



Exploration and Practice of Hybrid Teaching Mode in the Course of “Principles and Applications of Microcontrollers”

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Abstract. With the rapid development of electronic technology, more and more electronic devices are using microcontrollers. Learning and mastering microcontroller technology is a major task for contemporary engineering college students. The course “Principles and Applications of Microcontrollers” is an important course for undergraduate majors in electrical and electronic fields. Based on the analysis of the current teaching situation of the course “Principles and Applications of Microcontrollers” in engineering majors of application-oriented undergraduate colleges, a new mode of teaching the course “Microcontrollers” has been explored. Based on the superstar online learning platform, the overall design and resource construction of online courses are carried out in accordance with the teaching mode of combining in and out of class, online and offline. This promotes students’ independent learning before class, careful listening during class, and effective communication with teachers after class, stimulating students’ learning enthusiasm and promoting students’ initiative in learning.

Keywords: Applied undergraduate program · Singlechip · Superstar online learning platform · Reform in education

1 Introduction

In the “Internet plus” environment, the teaching content and teaching form of application-oriented undergraduate education need to keep pace with the times and continue to update [1]. The teaching of the course “Principles and Applications of Microcontrollers” in engineering majors of application-oriented undergraduate colleges also presents the characteristics of advanced technology and fast updates, facing new problems and requirements, such as students’ learning content in school not being consistent with the content of working in enterprises after graduation, and students not being familiar with enterprise projects [2, 3]. The microcontroller technology updates rapidly, while the book content is too outdated, and students cannot quickly integrate into society when they graduate and work. Traditional classrooms mainly focus on textbook knowledge and cannot keep up with technological updates. Therefore, students’ learning methods are no longer limited to traditional classroom teaching. Therefore, various application-oriented undergraduate colleges have successively built online teaching platforms, relying on various information based teaching methods to implement curriculum teaching reforms [4].

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The principle and application of single-chip microcontrollers is a compulsory course for electrical majors in our school. The course content presents the characteristics of strong practicality and close connection with reality. It is necessary to continuously mobilize students to independently delve into the course, drive theoretical learning enthusiasm by learning interest, and guide practice by theory. In order to improve students' learning ability, teachers have carried out teaching reforms on the course during the teaching process, such as using project-based teaching, task driven teaching methods, etc., integrating relevant knowledge points into relevant tasks for explanation, and improving students' practical ability and innovation awareness through the completion of actual projects [5]. However, in the process of teaching and learning, relying solely on classroom teaching is not conducive to improving students' enthusiasm and initiative in learning. The problems encountered by students in the self-learning process are not solved in a timely manner, leading to unsatisfactory project completion and loss of interest in learning microcontrollers [6].

In order to solve the above problems, stimulate students' enthusiasm for learning microcontrollers, and overcome the drawbacks of traditional teaching methods, this teaching reform has introduced the Superstar Learning Communication network teaching platform. Students can selectively learn independently based on their interests and hobbies, and can interact with teachers and classmates in real-time on the teaching platform when encountering problems. At the same time, teachers can also promote the improvement of their own information-based teaching abilities in the process of teaching reform and curriculum resource construction [7, 8].

2 Superstar Online Course Platform

Superstar online learning platform is a new online teaching platform that integrates course construction, teaching resource management, teacher interaction, teaching management evaluation, and teaching achievement display. Driven by the "Internet plus" environment, the emergence of online teaching platform has brought about major changes in teaching mode, and teaching activities have achieved flexible combination of in class and off class, online and offline. Teachers and students can engage in academic exchanges anytime and anywhere on the platform, enjoying the convenience and speed brought by the new online teaching platform. Superstar online learning platform mainly includes several modules, including course portal, teaching resource management, course materials, notifications, assignments, exams, teacher-student interaction, and statistical management [9]. Teachers can open courses in the course portal, upload teaching resources such as PPTs, videos, and images to the resource management space, and communicate notifications and assignments to students through the teaching platform. They can organize chapter tests, and use statistical data to understand students' learning dynamics in real time. They can adjust teaching objectives appropriately. Students can also have a more comprehensive understanding of the course they have learned through the teacher's introduction to the course and interpretation of teaching tasks and objectives in the course materials, Self study based on teaching resources or engage in learning and communication with teachers and classmates. The above modules are closely integrated to provide comprehensive support for the smooth implementation of online teaching [10].

3 Overall Design of Teaching Reform

3.1 Reform Objectives

This course is guided by the teaching goal of application ability training, and combines the “Internet plus” education idea on the original basis of the course to carry out teaching research based on the superstar network platform. The purpose is to build a more reasonable course content system, improve teaching links and resource construction, and strive for breakthroughs in course content, teaching methods, and resource construction. The course “Principles and Applications of Microcontrollers” based on the Superstar Network Learning Platform will be built into a demonstration course of similar courses, promoting online teaching.

3.2 Design of Course Teaching Content

According to the course construction objectives, the knowledge structure of the course “Principles and Applications of Microcontrollers” is inverted, forming a teaching approach that starts from engineering applications and adopts project teaching, task driven, and other methods. The traditional teaching content of the course “Principles and Applications of Microcontrollers” mainly includes: basic knowledge of microcontrollers, structure and principles of microcontrollers, IO structure and programming, interrupt system and programming, timer and programming, serial port and programming. The original knowledge points are fragmentation and then combined with the real project to reconstruct seven projects, as shown in Fig. 1. The projects are: project 1, flow light and display circuit design; Project 2, Design of Electronic Clock; Project 3, Design of Calculators; Project 4, Design of electronic organ; Project 5, Design of Digital voltmeter; Project 6, Design of temperature alarm; Project 7, Design of Intelligent Car.

In the teaching of various projects, the programming is mainly in C language, combined with assembly language to enhance the understanding of hardware storage, and combined with the explanation of Keil and Proteus simulation software, the complete knowledge points of system design are integrated into relevant tasks. Through the completion of actual projects, students’ practical ability and innovation awareness

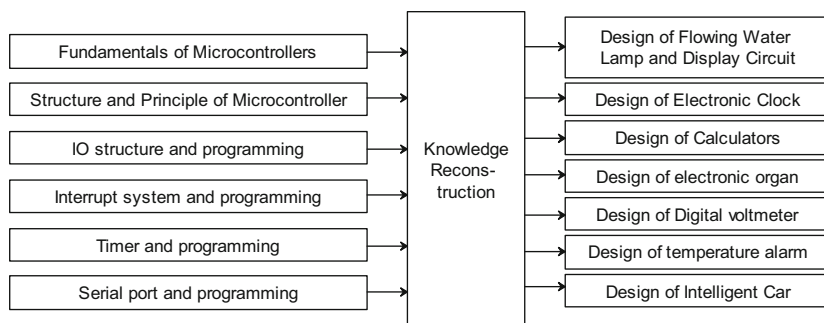


Fig. 1. Knowledge Reconstruction of the Course “Principles and Applications of Microcontrollers”

are improved, and their ability to analyze, solve problems, and learn independently is cultivated.

3.3 Construction of Online Course Resources

The construction of course resources should adapt to the needs of teaching and ensure the smooth progress of the teaching process. The construction of course resources for “Principles and Applications of Microcontrollers” based on the superstar learning platform starts from facilitating students’ autonomous learning and task progress, mainly from the following aspects:

Preliminary preparation work: In the early stage of the construction of online teaching resources, teachers should develop appropriate teaching schedules based on teaching objectives, teaching tasks, etc. Then, according to the schedule, create PPTs, record course videos, design teaching plans and teaching plans. The production of courseware and the design of teaching plans should meet the teaching requirements of applied undergraduate majors and meet the needs of students’ autonomous learning. In addition, in order to improve the subsequent assessment methods, teachers can also upload test question banks, set task points, and so on.

Specific implementation stage: After preliminary preparation work, sufficient course materials have been accumulated in the course portal. During the teaching process, teachers can selectively set task points based on the content of the lesson, requiring students to solve problems through learning to watch videos, consult materials, and other methods through the mobile app, and present them in class; During class, teachers can set up in class tests to consolidate and practice the knowledge points they have just taught, and understand students’ mastery of knowledge based on the feedback results from the APP, achieving a combination of online and offline learning.

Update and improvement stage: During the use of the Learning Communication online teaching platform, the original materials can be supplemented and updated in a timely manner based on the effectiveness of teaching and feedback from students; Or showcase students’ excellent works, and even write them into a case library for future teaching activities.

3.4 Design of Evaluation Methods

The traditional teaching methods have a relatively single evaluation method for students. On the one hand, due to the large amount of materials required for process evaluation, it is difficult for teachers to take the time to organize the process evaluation materials for students in addition to preparing lessons, attending classes, correcting homework, and tutoring and answering questions; On the other hand, a teacher often takes on more than just teaching a course, with a large number of students. For some open-ended assignments, it is difficult for the teacher to give an objective and fair evaluation of each student’s daily performance.

Superstar online learning platform can automatically track students’ learning progress, grade assignments, and calculate their current scores, reducing the workload of teachers. In this teaching reform, the online and offline combination mode constructed by using the Superstar Learning Network Teaching Platform is shown in Fig. 2.

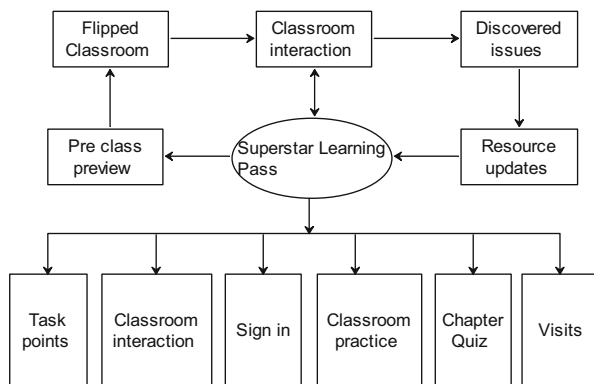


Fig. 2. Network Teaching Mode Based on Superstar Learning Platform

In practical applications, teachers can independently set the composition modules and weights of grade management based on the characteristics of the course. The system will automatically provide an evaluation and update the final grade for each assignment completed by students on the learning platform. In this teaching reform, the final assessment is still conducted in the form of test papers. However, in order to promote students' initiative in autonomous learning, it is required that students achieve a comprehensive score of at least 70 points in their overall academic performance before they can participate in the final exam.

4 Teaching Effectiveness

The online course “Principles and Applications of Microcontrollers” constructed through the Superstar Network Platform fully integrates teaching resources and systematizes dispersed knowledge points. During the teaching process, teachers use this as a basis to continuously supplement and improve teaching resources, making them more abundant and covering more comprehensive knowledge points.

In order to explore whether the use of the superstar online teaching platform can improve teaching effectiveness, this article takes Class 1 and Class 2 of the 2019 Electrical Engineering and Automation undergraduate program at Nanning University as pilot classes, carefully designs implementation plans, and leads students to implement new learning modes. Taking the statistical data of Class 1 of Electrical Engineering and Automation in 2019 on the Superstar Learning Platform and the statistics of participating in competitions this semester as an example, the following conclusions are drawn:

(1) The enthusiasm and initiative of students in learning have significantly improved. A total of 10 video task points have been uploaded in the course resources. Through the statistics of students' learning progress, it can be found that in only two weeks, each task point has been watched by students, and some students have already completed all the task points; In addition, the number of student visits has also significantly increased, reaching 134 even when there were no class assignments. This indicates that students are using their spare time for learning. The online teaching platform built by Superstar

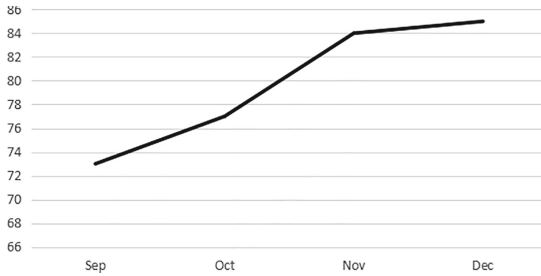


Fig. 3. Assessment Results from September to December 2022

Learning has broken through the limitations of traditional teaching methods in terms of time and location, greatly improving students' enthusiasm and initiative in learning.

(2) The mobile learning method on mobile terminals is very popular. After communicating with students, it was found that almost all students are using mobile learning devices for learning, while very few use computer terminals. The reason is that mobile phones are smaller than computers and can be carried around, making full use of fragmented time and improving students' learning efficiency.

(3) The performance of stage assessment has significantly improved. A total of 4 phased assessments were conducted from September to December 2022, and the average score of the assessment results is shown in Fig. 3. The four assessment scores in the figure are 73, 77, 84, and 85 respectively, showing a gradual upward trend. This indicates that adopting a new teaching model can help students master knowledge and improve teaching quality.

The practical abilities of students have been greatly improved. The course "Principle and Application of Single Chip Microcomputer" is highly practical. After a semester of teaching reform, some students have developed a high interest in learning single chip microcomputer. In the 2021 Guangxi Undergraduate Electronic design competition, 18 students from the class participating in the teaching reform formed a team to participate in the competition based on single chip microcomputer, which improved the students' practical ability and innovation awareness, and 6 students won the first prize in Guangxi, 9 people won the second prize in Guangxi region.

5 Conclusion

To sum up, compared with the traditional teaching mode, the use of Superstar based online teaching platform has greatly improved the enthusiasm and initiative of students in learning, effectively promoted the interaction between teachers and students, improved the learning efficiency of students, prompted more and more students to turn passive acceptance into active learning, and improved students' practical ability. Therefore, blended teaching models can be used in university teaching activities, and online teaching platforms can be appropriately introduced.

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