Flipped Classroom in Hong Kong Higher Education: An Experience Sharing

Ho-Yin Cheung, University of Bristol, UK
Gary Ka-Wai Wong, the Hong Kong Institute of Education, Hong Kong

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Abstract
Flipped Classroom is a pedagogy in which direct instructions in class are flipped with practices and revisions at home. Students watch video lectures or complete other pre-class preparations before the taught sessions, while the face-to-face contact hours are left to active learning activities. This pedagogy, theoretically supported by the constructivism learning theory and practically inspired by the newly arising paradigm of distance learning demonstrated through Massive Open Online Courses (MOOCs), has drawn attention from teachers from various educational sectors all over the world. This paper presents our experience piloting a flipped classroom in an undergraduate course in Hong Kong. A 5-week course in the summer semester is selected for the study, in which students are asked to watch about half an hour's length of video lectures per week, while face-to-face instruction is replaced by group discussions, lab exercises, and presentations during lesson time. This paper will highlight the theoretical considerations in pedagogical design and the practical issues filming the video lectures and conducting in-class activities. In addition, quantitative and qualitative data are collected through questionnaire, class observations and focus group interviews to study the response of the students and the effects of flipped classroom on their learning. Implications of the results are discussed and suggestions for further investigations are made.

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Introduction

Flipped classroom is a pedagogy in which didactic instruction in class is flipped with homework at home. Such pedagogy is drawing a lot of attention in recent years from both academic researchers and practitioners.

In a recent seminar on flipped classroom delivered by one of the authors in his institution, teachers from local schools showed a lot of interest in the idea of flipped classroom. They also seemed to believe, at least intuitively, that flipped classroom could enhance the teaching and learning effectiveness in their classroom due to the increased interaction time in class. However, many also reflected a lack of experience and technical skills adopting this pedagogy. Their concerns ranged from the time and effort required for producing the video lectures to the tactics of conducting in-class activities.

This paper addresses some of these concerns by sharing the authors' experience in a pilot trial of flipped classroom in the local tertiary education context. There are four focuses in this paper. First, the theoretical consideration behind the pedagogical design is presented. Second, the practical steps of preparation and delivery of the course is outlined in five main steps. Third, research data collected throughout the trial are presented to show the effects of the flipped classroom on students' learning. Forth, suggestions are made for further implementation and research.

Context

A university level course in one of the authors' institution is chosen for the trial. The course, titled "Mathematical Exploration with Technology", is tailored for pre-service teachers who are going to pursue their teaching career in primary mathematics. The course covers the use of Microsoft Excel VBA and GeoGebra in primary mathematics education. There are three intended course learning outcomes (CILOs) specified in the course syllabus:

- CILO1: Evaluate the impact of technology on the teaching and learning of mathematics;
- CILO2: Use technology to enhance teaching;
- CILO3: Adapt mathematical software packages appropriately in their classrooms and in carrying out mathematical explorations;

The traditional way of teaching this course in the past was for the instructor to give didactic instructions on the use of the software packages, after which the students were allowed some time, usually not exceeding one-third of the total contact time of the lesson (i.e. one out of three hours per week), to work on worksheet problems using the software. The students then took time at home to complete a final assessment paper by the end of the semester. It is apparent that most emphasis of the face-to-face lesson had been on the technical skills to achieve CILO2, while students were required to work mostly on their own on the assessment to show that they had achieved CILO1 and CILO3.

Pedagogical Design Considerations

Flipped classroom provides a way rearrange the teaching and learning components for a more even distribution among the CILOs. The key decision to make is what to include in the video lectures and face-to-face teaching sessions respectively. Two

factors are considered in this study: the cognitive processes involved in the CILOs, and the level of interaction required for effective teaching and learning.

For the first consideration, didactic instructions are effective to teach students to remember facts or understand simple concepts, while active learning, defined as peer-assisted and problem-based learning activities (Bishop & Verleger, 2013), is shown to benefit the higher level cognitive processes (Hamdan, McKnight, McKnight, & Arfstrom, 2013; Redekopp & Ragusa, 2013). The CILOs of the course concerned obviously involve relatively high levels of cognitive processes, which should be taught via active learning activities. On the other hand, the factual and conceptual contents, which lay the foundation for students to perform these active learning activities, are delivered using didactic lectures.

Didactic lectures are mostly taught using video lectures in the flipped classroom. Recent development of Massive Online Open Courses (MOOCs) has nurtured the advancements of video lectures technology for asynchronous online learning, making it easier for teachers to film and upload video lectures for students to view before lessons. These video lectures reserve class contact time for active learning (See & Conry, 2014), which is the main purpose of flipping the classroom. Nevertheless, didactic lectures still have a place in face-to-face sessions based on our second consideration – the level of interaction required for effective teaching and learning. Obviously, the teacher cannot get instant verbal or non-verbal feedbacks from the students while filming the videos. These feedbacks are important for the teacher to assess the progress of the students and adjust their teaching on the go. Therefore, in designing the pedagogy in the present study, video lectures were used only if the didactic instructions could be effectively delivered without interaction with the teachers. Otherwise, face-to-face mini-lectures were used between sessions of active learning activities in class.

Practical Advices on Course Preparation and Delivery

Based on these principles and the teaching experience of the authors, the following five-step process was used in the study for course preparation and delivery.

Step 1: Determining the Lesson Intended Learning Outcomes (LILOs)

Although the course intended learning outcomes were already laid out in the syllabus, it is still necessary to write down a more detailed list of the lesson intended learning outcomes (LILOs), the learning outcomes to be achieved in each lesson. As in any learning outcome statements, these LILOs should be written in specific terms. For example, instead of "Introduction to MS Excel VBA", "Operate the interface of the MS Excel VBA" should be written so that when designing the teaching methods in the next steps, the teacher would know clearly what are to be achieved in that lesson.

Step 2: Deciding the teaching approaches to achieve these learning objectives for each lesson.

Next, the teacher should determine the teaching methods based on the principles presented in the previous section. A few advices are given below.

First, although the use of video lecture is common in flipped classrooms, some authors suggest that video lecture is not a necessity for the flipped classroom (Herreid & Schiller, 2013; See & Conry, 2014). From the constructive alignment's point of

view, any teaching method (e.g. pre-lesson tasks, pre-reading, etc.) that can effectively facilitate the achievement of CILOs should also be considered.

Second, video lectures, if they are to be used, should be broken down into small segments, each covering specifically a well-defined topic. There is no unique standard for the optimal length of each clip, but some studies suggest that the clips should be kept under 10 minutes each (Chen, Wang, & Chen, 2014; Neary & Vaughn, 2013) while the total length of the lecture should not exceed half an hour (Redekopp & Ragusa, 2013; Zappe, Leicht, Messner, Litzinger, & Lee, 2009).

Third, and in relation to the second point, it is imperative to recognize that direct instruction time can be greatly reduced in the video lectures. This is because in the traditional lectures, much of the time is used in repeating instructions in a hope that all students could keep up and achieve higher-level learning outcomes. When video lectures are used, students who cannot follow can simply pause or repeat the clip, while higher-level learning outcomes are to be achieved in the face-to-face sessions rather than in the video lectures. From the experience of the present study, direct instruction time could be reduced from 2 hours per week in the past to around half an hour per week in the flipped classroom pedagogy. As a consequence, the in-class activities should also be thought or rethought from the bottom up to make use of the extra time available.

Step 3: Preparing for video lectures and in-class activities

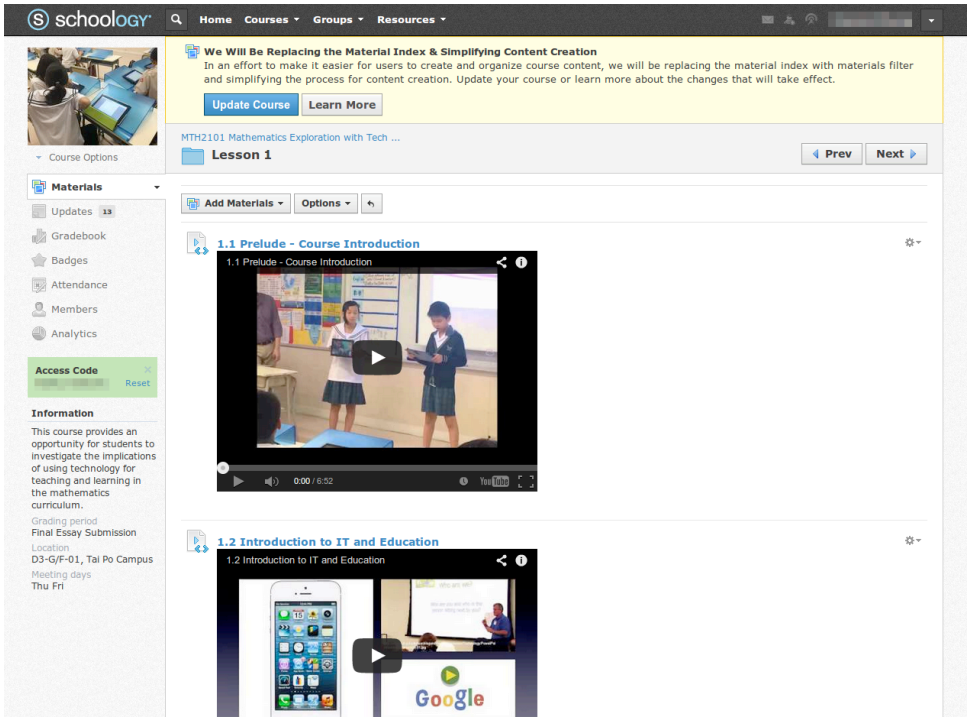
Video lecture preparation is a highly technical process. While it is beyond the scope of this paper to put down every detailed step, this subsection outlines the software tools used in the present study process and gives a few advices based on experience.

The filming of video lectures has a steep learning curve for beginning flippers. Unless one is already familiar with filming and video editing, it could take a huge amount of time to film the first videos. As an example, it took nearly three hours for the authors to film the first video clip in this study, which was only 7 minutes long. Therefore, beginning flippers should look for existing videos first to fulfill their purpose before filming, or to avoid using video lectures altogether.

Several types of video lectures have been used in this course, namely, talking head video, slide narration, and screencast. Talking head video features the teacher talking in front of the camcorder (a webcam in the present case). Slide narration could be easily done using the built-in functions of Microsoft PowerPoint or Apple Keynote. Screencast is used to demonstrate how to operate the software packages. Once the videos are filmed, a video editor is used for the post-processing to remove unwanted video segments, add special effects, glue different segments together, etc.

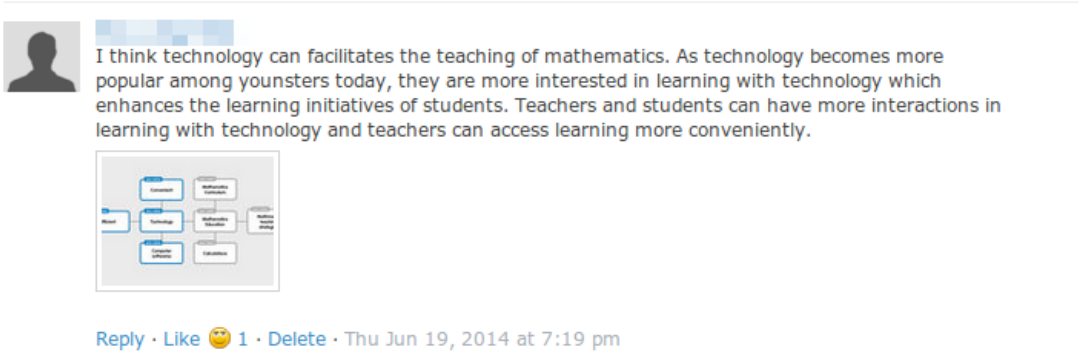
The completed video lectures are uploaded to YouTube and then the embed code is added to Schoology, a course management system similar to Moodle and Edmodo, so that students could access the videos via the course website. YouTube is chosen because it has better streaming support for mobile devices. A screenshot of Schoology showing the embedded video lectures is given in Figure 1.

Figure 1: Screenshot of Schoology Page showing the Embedded YouTube Videos for Lesson 1



Preparation for in-class activities is less technical. Once the activities are planned in Step 2, they are usually ready to be delivered during class time. Nevertheless, research suggests that students are benefited by technology even in the in-class activities (Kong, 2014). As an example, Socrative is used in the present study to collect instant feedback from the students. This tool allows the teacher to set a simple multiple-choice question and project it to the screen. The students could then log in to the web-based Socrative interface using the lab computer or their own mobile devices to submit an answer to the questions. Open-ended questions can be done via starting an online discussion in Schoology. Before the first lesson in the present study, the students were asked to join an online discussion about the relation between technology and mathematics education. They were required to use another online tool named Popplet to present and upload their answers as a mind map with their own descriptions. When the students met up in the face-to-face session, they worked in groups to compare the mind maps created by individual group members. Each group then presented their mind maps to the rest of the class. The teacher then started a follow-up face-to-face discussion on the submissions and presentations. An example of a student submission is shown below in Figure 2.

Figure 2: Example Student Submission for Follow-up In-Class Discussion



Another example was to use Google Form to collect peer feedback after students gave a presentation to the rest of the class. The audiences were required to submit their general comments for their peers. The anonymous comments were collected instantly by the teacher and then returned to the students by the end of the lesson. In this way the students were able to learn from their peers, an example of peer-assisted learning. A summary of the software tools used for video lectures and in-class activities is given in Table 1.

Table 1: Software Tools for Video Lecture Preparation

	MS Windows	Mac OS X	Web-based
Slide narration	MS PowerPoint	MS PowerPoint for Mac / Apple Keynote	
Screencast	Open Broadcaster Software (OBS)	Apple Quicktime	
Video editing	MS Movie Maker	Apple iMovie	
Hosting course materials online			Schoology (also for online discussion) YouTube
Other tools used			Socrative (for online polling) Popplet (for mind map creation) Google Form (for collecting anonymous feedbacks from students)

Step 4: Delivering the face-to-face session

A variety of activities were arranged in the class time: mini-lectures, lab exercises, lab exercises, group discussions, and presentations. Not every lesson had the same pattern of time usage, but most followed the pattern that active learning activities occupied most of the time, while mini-lectures were still required for various purposes. The time usage for Lesson 4 is tabulated below in Table 2 as an illustration. Lesson 4 was the last lesson on MS Excel and students were about to present a "product" to show how they used MS Excel to teach mathematics. As shown in the table, the total time

for didactic instruction in that lesson was 33 minutes, while the total time for active learning activities including lab exercise and presentation was 127 minutes. The total lesson time was 160 minutes.

Table 2: Time Usage in Lesson 4 as an Example Illustration

Time	Activities	Duration
18:40	Lesson started.	
18:40-18:59	**Mini-lecture:** The teacher recapped some of the key concepts and difficulties in the last lesson.	19 mins
18:59-19:15	**Lab exercise:** The students worked on an ad hoc exercise problem designed to help them tackle some of the difficulties encountered the last lesson.	16 mins
19:15-20:45	**Lab exercise:** While some of the students were still working on the ad hoc exercise, the teacher delivered the instruction sheet for the lab exercises of that day. Students gradually moved forward to work on the lab exercises.	90 mins
20:45-21:06	**Presentation:** The students took turn to present their products of the lab exercise for that day.	21 mins
21:06-21:20	**Mini-lecture:** The teacher wrapped up the day and gave overall comments on the presentation.	14 mins
21:20	Lesson ended.	

Step 5: Evaluation and reflection

In the present study, one of the authors worked as teacher and the other as the observer sitting at the back of the room during the lessons. As the lesson proceeded, the observer took field notes with time stamps marking what was happening. He also put down personal opinions beside his observation. After the end of the lesson, the observer wrapped up the field notes to the teacher and conducted a reflection together suggesting ways of improvement. The authors consider this a good practice because for any innovation being tested out, it is important for the different participants to exchange their observations and ideas and look for improvements together.

Evaluation and Key Findings

Preliminary results of the implementation are reflected from the research data collected in the study via class observations, interviews, and questionnaires. First of all, students' ratings in the questionnaires show that they overall welcome the flip initiative. Open-ended questions also show that some students did recognize the benefits of the flipped classroom especially that of active learning. Observation shows that students were very deeply engaged in the lab exercises. The preliminary data therefore conclude that the flipped classroom has received some initial success.

What the authors are more interested in are the less positive comments collected, which are important for any improvement for future implementations. One major concern identified was that most students were unable to finish watching the video lectures before the lesson. The major reason seemed to be the lack of time and motivation. Many students expressed that they were short of time and energy to watch the videos as they had full-time jobs during the day. They also expected more help from video lectures on how to complete the lab exercises, while the authors had intentionally chosen the opposite direction so that students could explore more on

their own. Students finding the video lectures unhelpful and the lab exercise problems too difficult therefore had less motivation to watch the video lectures. This also led to a ripple effect on the in-class activities.

Conclusions

One of the major promises of flipped classroom is the increased opportunities for active learning activities. Despite some signs of initial success in the present study, the relatively low completion rate of pre-class prepartion deserves some serious attention. It is important for the students to take more ownership of their learning, while teachers should put more emphasis in providing individual help to the students during the in-class activities. These would help to bridge the gap between the two sides and lead to more effective teaching and learning under the new pedagogy.

It is hoped that the experience and practical advices in this paper could help beginning flippers get started with their own journey. It must however be noted that due to the small sample size of data collection, the conclusions in this paper are considered preliminary and further research studies are required to confirm the findings.

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