

Inverting a Computer Programming Class with the Flipped Classroom

Wichai Puarungroj

Loei Rajabhat University, Thailand

wichai@lru.ac.th

Abstract - The application of the Flipped Classroom as pedagogical model has been one of the new trends in undergraduate teaching in recent years. The flipped classroom allows students watch video lectures and read assigned materials before coming to class. Then during class time, students participate in various class activities provided by the instructors. Much research has reported success in implementing the Flipped Classroom. This study sought to find benefits and possibilities of applying this model to a computer programming class at Loei Rajabhat University. The observation had been made throughout the semester and near the end of the semester, student perception was collected and examined. The results reveal that the Flipped Classroom increases student engagement. The students were largely motivated to involve in various class activities, which could solve certain problems previously found in prior classes.

Keywords - Flipped Classroom, Inverted Classroom, Computer Programming, Student Engagement

I. INTRODUCTION

Teaching undergraduate students is becoming harder than ever. The traditional lecture, which is a teacher-centered style, may not suit current studying practices. Goodwin and Miller [3] argued that although a traditional lecture has shown a good proof of its effectiveness, there are still some problems reported. For example, a problem of pacing where students feel that the lectures deliver too slowly, or cover what they have already known. Some students may find it hard to

catch up with the lectures or lack prior knowledge to help them follow the contents of the lectures. The problems may go further when the students miss the class, but have to do homework assigned in class that is certainly beyond their capabilities [3].

Some students may get frustrated from not being able to follow the lectures, thus lacking enthusiasm to concentrate and killing their class time by doing anything else in class, such as chatting on mobile phone, or updating Facebook [11]. Similar problems occurred when the author taught several undergraduate courses in computer science at Loei Rajabhat University. The author had made many attempts to improve teaching before coming across the Flipped Classroom model. The Flipped Classroom appeared to have the potential of solving current problems as stated due to its student participation concept.

This paper reports the results of the attempt to implement the Flipped Classroom for the computer programming class in the winter semester (between August and December 2014). The purpose of this study was to investigate the perception of students towards the Flipped Classroom and to find the possible practices for implementing it.

II. LITERATURE REVIEW

To flip or invert the classroom, Lage and Platt [7] suggest that “lectures take place outside of class and class time is devoted to group and individual problem solving, discussion, and experiments”. This means that any events that traditionally exist inside the classroom will be completed outside the classroom [8, 14]. To do this, students have to

prepare independently before class in their own time by means of various methods, such as watching video lectures, reading online books, viewing teaching slides, listening to screencast, or learning from other online materials. This can improve students' self-learner skill [10], which is important for present-day study. In this situation, students may communicate with friends whilst studying by themselves, in order to share their understanding. When students come to class, they are expected to have basic knowledge to work on class activities. In class, instead of listening to the lectures, students are required to complete tasks assigned by the instructor. One of the key benefits of preparing at home is that students can save their valuable class time for reinforcing content learned and clarifying any struggle they have [2].

Herreid and Schiller [5] and Mok [11] summarize a few key points of the Flipped Classroom that differentiate it from the Traditional Classroom as follows: 1) students can work on their own pace; 2) anything used to be carried out outside classroom such as homework, is now accomplished in class; 3) the instructors can adjust their pedagogy more flexibly; 4) students no longer listen to lectures in class; 5) class time is devoted to effective learning tasks; and 6) the Flipped Classroom depends largely on modern online technology. Students in a Flipped Classroom practice differently from those in a Traditional Classroom as depicted in Fig. 1.

	Pre-Class	In Class	Post-Class
Traditional Classroom		Attending Lectures	Doing Homework
Flipped Classroom	Learning from Video Lectures Or Other Materials	Involving in Class Activities	

Fig 1. A Comparison between the Traditional Classroom and the Flipped Classroom

Many studies have been carried out recently regarding how to implement the Flipped Classroom to various university courses. Marwedel and Engel [9] who embarked on

employing the Flipped Classroom for the cyber-physical system course at TU Dortmund University in 2013, report that they were successfully implement it where students praised this style of teaching. Apparently, students were found not being able to fall asleep in class. Triantafyllou and Timcenko [13] who employed the Flipped Classroom in a statistics course, have found that student performance had improved and students were satisfied with the instructional videos since the students could use them at their own pace. Enfield [2] who implemented the Flipped Classroom for a web design course, informs that his students were confident with their ability to learn outside of the classroom and most of them were satisfied with the Flipped Classroom. After employing a Flipped Classroom for an engineering mathematics class, Gullayanon [4] reports some evidence of student improvement in terms of their performance. Most of them were found comfortable with the Flipped Classroom. Furthermore, Marwedel and Engel [9] mention that by using the Flipped Classroom, all of their textbooks in library were lent to students, which had never happened before.

III. IMPLEMENTATION

When the author decided to implement the Flipped Classroom during the winter semester of 2014 for a computer programming course at Loei Rajabhat University, the Flipped Classroom was not widely aware among scholars in the university. Several things had to be prepared before employing it in the classroom. For example, the Flipped Classroom needed the suitable tools for organizing online video lectures and other teaching supplements including in-class assignments. Some tools were suggested in the literatures mostly in forms of course management systems, such as Moodle [6], Blackboard [5], or etc.

For the reason of technical concerns and availability, the author chose Google Classroom as a tool for managing the whole course materials. After the tool was ready, three main materials were prepared including

instructional videos, online books, in-class activity assignments. To prepare the videos, Brunzell and Horejsi [1] and Herreid and Schiller [5] suggest that the instructors can either search for available sources of videos or create by themselves. In this case, the author chose to find public videos from Youtube because there were a lot of great video lectures available. Each video was carefully selected based on its content coverage with the approximate length of 10 to 15 minutes as suggested by [3, 12].

The online book, written by the author, was provided to students chapter by chapter. The reason why the book is delivered to the students as a proper bit at each time is that it will help students easily read and apprehend. Furthermore, the students are not overwhelmed by the whole book content. The in-class activities were developed in accordance with each chapter to allow students practice what they had learnt from outside classroom. Near the end of each class, the instructional videos and book chapters are posted in the system for next week preparation. The in-class activities appear in Google Classroom at the beginning of the class as shown in Fig. 2.

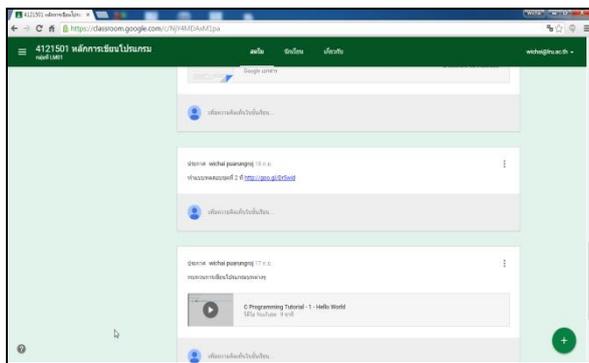


Fig 2. Google Classroom was Used to Organize Out-of-Class Materials and In-Class Activities

To implement the Flipped Classroom, a computer programming course which enrolled 32 freshmen in a winter semester (Between August and December 2014), was chosen to be part of this trial. The course comprised programming concepts and fundamentals of C programming. The course covered language structures, variable declaration, input and

output functions, decision making, loops, and functions. Every class took place in a computer laboratory where computers were provided to every student. At the beginning of the course, the author, as an instructor, explained students about the course syllabus and a teaching approach which involved the Flipped Classroom model. The students agreed with the concept and accepted to learn through technologies. In each class, the 10-minutes quiz took place before other activities in order to re-check whether student had prepared before coming to class. This helped encouraged students to prepare continually, and partially stimulate them to come to class on time.

After the quiz, the instructor started with a quick walk-through to the class content. Then, instructor told the students to complete tasks provided in Google Classroom. Students were allowed to work in pair or in a group not more than 3 people by choosing their partners of their choice. To make the course more flexible, the students may not stick to the same partners for the whole course, but may change to anyone that worked well with them. During each class activity, the instructor circulated around the room to see the progress of each group.

The instructor controlled the time slot of each activity. Once the time of each activity was out, the instructor provided possible solutions and asked students to go on the next activity. When the class was almost finished, the instructor described the outside classroom assignments for the next coming week. The students were asked to checkup the video lectures and other related materials provided in the system while the instructor was giving explanation about the materials for out-of-class preparation. Near the end of the semester, the students were asked to assess the Flipped Classroom employed in the course by using survey questionnaires. The questionnaire comprised 2 sections. The first section, which composed of five-point Likert scale questions ranging from 1 (strongly disagree) to 5 (strongly agree), investigated student perceptions in 4 issues including: 1) instructor-

student interaction; 2) student engagement; 3) self-paced learning; and 4) impact of social media. The second section was an open-ended question section that examined into perception and recommendation from the students towards the use of the Flipped Classroom.

IV. RESULTS

There were 32 students (the whole class) replied to the survey questionnaires. The questionnaire data were analyzed together with the in-class observation data. The findings can be organized in four issues as follows:

A. Instructor-Student Interaction

This investigated how well the instructor interacts with students in class. The instructor applied this strategy by circulating around the room to see the progress of each group activity. It provided opportunities for the instructor to both meet everyone in class and answer their questions. The instant feedbacks from the instructor in this way improved the interaction between the instructor and the students. In Table I, the result of the survey indicates that students were highly satisfied with the interaction with the instructor (Mean=4.22, SD=.706).

**TABLE I
A SURVEY QUESTION FOR INSTRUCTOR-STUDENT INTERACTION**

Survey Questions	Means	SD
I like the way the instructor walks around the room to give comment on everyone's work.	4.22	.706

B. Student Engagement

The student engagement refers the students' fascination or motivation towards teaching practices. Students can show their engagement both in and outside classroom activities through their willingness, interest, or passion to take part. In the Flipped Classroom, the student engagement can be examined using different pieces of evidence, for example, student motivation, in-class participation, and outside-class material engagement, and etc. In Table II, the first question asks how students thought about their engagement with the video

lectures and other out-of-class materials. The result shows that the response to this question is highly positive (Mean = 4.19, SD = .738). The second question asks how the students perceived whether they were more motivated with the Flipped Classroom than the Traditional Classroom. The student response for this question is high (Mean = 4.28, SD = .634). For the third question, the students accepted that in-class activities were useful for them (Mean = 4.38, SD = .609). For the last question, most students felt that the class was fun a lot with the Flipped Classroom (Mean = 4.16, SD = .723).

**TABLE II
SURVEY QUESTIONS FOR STUDENT ENGAGEMENT**

Survey Questions	Means	SD
I like to learn through technology especially video lectures, online books, and other online material outside of classroom.	4.19	.738
I am more motivated to learn in the Flipped Classroom than the Traditional Classroom	4.28	.634
Involving in classroom activities helps me learn faster.	4.38	.609
The Flipped Classroom makes the class a lot more fun.	4.16	.723

C. Self-Paced Learning

Self-Paced Learning means that students can use or learn from instructional videos or other materials on their favorite speed and time. Students can also repeat those learning as frequent as they require. For example, the students may watch videos more than once on their own time or move them forwards or backwards as needed. These activities are done without pressure. Furthermore, the students can have different choices of materials for them to choose from. In Table III, the students were mostly satisfied with learning on their own paces by using online materials (Mean = 4.28, SD = .683) and having multiple choices of materials to serve their demands for outside class preparation (Mean = 4.31, SD = .592).

**TABLE III
SURVEY QUESTIONS FOR SELF-PACED
LEARNING**

Survey Questions	Means	SD
I like the way I can view the videos or move forwards or move backward as needed.	4.28	.683
I like that the course provides me with various materials for each chapter.	4.31	.592

D. Impact of Social Media

This issue examined whether the social media have an effect on the Flipped Classroom. In Table IV, the question examines the status of student in-class behaviors towards the use of online chatting and internet surfing that was outside the scope of the study. Interestingly, some students admitted that both online chatting and internet surfing for anything irrelevant were still existed in class (Mean = 3.38, SD = .793).

**TABLE IV
SURVEY QUESTIONS FOR OTHER TOPICS**

Survey Questions	Means	SD
In class, I reduce my online chatting and internet surfing for anything irrelevant.	3.38	.793

V. DISCUSSION

Results of the study draw out the benefits of the Flipped Classroom implementation. The students apparently concentrated on the subject being study. Most of them felt that they improved their relationship with the instructor and had less pressure to ask questions in class. One of the students commented that “My skill improves by learning in this way. When I get struggle with the project in class, I can instantly ask the instructor.” With regard to the student engagement issue, the students perceived motivation and enjoyment with the Flipped Classroom. One student suggests that “While practicing in class, the study is not boring anymore”.

With the self-paced learning issue, students worked fine on the outside-class assignments with their own speed and time. The evidence suggests that some students still had questions although they had spent time with the video

lectures and online books. The Flipped Classroom allows students to get further clarification of their existing questions in class. One student gave a comment that “when I get confused at home, I can bring it to the class and find a good explanation for it”. Regarding the issue of impact of social media, some students insisted that they still addicted to the internet by updating Facebook or chatting online in class even though the instructor told them not to do so. One of the students asserted that “I should reduce my time spent on Facebook. Most of my friends also use Facebook in class. This can surely affect our study results.”

Although the Flipped Classroom embraces a student-centered learning approach where the teaching focus is shifted from teachers to students, previous research has reported a problem of student resistance, which occurs when students come to class unprepared [5, 13]. To deal with this problem, this research applied 2 strategies. Firstly, students have to take a short quiz at the beginning of the class and secondly, a brief summary is provided to students before running class activities. To implement the Flipped Classroom for the computer programming course, the research conducted different strategies as summarized in Table V.

**TABLE V
STRATEGIES USED FOR PREPARING AND
IMPLEMENTING THE FLIPPED CLASSROOM**

Strategies
<p>System Preparation A course management system, such as Google Classroom has been prepared. It is used for organizing video lectures, online books, slides, in-class activities, assignments, quizzes and etc.</p>
<p>Material Preparation Video lectures (about 10-15 minutes in length), and other out-of-class materials e.g. online books, text books, slides, and etc. were prepared.</p>
<p>In-class Strategies 1) A short quiz is taken at the early of the class to assess students’ out-of-class preparation 2) A quick walk-through to the contents may be given before running the in-class activities. It depends on the decision of the instructor whether or not to give a brief review of out-of-class materials. 3) In-class activities are facilitated by the instructor who circulates around the room in order to give instant feedbacks to students and see their progress. 4) Students work in pair or group not more than 3 for completing in-class activities. 5) Out-of-class materials for the next coming week are provided in Google Classroom. The instructor describes about those materials before finishing the class</p>

VI. CONCLUSIONS

It is apparent that the students in the Flipped Classroom were largely motivated to involve in various activities both in and outside classroom. The results of this study suggest that teaching organized in this style can improve student-instructor interaction, student engagement, and self-paced learning. Some students in the class under study, who were previously found lack concentration in traditional classes, improved significantly in their class involvement. While being busy with in-class activities, the students were found still spending much time on Facebook or chatting applications for something not related to the study. This implies that the Flipped Classroom may not help improve students who addict to social networks.

The results of observation show that some teaching problems found in other courses have been resolved. Firstly, a problem of student boredom in class was decreased since everyone had to pay attention to class activities. Secondly, a problem of homework copying and negligence had clearly disappeared. Finally, a situation that “teachers have forever struggled to get students to study on their own, either ahead of time or as homework” [5] had been improved. Although most of students conform well to the Flipped Classroom, there is still a difficulty dealing with students who come to class without preparation [13]. In this case, the instructor may begin the class with a quick introduction to the out-of-class contents in order to supply students with some basic knowledge. The last issue that should be mentioned here is that teaching in this style can be very exhaustive and time consuming. The instructor has to pay attention to everyone both in and outside classroom through the online system and also spend much energy running class activities, giving instant feedbacks, and circulating around the class to interact with students. Furthermore, the instructor may have to spend much time preparing a lot of teaching materials and class activity assignments. In summary, the Flipped Classroom has its strengths for present-day teaching that

requires student engagement. To implement it, the instructors can freely adapt it to meet the needs of their students and the availability of technologies.

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