Innovation and Practice of Diversified Teaching Mode of Microcontroller Principles and Applications in the Context of Engineering Certification

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Abstract. In recent years, with the rapid development of the information society, the demand for professional talents is also increasing year by year. Colleges and universities are an important support for the development of talents in the education system, and an important way to cultivate the majority of young people in the field of technology for rapid development. As the cradle of cultivating technical and skilled talents, it bears the important social responsibility of cultivating high-quality talents, transferring technical skills, promoting entrepreneurship and employment, and accelerating social and economic development. At present, in the field of higher education, the traditional teaching mode is difficult to meet the needs of rapid social development at this stage, and there is an urgent need to innovate the mode of professional education and teaching, and from the perspective of professional certification of engineering education, the reform and practice of microcontroller curriculum system, teaching methods, talent training mode, and evaluation of curriculum effect. It solves the problems faced in professional education and builds an education system with Chinese characteristics that advances with the times. Diversified teaching mode consists of mobile learning-assisted online teaching and offline teaching, with students as the main body and teachers and teaching-related equipment as the auxiliary, reflecting the importance of personalised teaching, which enables students to clarify their learning objectives, improves students' learning effectiveness, improves learning attitudes, improves comprehensive ability, and plays an effective role in cultivating talents.

Keywords: Engineering Certification, Principles and Applications of Microcontrollers, Diversified Teaching Models.

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1 Introduction

In the era of rapid information society development, the demand for skilled professionals has witnessed a significant upsurge. Higher education institutions, particularly colleges and universities, play a pivotal role in shaping the educational landscape and cultivating talents essential for technological advancements. As the breeding ground for technical and skilled professionals, these institutions bear a crucial social responsibility encompassing the cultivation of high-quality talents, the transfer of technical skills, promotion of entrepreneurship and employment, and acceleration of social and economic development.

However, the current state of higher education faces challenges as traditional teaching methods struggle to keep pace with the dynamic requirements of rapid social development. It is imperative to innovate the professional education and teaching modes to align them with the evolving needs of the contemporary landscape. This paper delves into the reform and practice of the microcontroller curriculum system, exploring changes in teaching methods, talent training modes, and the evaluation of curriculum effectiveness within the context of engineering education professional certification.

Recognizing the urgency for a transformation in professional education, this study proposes a diversified teaching model incorporating mobile learning-assisted online teaching and offline teaching. Placing students at the forefront and utilizing teachers and teaching-related equipment as auxiliary components, this model emphasizes personalized teaching. By empowering students to define their learning objectives, this approach aims to enhance learning effectiveness, foster positive learning attitudes, and augment overall comprehensive abilities. The paper endeavors to address the challenges inherent in professional education and contribute to the establishment of a forward-looking education system with distinct Chinese characteristics.

2 Accreditation of Engineering Education Programmes

Professional accreditation of engineering education is an internationally accepted quality assurance system for engineering education, which is an important foundation for achieving international mutual recognition of engineering education and international mutual recognition of engineers' qualifications [1-2]. China's professional accreditation of engineering education began in 2006, and in November 2011, it formulated the Standards for Professional Accreditation of Engineering Education, and in June 2016, it joined the Washington Agreement and became an official signatory member of the Agreement. China's engineering education professional accreditation is organised by the China Engineering Education Accreditation Association, and carried out by specialised professional associations and societies together with educators in the field as a kind of qualified evaluation for engineering majors in higher education[3-4]. At present, as far as the engineering majors of Chinese universities are concerned, the professional certification of engineering education has become an inevitable trend, and the professional certification of engineering education has be-

come an important symbol of the strength of schooling level[5-6]. In this paper, we take the microcontroller principle and application course of electronic information engineering as an example, and under the guidance of the concept of professional certification of engineering education, we carry out reforms and practices in the course objectives, system, teaching methods and assessment methods.

3 The necessity and feasibility of diversified teaching in "Microcontroller Principles and Applications"

As a core compulsory course for mechanical design and manufacturing and automation majors, the course "Principles and Applications of Microcontroller" requires students to have a strong theoretical foundation and emphasises the operation of practical skills. Students generally reflect that the content of the course is abstract, illogical, scattered and difficult to grasp the key points in the learning process. The reform of the course has been continued, from the traditional teaching of theory and practice before participating in the engineering education certification, revealing a disconnect between theory and practice, the theoretical knowledge required in practice, in the prior learning and not really mastered; to the engineering education certification project-based teaching reform, the theoretical knowledge into specific course projects, and strive to achieve the integration of science and practice, but the teacher for the learning of the pre-course and post-course can not implement the management and effective management of learning. However, teachers are unable to manage and effectively guide students' learning before and after class, and it is difficult to take into account students' differentiated needs, which makes it difficult to complete a complete project task in limited classroom teaching and low learning efficiency. The following problems exist in the teaching and learning activities of the programme: the teaching method is single and ineffective; there is a lack of interaction in the teaching and learning process, which makes the cultivation of competence out of place; and the evaluation of the programme is unbalanced in terms of weighting and the lack of effective indicators.

4 Practice of Diversified Teaching Models

With the core concepts of "student-centredness", "output-orientation" and "continuous improvement" of the Engineering Education Accreditation (EEA), we have reconstructed the teachers' view of teaching and the students' view of learning by focusing on the problems in the teaching and learning of the courses. Teaching is not the transfer of knowledge, but the transfer of knowledge. Teaching is not the transmission of knowledge, but the processing and conversion of knowledge; learning is the active selection, processing and handling of external information by learners according to their own experience background. Diversified teaching mode is introduced into the course teaching, with the help of online teaching platform tools, around the three learning stages of pre-course, in-course and post-course, teachers' teaching activities and students' learning activities are interactive and cooperative, to complete the pro-

cess of constructing the meaning of what they have learnt, and to achieve the teaching goals together.

4.1 Design and development of curriculum teaching resources

Teaching resources are the basis of diversified teaching. The teaching resources of MCU course mainly include various teaching videos, development software (Proteus simulation software, KeilC compilation software), programme library, exercise library and teaching PPT. In addition to the introduction of high-quality online course resources on the Internet (such as MOOC of China University and the national quality course resources on the platform of Love Classroom), we have also built new resources of diversified teaching mode by combining with the characteristics and knowledge structure of students in this major. The main contents of MCU course include MCU structure and principle, assembly instruction system and programming, interface technology and application system design. Each part of the content has a strong correlation, at the same time the relevant chapters have independent basic knowledge, requiring students to face a wide range of knowledge content with systematic and hierarchical thinking ability. In view of the students' difficulty in grasping the characteristics of the learning process, we have designed the introductory reading part of each chapter, and with the help of the mind map, the main knowledge points of the chapters and the interconnection between the knowledge points and the extension of the application of the chapter will be more intuitively and hierarchically expressed. After students have a general understanding of the knowledge framework and key points of the chapters, they will watch the pre-study video and take the pre-study test to complete the whole process of self-study before class. In the chapters and units involving experiments, hard and soft skills are integrated into classroom teaching by recording corresponding experimental micro-videos, which facilitates the transformation of students' knowledge into competence.

4.2 Project-based Practical Teaching Sessions

Practical teaching is an important part of the MCU programme, focusing on the cultivation and training of students' skill objectives. Skill objectives focus on the integration of hard and soft skills, requiring students to be able to skillfully design hardware circuits and microcontroller programmes, and master the debugging of microcontroller programmes and system circuits; cultivate students' information processing, problem solving, teamwork and communication skills, as well as a sense of innovation. According to the teaching content and the sequence set up a running light, traffic signal control, digital tube and matrix keyboard, timer and digital display, alarm generator, infrared stepper motor control and other 6 experimental projects. The use and skills of the tool software Proteus and KeilC are learnt by the students in advance through the micro-video recorded by the teacher and the uploaded software manual. Before the implementation of the project, the teacher releases the project content and requirements on the platform, and the students complete the system scheme design and control algorithm design of the project by themselves, and the teacher carries out diagnosis

online. In the project implementation stage, students use Proteus software to draw the system circuit schematic diagram, and compile and debug the program according to the project requirements, and carry out simulation in Proteus software; the teacher organises to explain the problems in the system hardware and software design, and the students complete the error correction and adjustment of the system hardware and software through interactive discussion, and then go to the experimental development box to complete the verification of the system function. After the completion of the experimental project, the students complete the writing of the experimental report, the hardware and software design and debugging of the experimental project to summarise. At the later stage of the project, students complete the physical production in the form of a group outside the classroom, and after submitting the results, the quality of the project is comprehensively evaluated by combining mutual evaluation of the group and teacher's review. By carrying out the student-led. Teacher-led project-based teaching activities based on the integration of hardware and software skills, promoting the transformation of theoretical knowledge into practical ability, students in the digestion and acquisition of professional knowledge at the same time, but also effectively improve their professional skills and vocational ability.

4.3 Course evaluation methods

In the traditional teaching mode, teachers are the main body of evaluating students' learning achievements, and the final examination results account for too large a proportion in the determination of learning achievements, and the monism of the main body of evaluation and the monotonous evaluation method can not truly reflect the overall development of students. The evaluation of teaching under the learning outcome orientation is no longer limited to the investigation of the knowledge acquired by students, but also emphasises the evaluation of students' good teamwork spirit and organisational and coordinating ability, practical problem solving ability, innovative ability and innovative thinking ability. Therefore, the evaluation index system under the blended teaching mode should not only focus on the process evaluation and summative evaluation of students' knowledge, but also pay full attention to the evaluation of learning outcomes. Combined with the diversified interactive design of each link of the blended teaching activities, and with the help of the full-cycle teaching data analysis provided by the teaching platform, the diversified evaluation combining the learning process evaluation with students' self-assessment, peer assessment and teachers' evaluation is incorporated into the course evaluation system, so as to carry out a more comprehensive, scientific and objective evaluation of the development of the students from multiple aspects and multiple perspectives. The original assessment content and evaluation method of the course are revised, forming a comprehensive assessment method combining theoretical assessment and practical assessment, process assessment and result assessment, online assessment and offline assessment. The assessment results are composed of three parts: the usual process assessment results, practical assessment results and final assessment results, of which the usual process assessment results include attendance, homework, quizzes, classroom discussions (self-evaluation, group evaluation, class evaluation, teacher review) and midterm exams, which account

for 30% of the overall results; the practical assessment results include lab reports, design reports (self-evaluation, group evaluation, teacher review), operation levels of the lab projects, and the results of the lab projects are based on the results of the practical assessment. Practical assessment results include lab reports, design reports (self-evaluation, group evaluation, teacher's comments), the level of operation and results of the experimental projects, accounting for 30% of the overall grade; the final assessment is in the form of a closed-book examination, accounting for 40% of the overall grade.

5 Conclusion

Principles and Applications of Microcontrollers" is a course with strong theoretical nature and relatively close connection with engineering practice. In this paper, the drawbacks of traditional classroom teaching methods and course assessment are given to introduce the experimental teaching reform of the course under the background of professional accreditation of engineering education. The concept of professional accreditation, which requires results-oriented, student-centred, and continuous improvement mechanism, has been gradually accepted by engineering majors in institutions of higher education in China. Through this semester's experimental teaching has achieved good results, the teachers who participated in the training of computer professional engineering certification have also benefited greatly from the realisation of the traditional teaching mode into a diversified mode of teaching, and gradually in line with the international engineering education. Teachers have always believed that in the future teaching courses, all courses related to engineering majors will be taught in accordance with the engineering certification method, and at the same time, they will also visit employers regularly to make continuous improvement of this course and improve the employability of graduates to meet the domestic and international demand for engineering talents.

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