Practice of Project-centric Flipped Classroom Learning in Microcomputer Interfacing Technology Course

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ABSTRACT

The microcomputer interfacing technology is an important course to communication engineering students. A project-centric flipped classroom learning model is proposed to reform the course teaching paradigm. A Proteus project framework is introduced to organize and integrate lecture contents, and is implemented by the flipped classroom learning model which is composed of students’ activity loop, teacher’s activity loop, and problem driven loop in the classroom. Practical experiences show that the new learning model has improved the students’ performance.

I. INTRODUCTION

In a world of smart devices, the ability to understanding working principles of microcomputer system is very important to undergraduate Communication Engineering (CE) students. The microcomputer interfacing technology is the course to integrate software and hardware design, and it plays a key role in CE curriculum. According the course standard of AEU, the teaching contents are involved in the X86 assembly language programming and hardware subsystem designing.

In traditional teaching paradigm, teacher will lecture the contents in the classroom, and spend the rest time for case study to practice analysis and design skills in the view of microcomputer system. Therefore, there is the limitation of discussion and sharing opinions between students in the classroom. To better engage with students, the teacher should adopt some new teaching methods to arouse students' enthusiasm for study.

Both flipped classroom and project based learning (PBL) have gained traction in recent years as student-centered pedagogies to improve students’ engagement. The flipped classroom intentionally shifts the traditional teacher-centered model to a

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flexible learner-centered pattern in which class time discuss topics in depth and make meaningful learning activities, while lecture materials, videos and exercises are used to 'deliver content' outside of the classroom [1]. PBL has long been established in the field of education, and it is believed that students acquire a deeper knowledge through active exploration of real-world challenges and problems [2]. Based on previous studies, a number of researchers chose PBL as learning activities in the classroom [3][4].

Proteus is a virtual system modeling (VSM) tool, which can support microcontroller interactive simulation [5]. It is now chosen as the environment for the course projects due to its ability to provide hands-on experiences for college students [6].

In this paper, we propose a project-centric flipped classroom learning paradigm in undergraduate microcomputer interfacing technology course. Proteus simulation projects run through the whole learning process to give students the opportunity to achieve and apply systematic knowledge of microcomputer. The rest of the paper is structured as follows: Section II describes the proposed learning model, and the practice results with the discussion are demonstrated in section III. Section IV is summary discussion and conclusions.

II. THE PROJECT-CENTRIC FLIPPED CLASSROOM

The microcomputer interfacing technology is a practical and comprehensive course. The core of the project-centric flipped classroom learning model is a project framework about software and hardware design in Proteus VSM environment. Most of the lecture contents are organized into the framework. Then the flipped classroom can be carried out along with those projects.

A. Project Framework

The course contents are integrated into three project groups, and each group includes several projects. The project framework is shown in Figure 1. Since the course is application-oriented, the application projects are the most important part in whole framework. The programming projects are started firstly. In Proteus VSM, the simulation of assembly programing is very easy because only a single 8086 chip is needed. When student is familiar with 8086 assembly language, the chipset projects are introduced to practice the chips’ usage and configure method. At last, the application projects are used to cultivating students’ practical and innovation ability.

Each project, especially the application project, is designed into several open tasks with different challenge levels. For example, the keyboard and display application project has easy, normal, and hard tasks. The easy task is to design an 8086 I/O system with programmable peripheral interface chip 8255, 4*4 matrix keyboard and seven segment digital display. The student may use polling or interrupt program structure to solve the I/O access according their interest and capability. The normal task use LCD replace seven segment digital display to the simple task, and the program is more difficult. The hard task is to implement a calculator with LCD and keyboard, and only open to students with learning potential.
B. Flipped Classroom

The flipped classroom learning model can be briefly summarized into three key loops: students’ activity loop, teacher’s activity loop, and problem driven loop in the classroom, see Figure 2. The students’ loop is the key cycle which makes education happen, and the teacher’s loop is a support cycle to ensure and enhance students’ engagement. The problem driven cycle is the joint point of the former two loops.

To start a new lecture, the teacher’s loop is active first. The startup step is that teacher prepares various teaching materials, such as outline documents, lecture videos, reading references, exercises, and project tasks. When materials are ready, teacher need to publish to learner with self-study guidance. It is noted that each lecture video should cover a single topic and keep short. Before attending class, teacher should conceive learning activities to control the teaching process. After class, teacher needs to judge and evaluate every student’s performance, and feedback advices to the learner.

From student’s perspective, the first step is to study alone or in group on teaching material according teacher’s guidance. The learner may need to watch lecture videos and reading materials, do exercises or answer questions after learning, propose some ideas or opinions about subject, present and verify project solutions. Before attending class, student needs to prepare presentation or demonstration for the assigned tasks. After class, students need to decide whether or not to do more exercises or labs on previous subjects according to their actual situation.

Attending in classroom, students and teacher interact to complete several activities shown in Figure 2. The problem driven loop which carried out around the projects and subjects is the main activity to promote the deepening of discussion and learning. The teacher should keep a clear awareness of the efficiency and direction of interaction and keep the order under control.
III. EFFECT AND DISCUSSION

In recent two year, we have investigated the effect of the new learning paradigm, it has found that the students examination scores are higher than the ordinary class of about 3%. Students attending flipped classroom are more willing to choose challenging projects and show some creative thinking. The questionnaire showed that students welcomed the new teaching model.

Although the flipped classroom model has improved students’ engagement, we have also found some problems in the teaching process. First, how to objectively evaluate students’ performance in flipped classroom is very difficult. The teacher needs to keep balance between evaluating the students’ true level and encouraging underachievers. Second, the classroom tilts to be dominated by a few outstanding students. The teacher should control the process in classroom, and push the problem driven loop on key subjects in depth and make meaningful learning activities. Third, teacher should reduce the burden of extracurricular learning for student as much as possible.

IV. SUMMARY

The microcomputer interfacing technology is a practical and comprehensive course. The project-centric flipped classroom learning model is proposed to reform the course teaching paradigm, and shifts the traditional teacher-centered model to a flexible learner-centered pattern. Utilizing the proposed model can promote learner’s interest and motivation effectively. Practical experiences show that it has improved the students’ performance and welcomed by both students and teachers. However, it should be noted that the accumulation of teaching
resources and skills is a great challenge to teachers. In the future, establishing an online course may be a good way to accelerate the accumulation and distribution of teaching resources.

REFERENCES


