Flipped Classroom Model Based Teaching Reform and Practice in Embedded System

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ABSTRACT: Embedded technology is a key technology for Cyber-Physical Systems, and embedded system is a core course of computer and electronic specialty. Improving teaching method is particularly important for raising teaching level of embedded system course and cultivating talents on high-end embedded development. In this paper, Flipped Classroom mode is used for embedded system teaching design. In practice class students are taken as the main body, self-organization and independent implementation; in theory class the main teaching form is to explain key concepts, answer questions, discussion and summer, etc. The network teaching platform is the crucial part of the Flipped Classroom and it is an important link to contact theory class, practice class and after-class learning. Two years teaching practice shows that this method greatly improves the students' learning interest and confidence, and the teaching effect obviously improves.
KEYWORD: Flipped Classroom; Embedded system; Class Practice; Teaching Reform

1 INTRODUCTION

As an emerging field, embedded system reflects the characteristic such as diversification, application, application in intensive hardware and software platform. Because of its small volume, high reliability, powerful function, convenient use and many other advantages, the embedded controller has been successfully used in industry, agriculture, education, national defense, scientific research, daily life and other fields, which plays an important role in technological transformation, automation process, productivity promoting, and so on[1]. But persons engaged in the embedded development of high-end talent are still in a state of extreme scarcity, most of whom change career from other professional engaging field such as automatic control, engineering, computer engineering and other careers. The talents who master the low-end 8, 16 bit single chip microcomputer application are more excessive than those who really master high-end 32-bit embedded system development technology. So in order to meet society's need for professional talents, more and more colleges and universities offer courses in theory and practice of embedded.

This course is laboratory component of course principles of embedded systems, which makes efforts to train students the ability of embedded system design, practice, embedded system analysis and debug, and engineering quality.

Flipped Classroom is a kind of innovative teaching ideas developed nearly in recent 10 years[2]. Under the new concept, this paper introduces the Flipped Classroom teaching mode into the course of the embedded system to overthrow the traditional teaching mode in order to fully promote the students' study enthusiasm and autonomy. What teachers should do is to guide and assist students, develop students' potential, improve the self-learning ability, enhance the grasp and application ability of the embedded system, and to provide references for the teaching mode reform of research in the future.

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2 COURSE ANALYSIS AND MAIN PROBLEMS IN COURSE TEACHING

2.1 *Course features analysis*

Embedded systems is an important required practice course in hardware direction of computer science and technology specialty, and it is consolidation and sublimation of prerequisite courses such as principles of computer organization principle, computer interface technology, digital logic, principle of embedded systems and so on. Let students make the analysis and design of the actual task on the basis of the understanding of the embedded platform to cultivate the ability to apply the theoretical knowledge, engineering practice and innovation[3]. The features of this course are: (1) Aiming at application: outstanding practicality follows the guiding ideology of the construction of the curriculum; (2) Combine abstract theory with practice: theory and practice are directly related, and the abstract theory is used to solve practice problems; (3) design method for practice is not unique: various different methods may be found to resolve one problem.

2.2 *Problems in the course teaching*

By the former teaching, following problems are found: (1) theory is too abstract, in the process of learning students' enthusiasm declines as a result of difficult, therefore it makes teaching result is not satisfied, and directly influences the practice effect. (2) the linear arrangement of theory and practice makes students have no purpose in theory study and don't know what the theory they learn can be used to do. While when the corresponding theoretical knowledge is needed to resolve problems in the practice step, students can not apply smoothly. (3) the confirmatory experiments are more than design ones, in which students just do what according to the experimental instruction and have little chance to take initiative to think and explore, and it will inhibit the enthusiasm of active learning and the spirit of innovation research of students. (4) There are 6 experiments in this course, but each experiment content is isolated from others, and they have no continuation of the connotation of the relationship, so they can not help students set up complete knowledge structure.

3 TEACHING METHOD RESEARCH BASED ON FLIPPED CLASSROOM

3.1 *Flipped Classroom*

Flipped Classroom is to converse teaching knowledge and knowledge internalization in the process of the traditional classroom, where knowledge teaching complete after class in the auxiliary of information technology while knowledge internalization complete in class by the help of teachers and students[4]. In north America, Flipped Classroom is accepted by more and more schools and becomes a main education and teaching reform method. By contrast, there is less teaching practice in China but theoretical research is more, such as Zhang Yueguo[5], Zeng Zhen[6], Zhang Jinlei[7] etc all have done research and analysis on the Flipped Classroom theory. The contrast between traditional classroom and Flipped Classroom is shown in table 1.

Table 1.contrast between traditional Classroom and Flipped Classroom.

	Traditional Classroom	Flipped Classroom
Teacher	Teacher and manager	Instructor and promoter
Student	Passive recipient	Active researcher
Teaching form	Lectures and homework	Learning fore-class and in-class explain and discussion
Class content	Teach knowledge	Explore problems
Technology application	Knowledge show	Self-study, communication and reflection
Evaluation way	Traditional test paper	Multi-way and multi-perspective

3.2 *Practice of Flipped Classroom*

3.2.1 *Theory teaching practice*

Because embedded theory is boring, the hybrid teaching mode is adopted that it is the fusion of teaching in class and self-study after class during theory teaching, and project driven mode is used, the process is shown in figure 1.

The case and important and primary knowledge points are shown to students before class by internet. Students access to information, read and comprehend, do self-test on internet to evaluate how about new knowledge master, then find the solution of the problems in case and discuss and analysis in discussion on internet. When in class student group report about the self-completion case and group discuss with other students and teacher. Teacher understand students mastery of knowledge points through a serious of discussion questions and know what students know well and what they cant not comprehend correctly and deeply. Then teacher explain the knowledge student can not grasp well and the problems he find from the self-test and discussion in the class. After class students modify, improve the case according to class discussion and the teacher explain about the content of it, thus deepen the understanding of theoretical knowledge through the reflection. This is a whole process of a theory teaching activity.
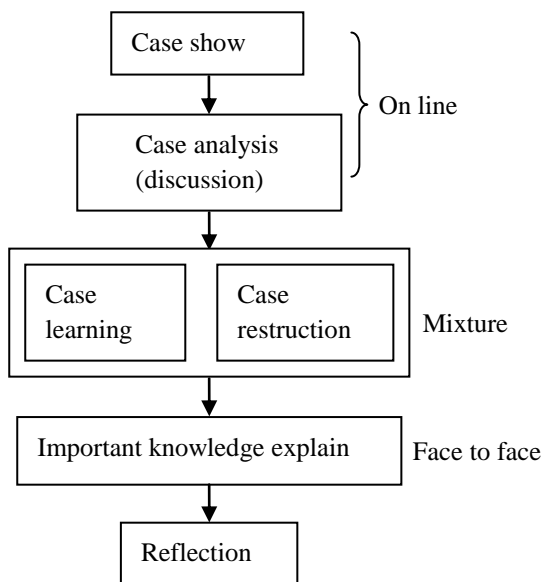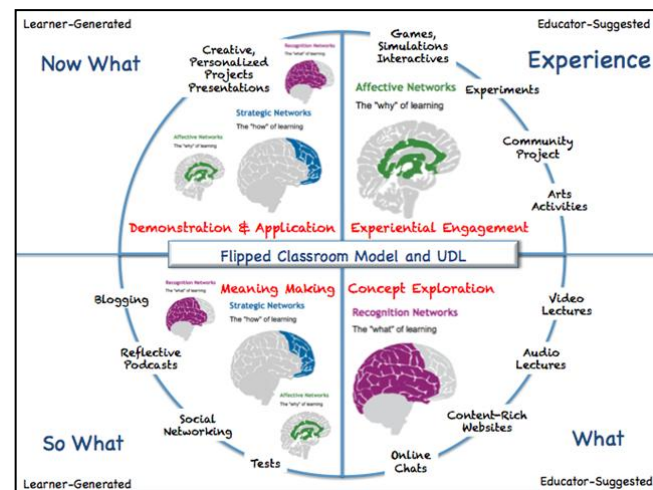
Figure 1 Theory teaching process

Figure 2 Model of Flipped Classroom.

3.2.2 *Experiment teaching design*

The course contains a larger proportion of experimental class hour, and it requires students to make full use of time after class. Students need sufficiently to prepare knowledge used in the experiment, understand the experiment content and steps in detail, and complete corresponding preview test on internet to verify how about grasp the knowledge. In class teacher discusses and explains the problem found from students, and most of in-class time owns to students for completing the experiment. On account of sufficient preparation before class, students have enough time for the task even can also expend the experiment content for in-depth study or system optimization and improvement in order to improve the effect of learning. So in the Flipped Classroom teaching model reform, curriculum network platform construction is of great significance.

3.3 *Construction and application of curriculum network platform*

The obvious difference between Flipped Classroom and the traditional classroom is that in the Flipped Classroom the knowledge is taught by video lecture while in traditional teaching mode the knowledge is taught by teacher in class. Figure 2[8] shows that teacher helps students to complete exploration of the concept and knowledge by video lecture, audio lecture, content-rich website and online chat. Therefore the construction of network resource is a key factor for Flipped Classroom, and will affect the teaching effect directly.

In the network platform construction of this curriculum, main task is the implementation of teaching resource sharing, communication online between teacher and students or among students and self-learning evaluation.

In order to facilitate self-learning, teachers should provide students with instructional videos, which may be chosen from excellent teaching resources on the internet, but most of them need to be made by teachers themselves based on the actual situation of their own students. High quality teaching video requires lively, educative, creative, thought-provoking, understandable, relevant, enjoyable and etc characteristics, and it is the critical first step in the Flipped Classroom implementations.

In Flipped Classroom, teachers guide students to study deeply and communicate. When they meet difficulties, teachers give timely help, and the students are the main body in the process of teaching. This curriculum platform offers BBS for students and teachers to communicate openly and On-site mailbox to communicate privately. These communication methods bring students to analysis and resolve problems and collaborate with others, improve the ability to cooperation and further study.

As mentioned above, teachers want to master students self-learning effect, find widespread problems among student, in order to design in-class teaching content, so the platform provides student self-test and evaluation system. According to the knowledge of each class a few representative questions are designed for students, and the system will feedback the answer from the student to him own and his teacher to know about the grasp of the knowledge. From the self-test students may find what they don't understand and discus it in class with teacher, while teacher may find what point is not well understood by students and targeted design teaching content in class and explain it in class in detail.

4 CONCLUSION

Flipped Classroom is to converse teaching knowledge and knowledge internalization in the process of the traditional classroom, where knowledge teaching completes after class in the auxiliary of information technology while knowledge internalization completes in class by the help of teachers and students. It can not only improve the interaction between students and teachers, but also conductive to promote students understanding and grasp the new knowledge. According to the characteristics of embedded system course, The embedded system course reform and practice based on the Flipped Classroom is done, where students are regarded as the main body in the cognitive, change passive learning into active learning, use network platform as the link to learn the embedded system. It improves the students' capability of system analysis and design and the ability to engage in scientific research and technical development.

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REFERENCES

[1] Wang, Larl L & Cole, Clint S. 2013. An effective project-based embedded system design teaching method. 120th ASEE annual conference and exposition: 1323-1327

[2] Yu Jia 2010. Innovation teaching method researching on embedded system course based on robot project-driven idea. 2010 international conference On E-Health networking, digital ecosystems and technologies: 249-252

[3] J.P. de la Croix & M, Egerstedt 2014. Flipping the controls classroom around a MOOC. 2014 American control conference:2557-2562

[4] Zhong, Xiaoliu & Song Shuiqiang & Jiao Lizhen 2013. Instructional Design Based on the Idea of the Flipped Class room. Open Education Research, 19(1): 58-64.

[5] Zhang, Yueguo & Zhang Yujiang 2012. Study the "the flipped classroom". ict education in basic education : 3-5

[6] Zeng Zhen 2012. The flipped instruction: feature, practice and problems. China educational technology: 114-117

[7] Zhang Jinlei, Wang Ying & Zhang Baohui 2012. Introducing a new teaching model: flipped classroom. Journal of distance education, 30(4):46-51

[8] Gerstein, J 2011. TRhe flipped classroom model: A full picture. http://usergeneratededucation, wordpress.com /2011/06/13the-flipped-classroom-model-a-full-picture.