Flipped Classroom Model and Its Implementation in a Computer Programming Course

Eric Chen
Sektionen för hälsa och samhälle
Högskolan Kristianstad
291 88 Kristianstad

About flipped classroom
The flipped classroom is a relatively new educational model. It has become very popular among educators in all grades during the last several years. It is called the flipped classroom because the classroom/homework paradigm is "flipped", so that what used to be classroom lecture is done at home via video clips (created by tools like screencasting) and what used to be homework is now done inside a classroom. In this way, a teacher can spend more time interacting with students instead of lecturing, and students can watch the videos and learn themselves whenever and wherever it is convenient for them. With flipped classroom model, the student-centered learning is implemented, and students become more actively engaged in their learning process.

Flipped classroom in higher education
Flipped Learning Network is a professional learning community for educators. Currently, there are 19 790 members and 122 groups. Flip Research on Higher Education group has 89 members while College-Level Flippers group has 164 members at the moment (2014.05.24). A recent online survey conducted by Flipped Learning Network and Sophia showed that 80% of flippers taught in secondary schools and 27% were in higher education (some of them were both in higher education and secondary schools). Many international universities have introduced this model in some of their courses. In April, I joined Flipped Learning Network, followed some of the activities (Webinars), and started to put it into experiment. In this paper/presentation, I would like to report my findings and share experiences with interested educators.

Problems with programming courses
Computer programming courses were considered to be very difficult, especially for the beginners. Programming is a very useful skill and it is fundamental in computer science education. We have experienced that many students could not develop computer programs even they have completed many programming related courses. By some initial study, we find that the reasons include that most students are passive in their study, and they do not spend so much time on practices. They take the surface approach of learning. We realize that we have to do something to change the situation and some new approach should be experimented. In April, we started a new course entitled “Programming in C” for the students in computer engineering. We took the opportunity and determined to try applying flipped classroom model in the course.
Implementation of flipped classroom

DT103A Programming in C is a campus course in computer engineering program. There are about 20 active students from Sweden and other countries. It is a course in the second half of the first year study program. Before this course, students have learnt Fundamental Programming 7.5hp and Object-Oriented Programming 7.5hp. At the beginning of the course, a programming knowledge test was taken to learn about their fundamental understanding on programming. The result re-confirmed our experience on their programming skill, and was used to design the course delivery. In this course, the flipped classroom model is applied to facilitate the high level of understanding and promote the deep learning approach by providing various activities.

Since 2014.01.01, all campus courses at HKr can be hosted on the platform Itslearning. With this platform, many useful functions like discussion forum, online test, chat, messaging, etc can be used to improve the social, teaching and cognitive presence. The constructive alignment is used to design the course. Formative assessments are implemented to provide instant feedback and guidance for improving the learning outcomes. The course is divided into 8 units. For each unit, we provide a document that states the intended learning outcomes for the unit, aligned activities, and guiding questions. Some short video clips together with the listed textbook pages are provided for the students to learn at their own pace, time and place. Lecture and tutorial, practice and exercise, pre-lab and laboratory are provided to explain difficult concepts, and allow students to learn by doing in the classroom where interaction and discussion are enabled. Each unit has an online test as the assessment. Followings are a list of activities implemented in the course:

- **Lecture and tutorials**— Various programming concepts and techniques will be introduced, explained, and demonstrated with examples. Since it is shown that it is difficult to keep the concentration after about 20 min, it could be good idea to combine lectures with other activities.

- **Reading and self-study**— students should read textbook and watch videos before the exercises and laboratory work taken in the classroom.

- **Practices/exercises**—Practices/exercises are designed to enable students to practice more on the theory covered in the lecture. Group discussion and team work will be implemented to enable active learning.

- **Pre-labs**—it is designed for the students to go over related concepts from the lecture, discuss and understand the tasks to be solved in the lab, design test cases

- **Laboratory works**—laboratory works are more challenging tasks compared with practice/exercise. They follow the pre-lab activity. They are designed to enable the students to put theory into practice and become proficient in C programming language. The laboratory exercises consist of programming tasks. The students need to analyze the requirements and design programming solutions by applying (and combining) various techniques learnt from lectures and exercises. The students need to write a report to explain their ideas/algorithms using suitable presentation method (flowchart or pseudo-code), as well as observe the program output for the designed cases in pre-lab to test if the solution is correct. Oral presentation is required and direct oral feedback/comments will be given to students on their work.

- **Quizzes**— The quizzes assess the students’ achievements at various stages during the course. It provides formative assessment on their learning progress.
The discussion forum, chat, and messaging are used for communications. Due to the limited time, it is not possible to completely implement flipped classroom in the course, we have succeeded reducing the lectures and increasing the student-centered activities. A formative course evaluation was done on the 3rd week. 71% of the respondents liked the flipped approach; they said that they learnt more, understood better. The course is not finished yet at the moment. More analysis will be done when the course is ended.

The implementation of flipped classroom model is a process that requires time and other resources. More work and analysis will be done during the process, and the result will be presented in later papers.