Reform and exploration of the single chip experiment practice teaching

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Abstract. “The principle and application of single chip” is a very important professional course in electronic engineering, computer and control program. This paper which aimed at system bias problem in the experiment teaching course proposed the reform of the teaching mode from four aspects: experimental teaching system, teaching content, teaching method and evaluation. The students' practical ability is effectively enhanced by combining the theory and practice and the hardware and software during the teaching process. After 5 years of teaching practice, students get a number of awards, and achieved satisfactory teaching results.

Keywords: single chip experiment, teaching mode, teaching system, teaching content, teaching method

"The principle and application of single chip microcomputer" is a professional course of electronic information which has a strong application. So the experiment and practice teaching is a very important teaching link. Strengthening and deepening the teaching reform of microcontroller experiment course is not only conducive to cultivating students' ability to solve practical problems, but also of great significance to promoting the cultivation of innovative and applied talents.

In order to combine students' knowledge of the SCM theory with practice effectively, better cultivate students' practice ability and innovation consciousness, this paper accorded to the characteristics of professional and curriculum, the reform and exploration of the curriculum experiment practice teaching has been carried on from four aspects: teaching system, teaching content, teaching method and examination way. [1]

1. Clear teaching objectives and optimize the teaching system

At present, many colleges and universities have clearly put forward the training of excellent engineers which should improve students' practical ability and cultivate students' innovation consciousness.[2] As a result students have the ability of application research and technology development of this discipline and related fields. Not only theoretical knowledge should be taught but also enough experimental and practical training opportunities should be provided to students in the school. So that students can have the quality of excellent engineers.[3]

From the point of the teaching system of the existing course, theory teaching + experiment teaching is common mode in which the experimental class is less. The main goal of experiment is to deepen the understanding of theoretical knowledge and master the basic experimental operation. Students can have a certain ability. However, it has a certain gap with the goal of excellence engineers.
In order to meet the requirements of talent training, a scientific and reasonable complete teaching system of theory, experiment and practice should be formed by adding other practical teaching links on the basis of single in-class experiments. The MCU course and experiment are set up in the same semester, and the experimental teaching in the class is interspersed with the theoretical teaching, which is mainly to deepen the students' understanding of the working principle of MCU. Students can master the basic operation methods and experimental process of MCU experiment.

On this basis, design practice link is added at the end of the same or next semester. Students can be further trained to develop a small microcontroller application system independently under the guidance of the teacher. The develop process includes designing and making circuit, authoring software and debugging system, by which students can master the single-chip microcomputer application system design and development process.

At the same time, students can be arranged in the practice link to investigate the application of microcontroller in relevant enterprises in modern society, so that students have the opportunity to participate in the development of microcontroller system application, and constantly summarize the experience of development and design in practical work.

In addition, interested students can be guided to join a variety of related design competition training group in the teaching process, which have a stronger MCU system development ability by the way of intensive training. It can achieve the goal of hierarchical training.

2. Optimize experiment content with innovation orientation

Setting up reasonable experimental content is very important to improve the quality of experimental teaching. Traditional MCU experiment teaching focuses on theoretical knowledge and basic operation, and the cultivation of innovation ability is relatively weak.\[4]\] The content of the experiment is relatively simple in which the verification experiment accounts for a large proportion, the comprehensive design experiment is relatively small, and the open experiment training is even less. It does not reflect the systematicness of knowledge. Students' application design ability is more difficult to improve. It does not meet the requirements of the training of modern excellent engineers.\[5]\]

The application of SCM is very wide and close to the market. Therefore, it is very necessary to select experimental practice content according to the application market of MCU.\[6]\] After many times of exploration and improvement, we have determined the MCU experiment of three modules: basic experimental module, comprehensive experimental module and innovative experimental module. Specific experimental contents are shown in the table below:

| module                        | Name of experiment                                      | knowledge points                        |
|-------------------------------|---------------------------------------------------------|-----------------------------------------|
| basic experimental module     | MCU parallel port experiment                            | Parallel port control                   |
|                               | Interrupt system experiment                             | Interrupt system                        |
|                               | Timer/counter principle experiment                      | Timer/counter principle                 |
|                               | Serial communication experiment                         | Serial communication                    |
| comprehensive experimental module | A/D and D/A experiment                                   | A/D and D/A Convert chip control         |
|                               | 8253 programmable timer/counter experiment             | 8253 programmable timer control         |
|                               | LED16*16 dot matrix display experiment                  | dot matrix display control method        |
|                               | Stepper motor control experiment                        | Stepper motor control method             |
|                               | Temperature measurement experiment based on DS18B20     | Single-bus control method                |
|                               | Infrared communication experiment                       | Wireless communication control method    |
| innovative experimental module | From the scientific research project, students choose the topic independently | Integration of multiple knowledge points |

(—)Basic experimental module
The basic experiment module is the experiment content that all students must master. The main content is the application of parallel port, interrupt system, timer/counter and serial port. Through the completion of basic experiments, students can be familiar with the use of single-chip microcomputer, in-depth understanding of the internal structure of single-chip microcomputer, initially have the application ability of single-chip microcomputer.

(二) comprehensive experimental module

The comprehensive experiment module mainly expands the microcontroller minimum system, makes full use of the hardware resources involved in the basic experiment, and forms the experimental items with specific functions. The content of each experimental project includes hardware design and software design. Before doing the experiment, students should fully preview the working principle of relevant peripheral chips, design the hardware circuit and write the corresponding program according to the specific experimental requirements, and finally complete the whole experimental function through comprehensive debugging.

The comprehensive experiment module requires students to combine the hardware design with the software design organically, which improves the comprehensive design of the experiment and provides the content guarantee for enhancing students' development ability and innovation ability.

(三) Innovative experimental module

The innovative experimental module is mainly from the teachers' scientific research projects, and students are allowed to design the topic independently, but it needs to be approved by the teachers. Scientific research projects are generally closely related to the frontier knowledge of the market, which is conducive to students' closer contact with the market. In the realization process, student is the center and teacher is only the guider which can not only further improve students' practical ability, but also better cultivate students' exploration spirit and innovation consciousness.

3. Improve teaching methods with students as the main body

In the experiment teaching, the experiment is mainly carried out in the laboratory. The teacher explains the relevant operation in detail and assigns the experiment task to the students. The students carry out the experiment operation according to the teacher's teaching and the detailed steps and example procedures given in the experiment instruction book. This teacher-centered teaching method ignores students' dominant position, restrains students' initiative and is not conducive to the cultivation of students' innovative ability.

Combined with the construction of modern virtual experimental platform, experimental teaching is divided into two parts: online teaching and offline guidance. Online teaching mainly promotes students to master basic theories and operations through the methods of narration, questioning, assessment and discussion. Offline instruction mainly guides students' operation and design in the laboratory. The specific implementation process can be divided into the following steps:

(1) Release the experimental content and preview content. The teacher releases the specific experimental content and the basic knowledge to the students through the network teaching platform, and the students learn independently by watching videos and consulting materials.

(2) Through the network real-time interactive platform, the key issues in theory and operation are asked, discussed, and evaluated before the experiment, so as to promote the students to master the basic theory and operation.

(3) Students complete the design of hardware schematic and software source code on the virtual experiment platform, debug, and get the preliminary results on the virtual simulation software. Teachers can view students' designs by remote means, and master students' offline preview and completion status.

(4) Students completed the construction of the actual hardware circuit in the laboratory, and downloaded the software to run on the built hardware platform. Teachers guide the students in the concrete construction process and the actual debugging.

(5) Students complete the lab report, including the preview section, the experiment process section and the thinking section.
4. Reform the assessment method with the focus on the experimental process

The fair, scientific, objective and perfect assessment mechanism can not only test the degree of students' firm grasp of knowledge, but also stimulate the enthusiasm of students' independent learning. The traditional experimental course examination method is relatively single, the evaluation index is relatively few. The assessment content of the experimental course should not only include the basic experimental skills and experimental principles, but also include the ability to analyze and solve problems, teamwork spirit and scientific rigorous attitude.

In view of the above deficiencies, the assessment points are set in each stage of the experiment, and the corresponding records are made for each stage and each link, so as to increase the assessment intensity in the experimental process and build a more reasonable assessment mode.

According to the whole experimental process, we divided the experimental assessment into online and offline scores. Online scores were mainly based on students' online learning records, online questions and answers, and experimental design and results on the virtual platform. Offline scores are mainly assessed according to the debugging situation of students in the laboratory, the completion of the experiment, the writing of the experiment report and other contents.

By distributing the examination points to each stage of the experiment and establishing the multi-angle examination method, the students are guided to pay attention to the multi-aspect training in the experiment process, which effectively improves the students' comprehensive practical ability.

5. Conclusion

In the past five years, the practice of microcontroller experiment teaching reform has achieved good teaching results. Students' comprehensive practical ability and innovation ability have been significantly improved, the number and quality of students' participation in various related design competitions have been improved, and the number of students' employment positions related to hardware and software research and development has also increased.

Acknowledgments

Thanks to the support of colleagues in the teaching and research section, and also thanks to the support of the school's teaching and research project fund.

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