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Research on the Application of Blended Teaching Method in Microcontroller Principles and Applications Course

Guangping Qiu*

Zhujiang College, South China Agricultural University, Guangzhou 510900, China

***Corresponding author:** Guangping Qiu, zhikezn@163.com

Abstract: In the digital era, the teaching mode of university courses has ushered in a reform opportunity. Ways to address the current teaching problems of microcomputer principles and applications, leverage digital technology, design hybrid teaching activities, solve the problems of scattered learning resources, diverse student learning abilities, and disconnect between theory and practice in teaching, enhance student learning motivation, has become an important problem faced by teachers. This article takes the principle and application of microcontrollers as an example to explain the application value of blended learning method. Starting from the learning background, learning foundation, course content and learning enthusiasm, it analyzes the problems in course teaching and focuses on MOOC+SPOC, case teaching and project-driven teaching methods, as well as a diversified evaluation system, introduces digital platforms and teaching resources and explores the application strategies of blended teaching method in course teaching.

Keywords: Blended teaching strategies; Microcontroller principles and applications; MOOC; SPOC; Project-based learning

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1. Introduction

With the advent of the era of big data and Artificial Intelligence, digital technology has permeated various industries, facilitating the modernization and intelligent development of higher education. Digital technology is gradually penetrating into various aspects of the education field, becoming a key force in promoting modernization of education, especially in higher education, where comprehensive platforms integrating online resources and intelligent teaching have emerged. These platforms not only broaden teaching methods, but open up new paths for teachers to break through the limitations of traditional classrooms.

2. Current teaching status of microcontroller principles and applications course

In electronic engineering in universities, “Principles and Applications of Microcontrollers” occupies an

important position but faces challenges such as diverse student backgrounds, diverse learning foundations and complex course content.

2.1. Diverse learning backgrounds

With the development of society and the popularization of higher education, the backgrounds of college students are becoming increasingly diverse. They come from different regions, and there are differences in their family cultural backgrounds, educational experiences and learning abilities. In professional learning and growth, students have different levels of mastery of basic professional knowledge. Although some students have mastered circuit knowledge and programming language knowledge, they still do not know how to start in the microcontroller course, making it difficult to complete control tasks and have limited practical abilities [1].

2.2. Varied learning foundations

Students have different learning foundations. "The Principles and Applications of Microcontrollers" is usually offered in the second year of undergraduate studies. Due to the limitations of the forgetting curve, learning habits and understanding ability, the theoretical foundation among students varies. In addition, with many teaching classes and students, some students have limited interaction with teachers when studying introductory courses such as circuit analysis and digital circuits, making it difficult for them to receive detailed guidance and a weak foundation in learning.

2.3. Complex course content

The microcontroller course emphasizes practical and engineering applications, covering a wide range of complex knowledge, including principles, instructions, programming, and interrupt systems. Through development board practices such as temperature monitoring, interruption experiments, and running errand projects, the aim is to cultivate practical skills. The course integrates theory and practice, focusing on the practical application of knowledge, but the dense and slightly dull content may affect the interest of some students.

2.4. Insufficient learning motivation

The learning of microcontroller courses is facing difficulties: Traditional teaching fails to meet the diverse needs of students, weakening their learning initiative [2]. The course emphasizes theory and offers limited practical opportunities, reducing students' proactive practice and problem-solving opportunities and affecting their enthusiasm. In addition, with strict programming standards, students lack sufficient guidance when encountering problems, which can easily lead to frustration and further reduce their learning motivation and confidence.

3. Hybrid teaching design for microcontroller principles and applications course

Faced with students' diverse backgrounds, uneven learning foundations and complex and diverse course content encountered in this course, and the resulting decrease in learning enthusiasm, effective teaching reform measures have become particularly crucial. Therefore, this course aims to make innovative adjustments and optimizations from three aspects.

3.1. Blended learning platform

Addressing the challenges of "Principles and Applications of Microcontrollers" requires building an efficient

hybrid teaching platform, integrating educational digital tools, especially combining the breadth of MOOC resources in Chinese universities with intelligent interaction in Blue Ink Cloud classes, and creating a personalized learning environment centered on SPOC. SPOC is tailored to the practical characteristics of microcontrollers, combining online flexibility with learning supervision. Cloud class courses serve as a bridge to promote interaction, leverage big data to analyze personalized teaching, enhance learning motivation and enable teachers to flexibly adjust offline teaching based on students' online performance, ensuring a close integration of theory and practice, greatly improving teaching interaction and effectiveness [3].

3.2. Case and Project Driven Learning (PBL)

While integrating online learning platform resources to ensure a close connection between online preview and classroom teaching, teachers adopt case-based and project-based methods to reshape the classroom teaching mode and stimulate more efficient teaching interaction and learning depth [4]. Before class, the teacher combines online preview content and introduces cases, allowing students to learn new knowledge and try to operate according to the requirements of the cases, achieving "learning by doing." After class, the teacher implements project activities, allowing students to achieve "learning by doing" individually or on a team. In the case introduction stage, the teacher breaks down corresponding tasks based on each theme, creates micro lesson videos of practical application cases according to the knowledge points required by the tasks, collects pictures, animations and related learning materials, presents examples of microcontroller applications in the form of illustrations, introduces the principles of knowledge and then allows students to hands-on operate to deepen their understanding of operating principles [5]. In project-based teaching, teachers encourage students to form collaborative teams, analyze knowledge points and problems through cooperation and mutual assistance, enable everyone to communicate online and offline, stimulate students' learning enthusiasm, and master knowledge and skills more quickly.

3.3. Diversified teaching evaluation

In blended learning, a diversified evaluation system plays a crucial role, reflecting teaching effectiveness comprehensively and greatly stimulating students' learning enthusiasm and innovative spirit. Teachers adopt a combination of process-oriented and summative evaluation strategies. Through continuous formative evaluation, such as classroom observation, student interaction, and daily homework, they can grasp students' learning status in real time, provide immediate feedback, and encourage students to identify and improve deficiencies in the learning process [6]. At the end of the course, a summative evaluation is conducted to comprehensively evaluate students' performance in knowledge understanding, skill application and innovative practice, as well as to assess comprehensively teaching outcomes. The evaluation covers a multi-level project from basic knowledge to higher-order thinking, aiming to test students' subject foundation and challenge their ability to solve complex problems [7].

Teachers use diverse evaluation tools, including point systems, project evaluations and regular exams, to ensure the breadth and inclusiveness of evaluation methods. This allows all students to showcase their learning outcomes.

4. The application practice of blended teaching method in the course of microcontroller principles and applications

Based on the MOOC+SPOC teaching platform, teachers combine physical classrooms with online teaching to construct a student-centered blended learning model. The teaching process includes pre-class preparation,

classroom teaching, and post-class consolidation. Combined with the characteristics of the microcontroller course, theoretical and practical teaching are integrated and integrated throughout the entire teaching process.

4.1. Preparation before class

Before class, the teacher prepares fragmented learning resources based on student learning needs, uploads them to the smart learning platform, assigns preview tasks, and allows students to achieve self-learning goals using SPOC resources as needed [8]. Through light live streaming, interactive Q&A activities are carried out to transmit course knowledge. For example, relying on the cloud class platform, teachers can release the learning task of "Chapter 5, Section 3, Single Chip Microcomputer Control LED Digital Tube Display" in advance, including pre-class discussions, key and difficult points, self-learning tests, etc., so that students can fully understand the knowledge content to be learned in class, and use the platform to monitor students' online discussions, learning exploration, and self-learning test performance and unify student data. During the online preview process, students follow the preview resource prompts, explore self-learning ideas, summarize the key and difficult points they do not understand and master, and ask questions in the discussion area or during classroom teaching. For the experimental teaching part, teachers introduce experimental cases and guidebooks to help students understand the experimental instruments, software and precautions, stimulating students to think about theory and experimental content, and timely addressing any gaps in theoretical knowledge [9]. In light live streaming activities, teachers control the interaction and Q&A time based on the difficulty of the learning content, allowing students to summarize valuable questions within a limited time and independently think and collaborate to explore and solve simple problems.

4.2. Classroom teaching

After integrating online self-learning and live Q&A, classroom teaching focuses on three core stages: questioning and sampling, case analysis, and experimental practice, ensuring the deep application of knowledge. Firstly, through interactive questioning 5 minutes before class, using the cloud class platform for attendance, random roll call and voting, students can effectively test their preview situation and improve their participation [10]. Next, the case teaching method of integrating micro lesson videos and blackboard writing will visually demonstrate and guide students to actively explore chapter principles. In the experimental phase, guidance strategies are flexibly adjusted based on the difficulty level, using problem-guided learning to encourage students to solve experimental problems independently or in teams. Especially with the help of PBL project-based learning, complex experiments are encouraged to be grouped and collaborated to overcome difficulties. At the same time, special phenomena in the experiment are recorded and analyzed, and practical cases are combined to deepen understanding [11]. Finally, select high-completion experimental groups, record their process as video materials and upload them to the cloud class for learning resource sharing, promoting the improvement of practical ability and problem-solving skills for all students. This series of teaching activities are closely linked, aiming to build an efficient, interactive and practical-oriented learning system.

4.3. Post-class consolidation

After class, teachers design multi-level extracurricular assignments based on students' learning levels, allowing them to use their extracurricular time and knowledge to complete practical engineering projects and exercise their ability to solve practical problems [12]. In the process of post-class consolidation, teachers can design project creation, online communication and note-sharing sessions, allowing students to use their spare time after class to consolidate their knowledge and stimulate their knowledge application and creative potential. On the cloud class platform, teachers release extracurricular assignments with different difficulty levels and forms,

allowing students to communicate and interact in discussion areas [13]. They record knowledge that they do not have in place into electronic notes and consolidate it in a targeted manner. During the consolidation process, teachers encourage students to explain and support each other online, provide appropriate supplements and stimulate their enthusiasm for extracurricular consolidation. To summarize experimental operation experience, teachers provide real engineering cases, setting parameters, conditions and work environment requirements, allowing students to apply their learned knowledge, demonstrate team spirit and creativity, independently design experimental plans and develop their ability to solve practical engineering problems [14].

4.4. Assessment and evaluation of blended learning

In terms of assessment and evaluation, teachers are divided into two modules: online and offline evaluation. Online evaluation data comes from the cloud class platform, including online learning, interaction, self-test scores and homework assignments. Offline assessment includes project achievements, learning points, attendance records, and final exams. The evaluation is primarily conducted by teachers, comprehensively assessing students' knowledge, skills and quality levels [15].

5. Teaching effectiveness

After implementing the blended learning method, students have significantly improved their practical abilities and won awards in various competitions, such as the Blue Bridge Cup and the NXP Cup. Students have improved their research and innovation abilities, successfully initiated multiple national and provincial innovation projects and published papers at international academic conferences, demonstrating research potential, teaching and learning complement each other together with curriculum optimization. After implementing project teaching activities, teachers simultaneously improve their research and teaching levels and continuously optimize course content based on feedback.

6. Conclusion

In summary, blended learning methods have promoted teaching reform on the principles and applications of microcontrollers, significantly enhancing students' interest in learning, self-learning ability, control program design, and scientific research practice ability. Therefore, teachers should embrace the trend of digital development, fully utilize online teaching platforms, continuously develop case resources such as animated views, slides and audio, implement online and offline interactive teaching activities, provide students with a new learning experience, and deeply explore big data and Artificial Intelligence technology. They should optimize case teaching and project-based practical application strategies to meet students' personalized learning needs, enhance their learning participation and cultivate their craftsmanship spirit and innovative consciousness.

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Disclosure statement

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