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(China-Europe International Symposium on Software Engineering Education)

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Reform of C++ Programming Course

Reform and Practice on International Software Talent Training Model

Exploration on the Long-term Education System of Software Engineering

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MOOC construction of major core course and reform of Hybrid Teaching Mode
Taking "principle of embedded system" as an example

Ce Zhang,Weigong Lv,Sheng Sheng,Jianiong,LiDianhui Chu,Zhenzhou Ji,Weihua Guo

Abstract: The development of MOOC directly promotes the reform of physical classroom teaching, and leads to the reform of teaching mode and teaching method in the direction of improving teachers' teaching quality and students' learning effect and innovation ability. In order to meet the needs of MOOC teaching reform, based on the MOOC built by ourselves and running on the MOOC platform, this paper puts forward the hybrid teaching mode reform of the core courses of an computer specialty, which combines online and offline in depth. Sort out the knowledge system of an embedded system, build MOOC and put it online on domestic well-known MOOC platform, compile supporting teaching materials, and form an organic combination of online and offline teaching resources; proposing a hybrid teaching mode of online and offline combination, which focuses on interactive classroom teaching reform. On the basis of organizing students to carry out online autonomous learning, online and offline entity classroom carries out interactive classroom teaching reform; Using intelligent teaching tools to promote students to use mobile phones to participate in classroom learning, improve the universality of interactive teaching, carry out flipped classroom teaching, and improve the depth of interactive teaching. Based on the independent construction of MOOC, the hybrid teaching is carried out, which improves the pertinence of online teaching organization. The information-based teaching and flipped classroom teaching in the physical classroom improve the students' ability to solve problems, and lay a solid foundation for the improvement of teaching quality and learning effect.

Key words: MOOC; embedded system principle; professional core course; hybrid teaching mode; flipped classroom
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1 Introduction

With the rapid integration of embedded system and Internet of things system[1-2], as well as the emergence of online and offline Hybrid Teaching[3-5] derived from online open courses represented by MOOC[6-9], the traditional embedded teaching and talent training mode, ideas and guidance need to be reformed. The important direction and content of the reform is to explore the teaching mode of the embedded system that fits the social development of the Internet plus era and meets the characteristics of the new era. Through the reconstruction of teaching content and teaching methods, students should be guided to play the main value, stimulate students' interest and initiative in learning and improve their

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innovative consciousness and innovative ability. At the same time of implementing online teaching, the main direction is to carry out targeted teaching in offline physical classroom, especially in flipped classroom. At present, the main direction of MOOC's integration into classroom teaching is to focus on the mixed teaching mode based on MOOC, that is, while developing online autonomous and collaborative teaching based on students, the entity classroom carries out targeted teaching, especially the flipped classroom, discussion and discussion teaching. We have accumulated preliminary experience in the research and teaching practice of MOOC in the early stage, and basically mastered the basic method of online and offline hybrid teaching.

Based on the embedded system MOOC we built, this paper explores the online and offline hybrid teaching mode with classroom teaching reform as the core, hoping to provide reference for innovative large class Hybrid Teaching in the core course teaching of colleges and universities in China. The innovation of this paper includes:

（1）This paper puts forward a hybrid teaching mode of the core computer courses (non-basic courses) which combines the large class online and offline, and explores the innovation of the comprehensive teaching reform based on MOOC under the current teaching situation in China.

（2）This paper puts forward an effective heuristic interactive classroom teaching method driven by modern information technology: using the existing classroom teaching infrastructure and environment, no need to transform the classroom and move tables and chairs, whether it is intelligent teaching tools / platforms, or flipped classroom can be carried out on the spot, so that students' use of mobile phones can be reasonably applied to classroom learning, objectively promoting students review well, participate in class learning, and listen carefully in class;

（3）This paper puts forward a large class flipped classroom teaching method: flipped classroom requires students to deeply participate in classroom teaching, so that the identity of teachers and students can be exchanged. Students' mutual evaluation, students' evaluation of teachers, students' interaction, and students' interaction with teachers bring new changes to the participatory discussion teaching reform. It also provides an important guarantee for the process management of students' learning, the accumulation of achievements, and the promotion of learning effect.

2. MOOC construction of Embedded System Course

Different from the previous video open class and resource sharing class, MOOC has complete teaching characteristics, including short videos (the main teacher appears in the audience to teach), exercises, tests, assignments, forums (discussion and interactive exchange), examinations and other contents, and presents the traditional entity classroom teaching on the Internet using network information technology. Therefore, MOOC is the deep integration of information technology and teaching, it is as real and rich as the physical classroom, not limited to the single category of network video, so it is favored.

Considering the characteristics of online open course learning, especially the short video clips of MOOC is suitable for short-term learning and student-centered, combined with the typical characteristics of embedded system composition and development, we have conducted in-depth reconstruction of embedded course content, as shown in Fig. 1. In particular, the reconstruction of course content is not a simple knowledge discretization, but a comprehensive and in-depth review of the internal logic of all the knowledge of the whole course, to get through the old and inappropriate disadvantages, especially those that have been solidified for many years, and to form a more suitable systematic, systematic and scientific and rational knowledge context and system for learning.

The content of MOOC is divided into 4 parts and 17 chapters as a whole, including several sections. Each section is composed of at least one short video, which

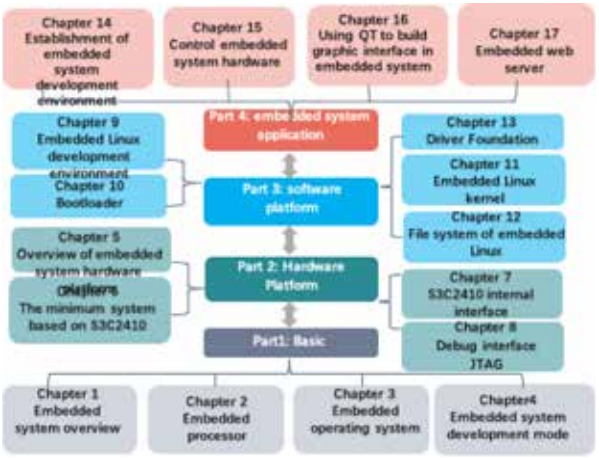
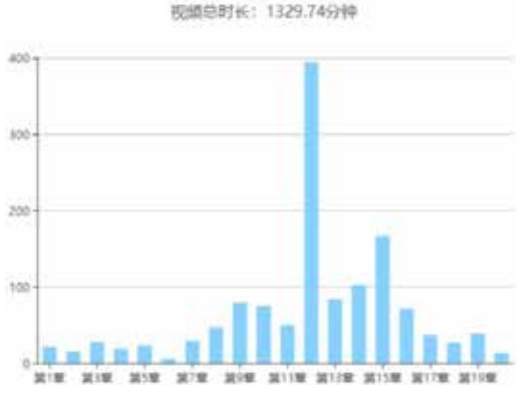


Fig. 1 content reconstruction of MOOC in embedded system.

describes the knowledge points of an embedded system content. Based on the content reconstruction, we have built the MOOC of embedded system design and practice, which has been running online for more than two years on the MOOC platform of "excellent course online", forming a systematic online teaching sharing resource, as shown in Fig. 2.

At present, there are 6 online teaching activities in total, MOOC has been applied to the embedded course learning of some students in nearly 30 domestic universities. In our own teaching, we actively explore and carry out the mixed teaching reform based on MOOC, introduce MOOC into classroom teaching, and have achieved positive results. At the same time, we have compiled the teaching material of embedded computer system design[10] (ISBN 978-7-5603-6133-8) to cooperate with teaching, forming an organic combination of online and offline teaching resources, and achieved good results.



(a) Video resources

(b) Other resources

Fig. 2 course log in "excellent course online" MOOC platform to share high-quality resources.

3 MOOC based hybrid online and offline teaching mode

Based on the built-in MOOC, when we carry out online teaching, we cooperate offline with the implementation of the flipped classroom, forming a hybrid online and offline teaching, and achieved positive results.

The main idea of hybrid teaching mode reform is to enrich online and offline teaching elements and reform methods. Through the implementation of online and offline combined large class participatory interactive discussion type teaching reform, students are trained to master online open course learning technology and online self-learning ability, and personal information processing devices such as mobile phones are transformed into tools to assist classroom teaching, Effectively drive students to participate in classroom teaching, through flipped classroom teaching to improve learning effectiveness and solve practical problems of innovation.

The reform of online and offline mixed teaching mode is carried out according to the offline requirements, that is, "online open course teaching + interactive classroom teaching + flipped classroom teaching", and its construction content is shown in Fig 3.

Online teaching design based on MOOC -- focusing on Online Autonomous Learning and online discussion, MOOC teaching is implemented. While helping students master the learning ability of online

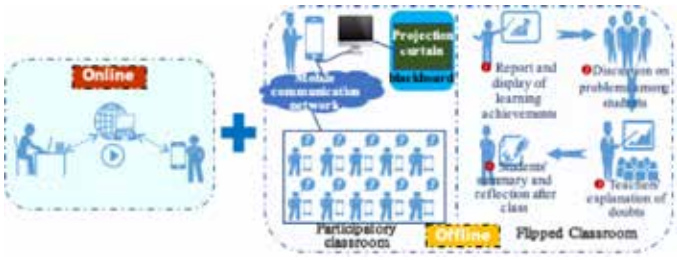


Fig. 3 a hybrid online and offline teaching mode centered on participatory discussion interactive classroom teaching reform.

open courses, online teaching resources are excavated in depth, basic knowledge of embedded system is organized for self-study before and review after class, making full use of the functional advantages of MOOC platform. And carefully designed video, exercise, test, discussion, examination and other elements of the organic integration of effective learning environment, improve the depth of students' knowledge of embedded systems and independent learning and thinking ability. In terms of teacher-student interaction, teachers organize online discussion, raise key and important questions, trigger high-quality topic discussion, and provide authoritative answers. It is more about the interaction between students, so that students can access to high-quality MOOC resources and master the learning technology essentials of online open courses.

Overall design of flipped Classroom: use intelligent teaching tools to effectively drive students to participate in the classroom and integrate into the teaching, implement flipped classroom teaching, stimulate students' in-depth understanding of knowledge, in-depth thinking of problems, in-depth discussion of communication, especially guided by specific and real complex engineering problem-solving ability, improve the comprehensive ability of the design and development of the complete embedded computer system, the ability of thinking and innovation, independent analysis and problem-solving, and effectively promote the cultivation of innovative thinking.

4 The physical classroom teaching reform centered on the interactive classroom teaching reform

At present, the biggest problem in China' s classroom teaching is that students' enthusiasm for participating in classroom learning and integrating into teaching activities is not high, the classroom is dull, and the energy is insufficient, which seriously affects the knowledge learning and ability improvement. In view of this, we carry out reform from two aspects, therefore, we call it "interactive classroom teaching reform of participatory discussion".

4.1 The reform of interactive classroom teaching based on participatory discussion

The reform of classroom teaching centered on participation, interaction and discussion, and adopted the method of flipped classroom teaching. There are two types of flipped classrooms. One is to use the intelligent teaching tools such as "rain classroom" to conduct participatory interactive classroom teaching. This is a broad-based flipped classroom. Students use mobile phone WeChat to scan codes to enter embedded system courses. Test questions are given using a computer, and students use mobile phones to answer questions. Teachers can get answers in time and explain accordingly. This method can be used at the beginning of a class to test the effectiveness of the last lesson, or it can be used in the class to grasp the student' s learning results at any time.

Organize flipped classroom teaching according to the clue of "in-class test → report of learning results → exchange and discussion → explanation and answer". The learning achievements reported include the basic knowledge of embedded courses, key and difficult points and problems, embedded system design and development, etc., which are discussed in the form of group flipping. After the innovation of students, in addition to the traditional ppt introduction and blackboard writing, the form of learning achievement report also includes playing the video recorded after class, on-site programming operation demonstration and on-site interactive communication, presenting a colorful classroom appearance. In the inter group discussion, students ask and answer each other's questions, even debate, which greatly promotes the improvement of thinking and critical ability. Flipped

classroom first “flip identity”, students board the platform, change their identity, through independent learning and on-site display of learning results, not only deepens the understanding of knowledge, but also brings confidence for students to show themselves and stimulate potential. There is another point. To a certain extent, it enables students to “observe” each other, plays the role of mutual promotion, stimulation, reminder and encouragement, presents the current learning effect, learning state and learning ability, and plays a very good mutual education effect, which is difficult to achieve in normal classroom teaching.

The flipped class is mainly used to improve students ’ability to think, innovate, and solve practical problems, in order to strengthen students’ ability of deep learning, participation in teaching and active learning. This mixed teaching mode, whether it is online MOOC teaching, “rainy classroom” or flipped classrooms, is an upgrade and reform of traditional classroom teaching, which uses appropriate technical means to effectively drive students to participate in classrooms and discussions. And test the learning effect and inspire thinking. Comparatively speaking, “Rain Classroom” is highly participatory and interactive, but the flipping depth is not enough; the flipped class is more participatory and interactive.

Highlights and features of this flipped classroom teaching reform include:

（1）Using the existing classroom teaching infrastructure and environment, there is no need to transform: whether it is wisdom teaching aids / platforms or flipping the classroom can be carried out on the spot;

（2）The use of mobile phones by students is reasonably applied to the study of classroom courses;

（3）Objectively urge students to review well and listen carefully in class;

（4）Flipping the classroom requires students to participate in classroom teaching in depth. The exchange of teacher-student status, student-speaking student reviews, student-speaking teacher reviews, student discussions, and teacher-student interactions bring new changes to participatory seminar-based teaching reform;

（5）It provides important guarantees for the process management of students’ learning, the accumulation of grades, and the improvement of learning effectiveness.

4.2 Summary

Based on the self-built MOOC, the online and offline mixed teaching model and method reform was implemented, which brings the advantages of online resources to improve students’ self-study and group learning ability to gain knowledge, and brings opportunities for deep teaching reform in offline physical classrooms. In the physical classroom, teachers focus on the use of mobile phones to carry out interactive teaching, and use exercises to test the learning effect, so as to make students do a good job in the review after class and real-time learning in class; in the physical classroom, teachers organize to carry out flipped classroom teaching, through flipped teaching of multiple plates, to promote students to participate in teaching and integrate into the classroom, so that teachers can evaluate students’ lectures and students’ evaluation of teachers lecture, realize the interaction between students and the interaction between teachers and students, improve students’ creative ability to solve problems.

Through the practice of reform, students can master the basic knowledge and ability of embedded system, and improve the ability of software and hardware collaborative development, especially the ability to design and implement the embedded computer system with obvious computer characteristics by using the course knowledge comprehensively, which will bring new environment, resources and methods for students to learn the course well. Promote the common progress of teaching quality and learning results.

5 Conclusion

In view of the shortage of the traditional teaching mode that the teaching of professional core curriculum still stays in the teacher-led classroom, it is not conducive

to the improvement of students' multiple abilities with innovation as the core. Based on the self-built MOOC and its online operation on the well-known MOOC platform, this paper carries out the reform of hybrid teaching mode. Focus on the implementation of interactive classroom teaching reform in physical classroom, interactive classroom teaching through intelligent teaching tools, and then carry out flipped classroom teaching, to provide a reference for the reform of professional core courses based on MOOC. To carry out the mixed teaching reform based on MOOC, it is necessary to combine the characteristics of the course with the actual situation of the students. We should focus on the reform of the design and implementation of the physical classroom, especially the flipped classroom teaching, closely improve the degree of students' participation in classroom teaching, gradually change the traditional one-way classroom teaching mode, bring opportunities for the collaborative reform of both teaching and learning, and improve the quality of teaching and talent training.

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