Introducing MOOC, Flipped Classroom and Rain Class into General Physics

Min Huang

ABSTRACT

Under recent trend of “Internet+”, intelligent online classroom platforms like MOOC, SPOC, and Flipped Classroom have permeated the education industry. Zhejiang University City College reorganized students’ learning experience in the public fundamental course of General Physics by introducing a platform shared by higher education institutions across Zhejiang Province called “SPOC + Flipped Classroom”, which combined both online and in-classroom learning. Following the trend of mobile network and adapting to student behavior in the Internet age, the author introduced a We-Chat based intelligent online education software called “Rain Classroom” to achieve real-time problem solving, multi-screen interaction, and screen overlay interactive subtitles and student data analysis. These tools improved student participation and brought better learning experience of General Physics.¹

KEYWORDS

MOOC, SPOC, Rain Classroom, Flipped Classroom.

INTRODUCTION

Data from CNNIC revealed that by the end of 2014, there were 649 million Internet users in China, among which 557 million have access to cellular Internet [1]. This presented educators a new classroom environment with unique challenges.

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Internet is so accessible that students often tend to search or discuss online whenever they encountered something hard to understand, instead of consulting their instructors. This combined with the fact that most materials covered in classroom are also easily available online lead to a weird scenario that students are paying less attention to the instructor in class while being more involved with their cell phones. This made it hard for instructor and students to effectively communicate with each other as fewer and fewer students were responding to their instructors, and instructors couldn’t get effective feedback from the students.

General Physics is a major public fundamental course aimed at STEM students in many universities. It followed the development of physics and introduced basic physical terms and laws to the students, as well as the developments of modern physics and scientific approaches. The current one-way lecturing process from instructors to students were found in many universities, under which the focus of instructors was predominantly “what to teach” and “how to teach”, while the only available feedback channels from students were a few questions raised by the students in class together with checking students’ homework. These channels were untimely and insufficient. Also, instructors needed to cover obscure notions and examples in a 45-minute class, which was often not enough time for students to follow and absorb.

The arrival of the era of Massive Online Open Courses (MOOC) provided huge impact to traditional classrooms of General Physics. Against the backdrop of “Internet+ Education”, it’s worthwhile to investigate how to introduce new resources and education models like MOOC, Flipped Classroom, SPOC (Small Online Private Course), Rain Classroom into traditional classrooms of General Physics, breaking up boundaries of time and space to create a student-centered interactive education experience.

RESEARCH CONTENT AND DISCUSSION

General Physics Education Based on “MOOC+SPOC”

Massive Open Online Course is an online course aimed at unlimited participation and open access via the web. As a localized version of that, University of California Berkeley Professor Armando Fox introduced the term Small Online Private Course. "SPOCs may provide what MOOCs can’t" that’s aimed at qualified students of a handful dozens from a particular affiliation [2].

In early 2016, Zhejiang University City College launched its General Physics online course on a government platform(http://zjedu.moocollege.com). The course includes: Summary, Study Goals, Prerequisite, Syllabus, Score Breakup, Course Materials and Schedules. After three semesters, thousands of students from Zhejiang University City College, Ningbo Institute of Technology, and Zhejiang Shuren University participated in General Physics in a “MOOC+SPOC” manner.
We uploaded video clips, text files and exercise materials onto the online course platform. After the online course became available, students can go over those materials at their own pace. At the same time, students meet up with their instructors for three times every two weeks, study activities were organized to help students absorb what they learned online. From time to time, discussion sessions were held so that students’ questions may be answered.

Reorganizing Current General Physics Classroom with “SPOC+Flipped Classroom” Hybrid Education Mode

Contrary to traditional education where instructors lectured in class and assigned homework for students after class to help them absorb knowledge, Flipped Classroom required students to conduct self-learning at home using digital materials (video, interactive software, etc.) prepared by instructors, then attend classrooms where students and instructors would interact and finish exercises together. Flipped Classroom revolutionized students’ learning process. Students actively participate in the learning process at home while instructors provided video clips and sometimes individual video assistance. In-class interactions provided efficient feedback to instructors together with effective and individual assistance to students. At the same time, discussions between fellow students provided both motivation and guidance as they absorb the course materials.

The hybrid “SPOC+Flipped Classroom” education process used in General Physics include four stages: knowledge preparation, knowledge deliverance before class, knowledge absorption in class, and evaluation after class [3]. The first is about instructors preparing video clips, course materials and exercises, the second is about students learning by themselves using those resources, the third is about instructors holding classroom activities and providing individual assistance to students, while students absorb knowledge through in-class discussions and exercises. The last is about instructors using data from online platform and feedback to evaluate the teaching process, while students got feedback from homework and quizzes.

It can be observed that the hybrid “SPOC+Flipped Classroom” education process reorganized both teaching and learning experience, as “teach-and-study” transformed into “study-and-teach”. During limited class hours, students are able to participate in problem-based study in a cooperative manner with other students, and thus better absorb course materials. Instructors would no longer be required go through course materials as they were introduced to students before the class in the form of video clips, reading materials and exercises. Students were also able to discuss in online forums with other students while managing their own pace of study.

In such education process, the role of instructors and students were fundamentally revolutionized. Instructors are organizers of classroom sessions and assistants in students’ learning process, while students were no longer passive recipients of knowledge, rather active pursuant of course materials. Classrooms were
no longer confined to instructors going through course materials, but dynamic
interactions among fellow students, instructors, course materials, and media. Class
sessions were lively as both instructors and students have lived access to feedback
and evaluation.

**Introducing Intelligent Platform “Rain Classroom” and Creating Interactive
and Effective General Physics Classes**

Traditionally, General Physics lectures were held in lecture halls of about 100
seats, where information predominantly flew in one direction from instructor to
students. So sometimes, an instructor may have professionally covered course
materials, while key information didn’t get conveyed to and perceived by students.
Experienced instructors might be able to obtain feedback by raising questions or
watching facial expressions from students, but these channels were limited and often
did not provide enough feedback from students. Apart from this, in traditional
General Physics classes, instructors need to cover course materials in a speed
uniform to all students, while different students may have different paces for
apprehension. Students used to similar speeds as the instructor may highly
appreciate the lecture, but students with faster perception speeds may feel the lecture
was boring and stopped paying attention, while students with slower perception may
find the lecture challenging and hard to keep up. It’s hard to adjust lecture pace to
satisfy all the students.

The widespread application of Internet in the education field sprout various
education software, one of which is Rain Classroom, which is developed by Online
Education Office of Tsinghua University. Aimed at serving every part of
“before/in/after class”, Rain Classroom implanted PowerPoint and We-chat with
advanced information technology and brought online education and real-world
classrooms together in the following ways:

With Rain Classroom, instructors can push a PPT file to students’ cell phones,
which include MOOC video, lectures recorded by instructors and problem sets.
Thus, students may preview that PPT file and come to class prepared. More
importantly, before class, instructors may know how the students feel towards that
particular class and prepare accordingly.

Rain Classroom platform may assist instructors in class in two ways: First, PPT
files were pushed onto students’ cell phone in real time. Students may click “I don’t
get it” whenever they feel puzzled by a particular part in the PPT file, and this
information is relayed in real time to instructors. Second, instructors can push
quizzes to students and require students to answer within a limited time. A student
may compare his or her quiz performance against classmates in real time while
instructors have real time and accurate response of how students are learning at that
particular moment.

Rain Classroom is easy to use as it only requires basic familiarity PowerPoint
and We-chat.
Starting 2016, all General Physics courses in Zhejiang University City College were integrated with Rain Classroom. Using We-chat services, Rain Classroom realized material pushing before class, multi-screen real-time interaction and student data analysis. This is especially useful as after recent revision of Zhejiang High School Curriculum revision, where students with different backgrounds in physics were studying the same General Physics course together. Before Rain Classroom, instructors often tend more to the students with weaker physics background while stalling those with better. With Rain Classroom, we could assign materials covering basic physics to those with weaker background and improve classroom efficiency. In conclusion, Rain Classroom serves as a bridge connecting students and instructors while improving interaction in between and facilitating classroom renovation.

Design and Implementation of Flipped Classroom

General Physics course in Zhejiang University City College realized Flipped Classroom under a government platform (http://zjedu.moocollege.com), where the entire syllabus and course schedule were made online. Of the 96 total course hours, 80 of which were conducted in a Flipped Classroom manner, which included video clips, course materials and PowerPoint, preview exercises, in-class exercises, in-class discussions, after-class exercises and homework, unit quizzes and so on, providing all-around guidance towards students. More than 600 students from 2016-2018 class computer majors participated in the course and were divided into classes of roughly 70 students each. Each class was further divided into 7 groups and a leader in each group was selected to oversee study activities in his or her group. Instructors would coordinate study activities across different groups and provide individual guidance. Computer rooms on campus provided hardware support for such education process. A detailed example of chapter 5.2 is as follows:

The Flipped Classroom experiment with General Physics made bold endeavor in exploring the role of instructors and the organization of classes. Unlike traditional classroom, we encourage the students to learn first and instructors would conclude later. We encourage students to cooperate with each other rather than study on their own. We promote the evolution from fragmented study to target study. We shift the role of instructors from lecturers to organizers. We allow mutual review between instructors and students to promote interaction and feedback.

<table>
<thead>
<tr>
<th>Task</th>
<th>Details</th>
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<tbody>
<tr>
<td><strong>Name of Course</strong></td>
<td>General Physics II</td>
</tr>
<tr>
<td><strong>Chapter Name</strong></td>
<td>Chapter 5.2 Biot-Savart Law and Its Application</td>
</tr>
<tr>
<td><strong>Education Goals</strong></td>
<td>1. Understanding the key notion of Biot-Savart Law—Current element</td>
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<td></td>
<td>2. Understanding Laplace Expression in Biot-Savart Law</td>
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<td></td>
<td>3. Understanding how Biot-Savart Law was conceived by comparing</td>
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<td></td>
<td>Current element’s magnetic field and Point Charge’s electric field.</td>
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<td></td>
<td>4. Using Biot-Savart Law to solve for magnetic fields around a straight</td>
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<td>current</td>
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5. Using Biot-Savart Law to solve for magnetic fields along central axis of a conducting coil.

### Before-Class Checklist

<table>
<thead>
<tr>
<th>Session</th>
<th>Details</th>
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<tbody>
<tr>
<td>1. Go through course files 1 to 3, sample problems 1 to 3, finish pre-class exercise 5.2</td>
<td></td>
</tr>
<tr>
<td>2. Watching videos 1 to 4.</td>
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<tr>
<td>3. Finish discussion questions 1 and 2 by replying in online forum and prepare for in-class demonstration between groups.</td>
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### Course Materials

<table>
<thead>
<tr>
<th>Session</th>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before Class</strong></td>
<td>Video 1 + File 1</td>
<td>5_1.mp4 + 5_1.pptx Biot-Savart Law</td>
</tr>
<tr>
<td></td>
<td>Video 2 + File 2</td>
<td>5_2.mp4 + 5_2.pptx Comparison Between Unit Current’s magnetic field and Point Charge’s electric field.</td>
</tr>
<tr>
<td></td>
<td>File 3</td>
<td>5_3.pptx Using Biot-Savart Law to Solve for Magnetic Fields</td>
</tr>
<tr>
<td></td>
<td>Video 3 + Problem 1</td>
<td>5_3.mp4 + 5_4.pptx magnetic fields around a straight current</td>
</tr>
<tr>
<td></td>
<td>Video 4 + Problem 2</td>
<td>5_4.mp4 + 5_5.pptx magnetic fields along central axis of a conducting coil.</td>
</tr>
<tr>
<td></td>
<td>Problem 3</td>
<td>5_6.pptx</td>
</tr>
<tr>
<td></td>
<td>Pre-class Exercise</td>
<td>Pre-class Exercise 5.2 (Online Platform)</td>
</tr>
<tr>
<td></td>
<td>Discussion Question 1</td>
<td>Comparison between Electric Field Lines and Magnetic Field Lines</td>
</tr>
<tr>
<td></td>
<td>Discussion Question 2</td>
<td>Comparison between Biot-Savart Law and Ampere’s Law in Solving Magnetic Fields</td>
</tr>
<tr>
<td><strong>In Class</strong></td>
<td>Lecture</td>
<td>Summary of Chapter</td>
</tr>
<tr>
<td></td>
<td>Discussion 1</td>
<td>Similarities and Differences Between Current element’s magnetic field and Point Charge’s electric field formula.</td>
</tr>
<tr>
<td></td>
<td>Discussion 2</td>
<td>Conclusion about Solving Magnetic Field with Biot-Savart Law: Process and Limitations</td>
</tr>
<tr>
<td></td>
<td>In Class Exercise 1</td>
<td>5_7.pptx</td>
</tr>
<tr>
<td></td>
<td>In Class Exercise 2</td>
<td>5_7.pptx</td>
</tr>
<tr>
<td><strong>After Class</strong></td>
<td>Quiz</td>
<td>5_7.pptx</td>
</tr>
</tbody>
</table>

### Extension Problem

The figure above describes a cloud room; the solid line is a trajectory of a charged particle traveling through the cloud room with magnetic field point inwards. A Plumbum plaque is placed in the middle horizontally.

1. The charged particle would loss kinetic energy passing through the Plumbum plaque. What direction is it travelling?
2. That particle carries positive or negative charge?

In 1932, American Physics C.D.Anderson discovered positive electron using this method and was awarded Noble Physics Prize of 1936.

### After Class Problems

Problem Set 5.2
CONCLUSIONS

Against the backdrop of “Internet+”, we adjust to the learning habits of students under the Internet age and introduced noted Internet+Education tools like MOOC, Flipped Classroom, SPOC and Rain Classroom and reorganized design of General Physics course. We created a corresponding education process and practiced it with students from Zhejiang University City College. With careful course design, we changed the classroom experience of General Physics from “lecture only” to the hybrid “SPOC+Flipped Classroom” education mode while shifting focus from instructors “lecturing” to students “learning”. We grant students the freedom to study by themselves and value their classroom interaction by providing individual assistance through Internet. We improved student participation in the process and the quality of overall education.

REFERENCES