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Teaching Reform of "Microcomputer Principle and Application" Course for OBE

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Abstract

Taking engineering education certification as an opportunity, combined with the training goal of engineering practice talents in the earthquake industry, the teaching reform of "Microcomputer Principle and Application" course under the concept of OBE (Outcome Based Education) was explored, including optimizing the theory teaching driven by industry characteristic application cases, and setting hierarchical software and hardware development experiments of a microcomputer system. Integrated EMU8086, Proteus and other platforms and rain classrooms to enrich the teaching means. This teaching method can improve students' practical ability in microcomputer system engineering.

Subject Areas

Mechanical Engineering

Keywords

OBE, Microcomputer Principle, Teaching Reform, Engineering Education Certification

1. Introduction

"Microcomputer Principle and Application" is a traditional and important professional basic course for undergraduates majoring in measurement and control, communication and electronic information. The course aims to equip students with the ability of microcomputer application system analysis and software/hardware co-development, and lay a technical foundation for the research and development of microcomputer measurement and control instruments and systems. With the continuous development of microprocessor technology, microcomputer system has been widely penetrated into people's life, from all kinds of daily household appliances to industrial production, and even aerospace control, the application

of microcomputer system setting and expanding market demand, also gives the relevant professional engaged in the development of microcomputer measurement and control instrument and system set higher capacity requirements. For colleges and universities with industry characteristics and specialties, how to not only keep up with the technology frontier tentativeness, but also meet the characteristic needs of the development of industry and specialty to carry out the course reform of "Microcomputer Principle and Application" is the current thinking of many colleges and universities problems [1] [2].

"Microcomputer Principle and Application" is a basic course in hardware technology for engineering majors in colleges and universities. The training goal of this course is to enable students to master the principles of microcomputers and related technologies and methods of hardware interface circuit design, establish the overall concept of a microcomputer system, and have the ability to preliminarily develop and design microcomputer software and hardware. At present, there are still some problems in the teaching of this course, such as students' low enthusiasm for learning, the separation between theory and practice, single evaluation methods, etc. The traditional teaching mode based on teacher's classroom teaching is difficult to give play to students' subjective initiative, and cannot meet the training goal of engineering construction applied talents.

There has been a lot of research and practice on the teaching reform of "Microcomputer Principle and Application", and the related work is mainly carried out from the aspects of teaching mode, teaching method and learning effect evaluation. In this paper, based on the problems existing in the teaching of "Microcomputer Principle and Application", the results-oriented education model is carried out, and the talent training and course teaching reform methods under the concept of OBE are actively explored, so as to improve the teaching quality of the course and cultivate applied innovative talents in engineering construction [3].

2. The Shortcomings of Traditional Microcomputer Principle Teaching in the Training of Automation Professionals

2.1. The Teaching Content Dimension Is Low and Students' Comprehensive Application Ability Is Weak

At present, the teaching content of this course has a low dimension, mainly transmitting chip structure, principle, basic program instructions and design methods to students, and little elaboration on practical scenes such as production and life. The practical content is mainly to practice the basic content through experimental courses, such as microcomputer cognition experiment, basic instruction experiment, or a single input-output experiment or timed counting experiment. Therefore, students can not link the course with practical production and life-related applications, and lack the analysis and comprehensive application ability of related problems [4] [5].

2.2. The Course Content Is Abstract and Students Have Little Interest in Learning

This course requires learning and mastering assembly language, operation instructions, storage structure, interface circuit, digital-to-analog conversion and other contents. For most students, it is easy to lose ideas when learning this course, and they do not know how to start in the face of numerous terms, concepts and principles. The characteristics of this course include a lot of content and lack of continuity; many abstract terms; and a combination of hardware and software. Taking this course at the same time requires students to master most professional courses, including important basic courses such as circuits, digital circuits, analog circuits and programming. Therefore, the knowledge points of the course are abstract and complicated, which reduces students' interest in learning, increases the difficulty of teaching, and the teaching effect is not significant [6].

2.3. The Form of Assessment Is Simple and Difficult to Comprehensively Evaluate Students' Learning Outcomes

At present, the examination form of "Microcomputer Principle and Application" course is simple, and the final score is mostly assessed by the final closed-book examination score and the time attendance. Among them, the closed-book examination mainly focuses on the examination of knowledge points, which can only unilaterally examine students' mastery of knowledge points, but cannot comprehensively evaluate students' processing ability of related applications in production and life. At the same time, attendance can only record students' attendance at class, but cannot reflect students' learning process. Therefore, it is difficult for teachers to comprehensively evaluate students' learning outcomes and fully reflect on teaching based on the feedback of outcomes [7].

3. Teaching Reform of Microcomputer Principle Course for Automation Industry

Based on microcomputer measurement and control system hardware and software design and development of automation industry demand, to engineering education accreditation OBE idea as the guidance, from the curriculum content, teaching means and examination methods, multi-pronged "Microcomputer Principle and Application" course reform, including the industry of microcomputer and interface technology application cases for traction, optimization theory course knowledge system; set up to solve practical problems oriented, hierarchical automation industry microcomputer system experiment items; based on the EMU8086 and Proteus platforms and the information means of rain classroom, students' learning situation can be mastered in real time and improved, and a diversified assessment and evaluation method of "paper assessment plus" can be constructed, so that students can combine "Microcomputer Principle and Application" with the application of automation industry, and effectively improve their application-oriented comprehensive quality and practical innovation ability.

3.1. Reform of Teaching Content

Theory teaching, while maintaining traditional chapters as the main line of the teaching mode under the premise of ensuring the strengthening of the original interface design and the comprehensive application ability training, and to improve student learning outcomes as the goal, through repeated research, optimizing the automation industry related typical cases of microcomputer and interface technology application and project, in case driving course teaching of theoretical knowledge. In case study, students are guided to learn the course content from solving the system hardware and software design problems, and comprehensively apply the professional knowledge learned to study the key technical problems involved, so as to train students' ability to analyze, think and solve problems [8] [9].

Such as basic knowledge in the teaching of microcomputer system, the traditional teaching of the computer technology application are mainly concentrated in traditional industrial control, instrumentation, home appliances and other fields, to let the student to the microcomputer with the characteristic of automation technology application more intuitive understanding, increased in the process of teaching composition of various areas of microcomputer automatic monitoring system and application case, This PAPER mainly introduces THE MICROCOMPUTER as the control core of the automatic monitoring system, coordinates and manages the subsystems of collection, data processing and analysis, and introduces the performance indexes and functions of the current mainstream microcomputer system in the field of automatic monitoring, so that students can have a clear understanding of the automatic monitoring microcomputer system and its application.

When teaching the 8253 timing counter, the oscilloscope commonly used in automation is taken as an example to introduce the working principle of the oscilloscope and design the system scheme. Combined with the circuit design, the application and programming method of 8253 are explained, and the oscilloscope application based on 8253 timer is programmed. Students can better master the use method and difficulty of 8253 in the process of completing the actual project design.

When teaching 8259 interrupt controller, the sinusoidal calibration signal generator is taken as an example. From the principle of calibration to the parameter index of calibration sinusoidal signal, to circuit design and system development, the method of using 8259A interrupt controller to generate interrupt and display output waveform is explained and demonstrated in the whole process. Students can intuitively design calibration signals that meet the requirements of different parameters through parameter adjustment. Through the engineering project, students can not only master the content of this course, but also integrate the knowledge of circuit and PCB design to improve the comprehensive ability.

In practice teaching, the traditional microcomputer principle experiment teaching hours are few, and most of the experiments are small confirmatory experiments, which is not conducive to the exercise and improvement of students' compre-

hensive ability. In view of the above problem, change the traditional experimental teaching for a simple example, set the layer classification ability to meet different levels students learning needs of microcomputer system hardware and software development of experimental projects, improve the students' engineering practical ability, guide the student to carry on the system design, and USES the engineering approach to system software and hardware development, from theory to practice.

For example, by integrating parallel interface, A/D and D/A conversion, the design requirements of seismic data acquisition system based on 8086CPU are proposed, and the students are guided to complete the design and software programming of data acquisition circuit by comprehensively applying the professional knowledge of circuit, PCB design and "Microcomputer Principle and Application" from the solution of system hardware and software design problems. The test tasks were divided into basic level, improved level and innovative level. The basic level required 100% students to complete independently, and the improved level required about 70% students to complete. The innovation level is not compulsory, and students need to integrate the knowledge of other professional courses such as "PCB Design" and "Circuit". Guide the capable students to design the system hardware PCB, and study the key technical problems involved, so as to improve the students' ability to solve complex engineering problems. Finally, about 30% of the students completed the experiment, and the experimental results were good. The students also showed great enthusiasm for learning and confidence. Part of the case teaching content is shown in Table 1.

3.2. Innovation of Teaching Methods

In order to enable students to understand and master the course knowledge more intuitively, the EMU8086 simulation platform is used to demonstrate the function and effect of each instruction when learning the microcomputer instruction

Table 1. Part of the case teaching content.

Number	Course content	Case development	Learning objectives
1	Composition and structure of microcomputer	Personal computer architecture	Composition of master computer
2	Assembler	Number size sort	Master basic assembly skills
3	8255 Input and output	7 section digital tube display	Master 8255 principle and application
4	8254 Timing and counting	Photoelectric encoder counting	Master 8254 count application
5	8259 interrupt	Timer interruption	Master 8259 interrupt
6	Analog-to-digital and analog-to-digital conversion	Light intensity detection	Master the principle of modulus and digital modulus

system, and combined with the observation of simulation results and the explanation of the principle, they can understand the use of each instruction more deeply. When teaching microcomputer interface application technology, combined with the case of microcomputer measurement and control system, through the combination of EMU8086 and Proteus, the design principle and programming process of the case are demonstrated, and the involved knowledge is integrated to explain, deepen students' understanding of instruction and interface application technology, and improve the classroom teaching effect. For students with learning ability, we will guide them to use Multisum, Altium Design and other software to complete the hardware circuit design of the system involved, so as to improve their comprehensive quality and engineering practice ability.

Due to the large content and difficulty of the course, the traditional teaching method is difficult for students to digest many knowledge points at one time, thus undermining their self-confidence and ultimately leading to a significant decline in learning enthusiasm. Guided by students' learning outcomes, the rain classroom perfectly integrates teaching, learning and interaction before class, during class and after class. Before class, some learning videos of knowledge points to be taught were released to activate students' self-study awareness and learning enthusiasm. Combined with the students' preview situation, the key points and difficulties that are difficult to understand before class can be emphasized again in class, and some small tests can be combined to detect the learning effect in real time. In order to improve the quality of teaching, we should reflect on the problems in the learning process in real time and improve the deficiencies in teaching and learning.

In the case that traditional assessment methods cannot meet the requirements of OBE teaching, this paper discusses the diversified assessment mechanism throughout the whole teaching process, optimizes the assessment form, assessment content and score distribution, and constructs the diversified assessment method of "paper-based assessment plus". Set the average score as 50%, and not only refer to the attendance, lab report and homework, but also use the interactive teaching function of the rain classroom to comprehensively measure the learning process. Final grade (50%), mainly through comparative economics exams test students' knowledge and application, and set the oscilloscope design course major assignments, make teachers on students' autonomous learning, problem solving, innovation, and team cooperation ability, complete quality aspects of comprehensive evaluation, in order to correctly evaluate students' learning effect. The assessment content and weight of each part are shown in **Table 2**. Discipline evaluation system of the competition for reference to extracurricular challenge with overall assessment, check the inspection at least three stages, the first phase for the project design scheme evaluation, the second phase of project implementation evaluation, the final stage of unified defense, defense evaluation team includes more than three teachers, two senior outstanding senior grade 2, the outstanding students, teachers' comprehensive control. The defense results include

self-evaluation among team members and cross-evaluation among team members in project activities. A large proportion of the defense score will be included in the course score, and the proportion of the non-course exam will be reduced. The grading details of the extracurricular challenges are shown in Table 3.

3.3. Stimulate Students' Initiative and Strengthen the Optimization of Assessment System

According to the educational philosophy of OBE, it emphasizes the characteristics of "students learn" rather than "teachers teach". In the process of "Microcomputer Principle and Application" teaching, students' initiative to learn should be strengthened, so as to promote students to absorb the course knowledge efficiently. At the same time, due to the complexity and high comprehensiveness of the course content, the teaching reform focuses on the research and exploration of a variety of teaching interactive methods such as thematic analysis, discussion, situational demonstration, encourage students to carry out active learning, let students fully participate in the course learning, actively explore the course content, and give play to the guidance of teachers. Examination is the examination of the students' learning achievements in the course. Under the concept of OBE education, the final outcome is not a single assessment model that is determined by the final assessment, which can not fully explain the learning process and knowledge mastery of students. Multi-process and multi-element assessment should be set up to strengthen the assessment. In the course of teaching, the teaching content

Table 2. Examination content and weight of each part.

Content	End of term	Experiment and practice	Usual performance	Testing stage
Proportion	50%	15%	20%	15%

Table 3. Scoring dimensions and criteria for extracurricular projects.

Number	Evaluation content	Evaluation items	Accomplishment ratio
1	Work ability and attitude	Good attendance, able to complete the design work independently	10%
2	Literature review	Ability to synthesize and summarize data	10%
3	Design effort	Meet all the requirements specified in the project task	20%
4	Design Task Demonstration	Program running and debugging correctness	10%
5	Defence	Summarize systematically, comprehensively and answer the questions correctly	30%
6	Specification	The content is complete, the text is smooth and standardized, and the references are sufficient	20%

and tasks of the course are decomposed, and the students are assessed by stages to understand the learning situation of the students at each stage. At the same time, students' test scores are no longer considered as a single assessment result in the assessment. Instead, students' collaboration ability, classroom status, after-class performance, practical design and other elements should be added to form a multi-element assessment system to analyze the learning situation from various aspects.

4. Teaching Result

4.1. Enhance Students' Comprehensive Application Ability

The reform of course content through OBE education concept has cultivated students' ability of analyzing and solving problems. Students can apply the course knowledge, reasonably analyze the relevant production and life practice scenarios, simplify some practice scenarios into physical models, apply chips to design hardware circuits and design corresponding programs through software. For example, digital traffic lights, according to the input and output interface chip and timing counter chip to complete the counting and display functions.

4.2. Improve the Enthusiasm of Students to Learn

In the teaching reform of "Microcomputer Principle and Application" course, the improvement of teaching ideas and the diversification of teaching methods have improved students' learning enthusiasm. After presenting cases, real objects, special topics and other contents in class, students can actively participate in group discussion on problems. After class, students will combine the online course knowledge and consult the relevant knowledge on the Internet to study the uncertain questions, and give further answers on the online platform.

4.3. Improve the Scientificity of Teaching Evaluation

According to the multi-process and multi-content assessment system of students, the scientific nature of teaching evaluation is improved. Teachers can timely grasp the students' situation according to the classroom status, homework and process assessment, reflect on the teaching process, further guide the teaching process, optimize the teaching system and continuously improve the course content and teaching methods by analyzing the completion of previous students' curriculum design, subject competition and graduation design.

5. Conclusion

Based on the course "Microcomputer Principle and Application" of comprehensive and practical characteristics, combined with the characteristics of our college of disaster prevention and mitigation talents training target and actual engineering education accreditation requirement, based on OBE-oriented teaching reform, including optimizing automated features of microcomputer and interface technology application case, case combined with theoretical knowledge learning;

in practice teaching, we should set up practical projects that are hierarchical and closely combined with the application needs of the industry, so as to meet the needs of students with different learning abilities and stimulate their learning enthusiasm. Emu8086 and Proteus platform were used to innovate teaching methods and means to help students understand and master key and difficult points, and set up assessment methods scientifically. The course teaching effect is good, can improve the students' microcomputer application and design ability, students' paper scores and final scores have been greatly improved, improve the students' comprehensive quality, curriculum reform method can provide some ideas and reference for the "Microcomputer Principle and Application" course reform.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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