

Research on the Teaching Reform of MCU Based on CDIO Teaching Model

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Abstract. CDIO (Conception Design Implementation Operation) is an engineering education model. It uses a project as a carrier to let students' learning process run through the whole process of project product conception, project product design, project product implementation and project product operation, so that students' personal ability, interpersonal team ability and engineering system ability can be comprehensively improved. The paper analyzes the problems of the current teaching mode of MCU (Micro Control Unit) course in colleges and universities, and proposes a teaching mode based on CDIO to solve these problems. After redesigning and reforming the MCU courses, students' interest in learning is stimulated, which helps students build a complete knowledge of MCU courses, and enhances students' sense of teamwork and ability of engineering practice.

Introduction

"Single-chip Microcomputer Principles and Applications" is an important professional foundation course for higher engineering colleges. It is not only suitable for electronic information, communication, control and other electrical majors, but also for computers, software engineering, optical information, network engineering and other computer-related majors. It is a basic course to further study other types of CPU, embedded technology, and electronic technology. Students are required to learn from the 51-chip microcomputer-based microcontroller to understand the knowledge of computer hardware structure, assembly programming, and system bus expansion of the 51 prototype, single chip microcomputer timer/counter, and interrupt and serial port communication. Enable students to master the design and development method of single-chip microcomputer system and the comprehensive application of single-chip microcomputer, provide necessary theoretical and application foundation for subsequent courses, and cultivate strong adaptability and lay a solid professional foundation for students to engage in the rapid development of electronic science and technology after graduation [1, 2]. Therefore, CDIO is introduced into the teaching of single-chip microcomputer course, and it combined with the teaching objectives, the teaching reform of single-chip microcomputer course based on CDIO engineering education mode is proposed. CDIO engineering education mode adopts a penetrating learning method, which is based on engineering projects and centered on students. It focuses on students' ability of innovation and practice while mastering basic theories and knowledge, and finally improves students' ability of finding, analyzing and solving problems.

CDIO Engineering Education Concept

The C of CDIO stands for conception, the D of CDIO stands for design, the I of CDIO stands for implementation, and the O of CDIO stands for operation [3]. CDIO engineering education model is a result of engineering education reform initiated in 2000 by Massachusetts institute of technology (MIT), united with linkoping university of Sweden, royal Swedish institute of technology and chalmers institute of technology in gothenburg, Sweden, and funded by Knut and Alice Wallenberg foundation. The training outline of CDIO engineering education mode expresses the basic engineering knowledge, personal ability, interpersonal team ability and engineering system ability that graduates must possess in a step-by-step refinement manner, so that the engineering education

reform has a clearer direction and system. The core of CDIO engineering education mode is learning in action. The key is the cultivation of ability. It takes the project as the carrier to let the students' learning process run through the whole process of project product conception, project product design, project product implementation and project product operation. The student's personal ability, interpersonal team ability and engineering system ability have been comprehensively improved. The training standard of CDIO engineering education mode systematically and comprehensively guides the implementation and inspection of the whole engineering education mode, making engineering education reform specific, operable and measurable, which has important guiding significance for teachers. CDIO engineering education mode is a systematic, scientific and advanced modern education mode, which is the development trend of contemporary engineering education, and also has strong reference significance for MCU teaching reform [4].

Status Quo of MCU Course Teaching

Fossilized Assessment of Students

At present, the evaluation of MCU course is mainly composed of three parts: daily assessment, practical assessment and final assessment. The result of daily examination accounts for 10% of the total result. The practical examination score accounts for 20% of the total score. The final examination results account for 70% of the total scores, and the examination is mainly conducted in the form of closed-book examination. The examination method is mainly the integration of teaching and examination (the teacher of the course and the teacher of the test paper are the same person). Students' learning based on this assessment is still in a learning style similar to that of ordinary high school exam-oriented education. Students' enthusiasm for learning is not high. The goal is to pass the final exam, ignoring the cultivation of individual abilities. Sometimes it would appear even the phenomenon of cramming, so that the MCU teaching requirements and social demand for talent is very different [5].

Fossilized Syllabus

The traditional syllabus divides the teaching content into two parts: theoretical teaching and experimental teaching. It does not highlight the systematic relationship between theoretical teaching and experimental teaching. The traditional teaching syllabus is rigid and has no new ideas, which cannot make students form a knowledge system. There is no connection between different experimental items in the traditional teaching syllabus, which cannot form a complete experimental system, and not conducive to students' understanding of experimental knowledge. All experimental projects in the traditional teaching syllabus are completed independently by individuals, which fails to cultivate students' teamwork ability.

Obsolete Teaching Content

The traditional MCU course content is divided into theoretical teaching content and practical teaching content. Most schools lay particular stress on theoretical teaching and neglect or weaken practical teaching. In addition, a few experimental items are too simple and often are confirmatory experiments, with old and boring topics and lack of corresponding engineering application background. In the process of experiment, students will follow what the teacher tells them. As long as students follow the given steps, they can complete the experiment without too much thinking. Students have no initiative in the process of doing the experiment and lack of independent thinking. In the course content setting. The main line of MCU teaching content is composed of single-chip microcomputer structure, single-chip microcomputer development and simulation tools, single-chip instruction system and assembly language program design, single-chip microcomputer basic I/O function, single-chip interrupt principle, single-chip timer/counter principle, single-chip serial interface and single-chip system bus knowledge points. These knowledge points are distributed in separate chapters, each chapter has the difficulty and key and the difficulty and emphasis between relatively independent, It is impossible for students to construct a complete curriculum knowledge

system for MCU courses, and it is impossible for students to combine the previous courses and successors. The curriculum builds a complete subject knowledge system, and it is difficult to keep up with the rapid development of modern electronic technology [6, 7].

Single Teaching Method

Influenced by the traditional teaching mode, teachers pay more attention to the knowledge explanation of individual chapters in the course of theoretical teaching and ignore the construction of knowledge system and the cultivation of students' comprehensive ability. Teachers due to the number of students in the process of practice teaching and related link complicated pay more attention to the individual confirmatory experiment data check. They ignore the supervision of students experimental process, evaluation and the cultivation of the student beginning ability, which leads to the vocational skills and quality of student not in conformity with social demand, affects the student's graduation and employment. The theoretical teaching and practical teaching of the MCU course are taught by teachers. The teachers are accustomed to "speaking", the students are accustomed to "listening", the students memorize while listening to the lesson and mechanically practice, and lack of autonomy to think and actively practice the intrinsic connection between theory and practice. Students have no interest and passion for self-learning, enthusiasm and initiative for learning, and lack of long-term rational planning and layout for learning [8]. Under such a teaching mode, the teacher plays the leading role in the whole class, while the students play the role of supporting or extras. Some students even become ordinary audiences. Therefore, the single-chip microcomputer course needs to refer to the advanced CDIO education concept, change the roles of teachers and students, and make students become the leading role in learning activities and teachers become the supporting role in learning activities, and even make teachers become the audience and judges in learning activities, so as to stimulate students' desire for knowledge.

CDIO-based Microcontroller Curriculum Reform

The Reform of Assessment Indicators

The MCU course assessment based on the CDIO engineering education concept not only focuses on the assessment of students' theoretical knowledge, but also emphasizes the assessment of students' engineering practice ability. The whole score is assessed in the whole process, and an assessment system of "process and result" is adopted. The assessment is mainly composed of three parts: routine assessment, project assessment and written assessment. The routine assessment score accounts for 20% of the total score, mainly including learning discipline and the completion of homework. Study including interactive learning, task collaboration, class discussion, class speech, data research and examination report, etc. The project assessment score accounts for 30% of the total score, including project conception, project design, project implementation, project operation, project design and summary report, project physical acceptance and summary defense. The written examination results account for 50% of the total results, mainly in the form of closed-book examination. The written examination is divided into mid-term examination and final examination, which account for 20% and 30% respectively. The written examination paper adopts the form of teaching and examination separation.

The Reform of Syllabus

According to the requirements of CDIO engineering education concept, the current curriculum outline of single-chip microcomputer is reformed, and the training objectives and standards to be achieved are clarified. In the teaching, teachers must strictly follow the development process of the project to manage, and the knowledge of the MCU course runs through the whole process of taking one or several projects as an example, and implement the process management based on the CDIO mode, according to the interactive, collaborative learning methods and project management requirements of "conception", "design", "implementation" and "operation", to make sure the realization of curriculum knowledge points throughout the teaching of the project process [9].

The Reform of Teaching Methods

The reform of teaching method is to combine theory with practice. The CDIO-based corporate management method stimulates students' interest in learning. In the teaching process, the whole class is regarded as a business division. The supervisor of the class becomes the technical director of the business division, the class monitor becomes the minister of the business division, and the class vice monitor becomes the vice minister of the business division. Then the entire business unit was reduced to a group of 3-5 people to form a number of project teams and democratically selected project leader and deputy team leader. Then the technical director and the minister of the business division held a meeting to discuss the project development plan synchronized with the whole teaching cycle, and finally worked out the relevant project development plan. Then the minister held a meeting with the project team leader to assign project tasks according to the development plan. Finally, the project team leader called a meeting with all members of the team to detail the specific development tasks and schedule of the team members. The deputy minister fully supports the work of the minister in the whole project process and teaching cycle, and the deputy leader fully supports the work of the leader in the whole project process and teaching cycle.

The Reform of Teaching Content

According to the requirements of CDIO engineering teaching mode, the MCU course is divided into four stages for teaching content design.

The Stage of Conception. At the beginning of the course, the teacher mainly explains the history, present situation and future trend of MCU application technology development and the design example of MCU system. In the part of the single-chip system design example, the instructor will take the software and hardware design of intelligent environment monitor, car reversing system, liquid level automatic monitoring system, automatic weighing system and motor speed control system as examples to explain the system design. The teacher will explain the basic functional requirements of the system design, and specify the final effect to be achieved. Students are required to select one of the systems for specific design and implementation by a project team composed of 3-5 people. In the whole teaching cycle, the project team should complete the mathematical modeling, schematic diagram design of the system circuit, Multisim simulation of the system circuit, PCB design and implementation, system debugging and testing, system optimization and summary defense of the selected project. At this stage, the project team mainly completed the literature reading of the selected project, the conception of the overall system function and the design of the overall scheme [10].

The Stage of Design. After clarifying the project requirements that are synchronized with the whole teaching cycle, it is necessary for teachers to map the relevant teaching contents required by the teaching syllabus into the circuit design of each module of the project. Students will complete the learning of each knowledge module in the form of project team and finally design the principle of the project in a modular way according to their respective task requirements.

The Stage of Implementation. On the basis of the first two stages, students interact with each other, students interact with teachers, and teachers cooperate with each other to help students complete the simulation and implementation of the project. Students perform Multisim simulation on the designed module circuit in the form of project team. After passing the simulation, members of the project team are responsible for the specific implementation of a module circuit with relatively independent functions.

The Stage of Operation. On the basis of the first three stages, students improve, optimize, summarize and present the implemented projects according to the operation of the system.

Conclusion

The penetrating learning method based on CDIO makes theory teaching run through the whole process of project development, which makes theoretical teaching and practical teaching complement

each other. The core of teaching reform of MCU course based on CDIO is to combine individual learning with team learning and theory with engineering projects, so that the engineering education mode based on CDIO can be integrated into MCU teaching. This will be helpful to put forward a training plan that pays attention to both theory and practice for the teaching of professional basic course, and will help students master the basic knowledge of engineering and cultivate students' personal ability, interpersonal team ability and engineering system ability.

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