Open Access Library Journal
2022, Volume 9, e9405
ISSN Online: 2333-9721
ISSN Print: 2333-9705

OBE Integrated Teaching Practice of Single-Chip Microcomputer Course

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How to cite this paper: Xu, X.Z. (2022) OBE Integrated Teaching Practice of Single-Chip Microcomputer Course. *Open Access Library Journal*, **9**: e9405.
https://doi.org/10.4236/oalib.1109405

Received: October 1, 2022
Accepted: October 30, 2022
Published: November 2, 2022

Abstract

The teaching practice and the problems in traditional teaching of principle of single-chip microcomputer and application course are expounded. In order to improve the application ability of students, with the concept of OBE, the integrated teaching mode of theory and practice teaching is adopted. From multiple perspectives, the cultivation of application ability is enhanced through teaching content, teaching methods and assessment methods. Students are encouraged to design independently, and practice-based teaching is discussed to improve the application ability of students.

Subject Areas

Mechanical Engineering

Keywords

Principle of Single-Chip Microcomputer, Practice Teaching, Integrated Teaching, Application Ability

1. Introduction

In view of Germany's "Industry 4.0", China puts forward the development strategy of manufacturing industry with Chinese characteristics. "Made in China 2025" makes clear that China's manufacturing industry follows and makes up for the lack of industry 3.0, catches up with the development of industry 4.0, and then realizes the three development stages of manufacturing power. At the same time, it makes clear that the manufacturing industry takes automation and intelligence as the development direction. Under the new situation, industrial enterprises put forward higher requirements on the electromechanical control skills of graduates, especially the design ability of automation system based on single-chip microcomputer [1]. As one of the main controllers of electromechanical system, the principle and application of microcontroller are the knowledge that students must master.

In view of the shortcomings in the application process of single-chip microcomputer system, many teaching workers have put forward teaching reform methods, teaching mode, teaching content and other innovative suggestions. However, in view of the integration of theory and practice in the teaching process, there is still a lack of corresponding research on detailed assessment.

Aiming at the problems of outdated syllabus, insufficient practice links, backward teaching methods, single assessment methods and other problems in the teaching of Principle and Application of Single-Chip Microcomputer in our school, the course of integrating theory and practice is adopted, and the original course content is reintegrated under the concept of outcome-based education (OBE). Improved training objectives, teaching content, experimental teaching, assessment methods, etc., in order to systematically improve the teaching level of single-chip courses, and enhance the ability of students to adapt to the new situation of industrial enterprises for the skills of graduates.

2. Problems in the Teaching of Single-Chip Microcomputer

SCM is a heavy practice heavy application of the course, and the practical ability and application ability is the need to continue to explore and trial and error in the slow accumulation of learning experience. However, due to various reasons, single-chip teaching in many colleges and universities is still carried out in the traditional classroom, where teachers pass information to students unilaterally through PPT, videos, animations, etc. Students have a thorough grasp of theoretical knowledge, but cannot apply it to practical projects [2] [3].

In the traditional teaching method, the teaching link of single-chip microcomputer is mainly divided into two parts. 1) The first part is classroom teaching. Teachers introduce knowledge points by PPT in the classroom. 2) The second part is practical teaching. In this part, the teacher asks students to complete some confirmatory experiments through the experiment box. According to the normal course schedule, 4 credit courses will be arranged twice a week, each class will be 2 credit hours, and the two classes will be separated by one or two days. From many years of teaching experience, it is common for students to understand the knowledge in theory class, but two days later in the laboratory, students have forgotten some important points, and become unable to start.

At present, many colleges and universities use the experiment box or Proteus simulation platform in the practice course of single-chip microcomputer [4]. The experimental box has some problems such as slow update speed and fixed module. In addition, most of the experimental contents of the experimental boxes are confirmatory experiments. When the experimental results appear, students will think that the experiment has been completed, so as to stop their learning pace. Practical teaching through simulation software can solve problems such as insufficient hardware resources. However, in practical application, it will be found that there is still a certain gap between simulation software and actual projects, and over-reliance on simulation software will also affect the learning effect [5]. The simulation of water lamp in Proteus software is shown in Figure 1.

3. Teaching Practice of Integration of Theory and Practice Based on OBE Concept

3.1. Adapt to the Development of Subjects and Optimize the Teaching Model

After the teaching reform, the original teaching method of separating theory and practice was changed to the integrated course of theory and practice. At the same time, in order to improve the learning effect of students and the density of learning knowledge, the original form of 2 classes once a week was changed to 4 classes once, which was convenient for teachers to practice immediately after they finished a section of theory. Through teachers' control of classroom progress, students can conduct practice training in time after each knowledge point, teachers can know students' grasp of the knowledge point in time, adjust the teaching progress, and explain common mistakes in a targeted way. Questions that students do not understand in the course can be answered in time, which improves the effect of knowledge absorption. Through practice, it can not only ensure the integrity of a knowledge point, but also let students have free space to play, and students generally reflect that the teaching effect is good. Therefore, the arrangement of four classes at a time can not only complete a large project, but also not make students feel very tired [6] [7].

3.2. Innovate Teaching Content and Strengthen Application Ability

The content of the course is no longer taught by chapters, but integrated. According

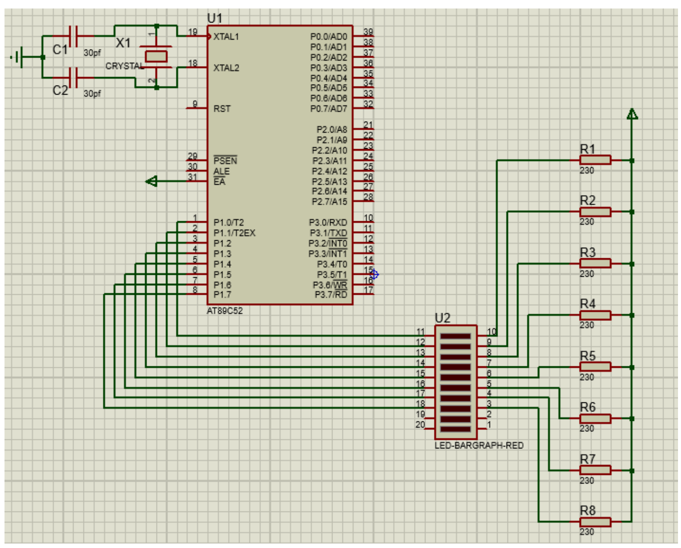

Figure 1. Simulation diagram of water lamp.

to the different knowledge points required by the target, the teaching content is redesigned to ensure that each class has theoretical and practical content, so that students can feel the process of building a system and sense of achievement. The whole teaching emphasizes the application, first introducing the basic functions, letting the students realize the basic tasks, then putting forward higher requirements, and letting the students with questions learn the theoretical knowledge of the next part. Take the single-chip microcomputer in the simplest water lamp project as an example. We combine the flow lamp experiment with the internal structure of MCU and C51 language. The whole adopts a gradual way, starting from lighting a lamp, until finally, you can choose more than one pattern lamp. In learning, students gradually master the IO port configuration and use of single-chip microcomputer, C51 data types, operators, loops, functions and other knowledge points, and each class has certain progress, and through continuous practice, slowly understand the general process of single-chip application. Each practice will be put forward to the students to expand the task, for learning to have the power of the students to play, and deepen learning [8] [9]. The course arrangement of the project is shown in Table 1.

3.3. Keep up with Technological Progress and Enrich Teaching Methods

In the advanced course "Printed Circuit Board Design", students draw a single-chip microcomputer minimum system by themselves, and make. This semester, according to the teaching requirements, the corresponding peripheral module will be added. This way not only trains students' hardware-making ability, but also avoids students only knowing how to program software and neglecting the importance of hardware design. At the same time, each student has an experiment board. In addition to conducting experiments during class time, students can also explore or practice by themselves in the dormitory. In addition to completing tasks following the course progress, students can also add more modules

Table 1. The teaching arrangement of water lamp project.

number	theoretical content	practice content	project objective
1	microcontroller minimum system and pin function	Keil project establishment and C51 program structure	turn on an LED light
2	the data type of C51 language, the output of IO port of single-chip microcomputer	light a row of running lights by means of a cyclic addend	running water lamp left and right circulation
3	the operator and loop structure of C51	with shift operator, shift function call, loop nested three ways, design pattern flow lam	a single flow light flashes 3 times before the left cycle
4	microcontroller IO port input, C51 function	the use of independent keyboard, a variety of patterns designed into sub-functions	press the key to display different patterns

by themselves to conduct more in-depth and complex experiments. This avoids the real the verification experiment of the inspection box and is also better than the simple simulation of Proteus.

"How teachers test, how students learn", in the past "ordinary grades combined with final grades" only to the final exam can arouse students' attention, to a certain extent, encourage students' inertia. Therefore, this course adopts the whole process assessment to assess students' classroom attendance, knowledge ability, operational ability, learning results and other aspects, emphasizing the learning process and weakening the final examination. Effectively avoid students do not study at ordinary times, the phenomenon of final coping. At ordinary times, "Rain classroom" is used for the online assessment of theoretical knowledge in each project. In the experiment part, students are required to complete the experimental tasks, and students are encouraged to explore and add functions freely. In the traditional teaching, many students will be able to grasp the theoretical method, but they are confused about how to start the real project, mainly because of the lack of hands-on process. Therefore, the final assessment requires students to team up freely and complete a project with practical application value by combining the knowledge points learned in this semester. At this time, students need to use their own hands and brains to have more space to play. **Table 2** is the final comprehensive project homework of a class.

4. Evaluation of Teaching Reform Effect

The systematic reform of this course aims to improve students' practical ability and design ability in electromechanical control, so as to meet the demand of industrial enterprises for electromechanical control skills of undergraduates under the new situation. Teaching reform, through the above three aspects of system, and after two rounds of automation junior teaching, we found that: 1) the students' interest in learning more in SCM, from passive learning into active buy carries on the practice learning development board (**Figure 2**), application programming problems will take the initiative to communicate with the teacher; 2) After 48 hours of theory and practice, students can fully master the working principle of the MCU, and can carry out simple system design, and make real objects (see **Figure 3**); 3) Through the co-simulation practice of Proteus and Keil, the students' ability to use design software for development was enhanced; 4) Through the detailed assessment, pay attention to the usual theory and practice input, release the pressure of the final examination. It can be seen that the

Table 2. Student's final project name.

the final comprehensive project of single-chip microcomputer in a class		
traffic lights at the intersection	multi-function ultrasonic anti myopia	remote control car
intelligent home system	the window nurse	automatic drying rack
simple smartwatch	the flower of self-reliance	intelligent clotheshanger

Figure 2. The student carries on the experiment of single-chip microcomputer system.

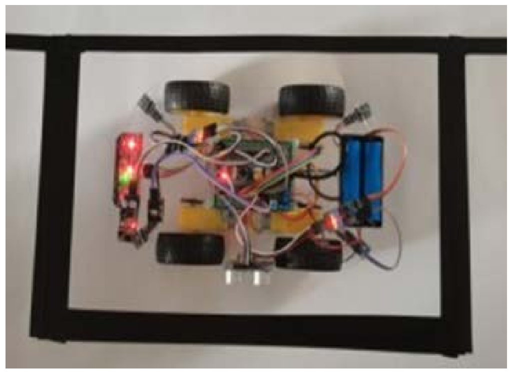

Figure 3. Students independently designed based on microcontroller small production.

teaching reform of this course has basically achieved the original intention of the reform, and improved the students' autonomous learning and practical ability, which is believed to play a positive role in their adaptation to the new employment situation after graduation.

5. Conclusions

The teaching model based on OBE is more in line with the learning characteristics of students. The integrated teaching of theory and practice can better improve students' interest in learning and achieve individualized teaching. Examination reform pays attention to both theoretical content and practical ability. The use of project exams at the end of the semester allows students to have practical engineering experience. After the completion of the project designed by the students themselves, the students felt a stronger sense of accomplishment and were more confident. The overall teaching effect is better.

After the teaching reform, the focus of teaching will be put back to the "application" of two words, through a number of teaching links, and exercise students' different abilities. After learning, the students' engineering application ability is greatly improved, and they can truly put what they have learned into practice.

Conflicts of Interest

The author declares no conflicts of interest.

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