the whole school.

Graduates were recognized by employers. With solid basic professional knowledge, good innovation ability, graduates were deeply welcomed by employers, with an average annual employment rate of 90.15%.

**Table 1.** Project assessment and scoring standard

No.	Project	Index	Base score	Full mark
1	Title	The design meets the requirements of the assignment, is reasonable, clearly stated, accurate and clear.	10	15
2	Presentation	PPT report is fully prepared, able to provide necessary and complete video data in the report, and able to complete the report within the specified time.	6	10
3	Results demonstration	The system design is reasonable. The function is perfect. The design is complete and can realize the expected function	20	30
4	Debate and discussion	In the process of defense, the basic concepts are clear, and they can use the knowledge obtained to answer the questions raised by the defense group accurately and comprehensively. They are able to put forward their own ideas on the problems encountered.	18	30
5	Innovation	Have the understanding, improvement or breakthrough of the previous work.	5	15

## 5. CONCLUSIONS

Project driven method is a teaching method based on OBE theory, which is characterized by "taking the project as the mainline, teachers as guidance and students as the main body". It has changed the passive teaching mode of "teachers speak and students listen" and solved the problem of poor learning effect. It has created a teaching mode of students' active participation, independent cooperation and exploration and innovation. By applying the project teaching method, the problems that the training mode of college students' learning and practical ability obviously lags, and the teaching content and curriculum practice system do not match with the training target of application-oriented talents were improved. The core competitiveness of students and future sustainable development ability were promoted. It has reference value to the teaching of peers.

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