FLIPPED MATHEMATICS CLASSROOM

Raeann Kyriakou, Ph.D.
Department of Mathematics and Computer Science
St. John's University
Jamaica, NY USA
kyriakor@stjohns.edu
raeannkyriakou@gmail.com

Abstract

The flipped classroom model has become a popular technique for classroom instruction, but is it an effective strategy? This study will discuss the strategies and tools used to implement the flipped classroom and the results of a study on flipped vs non flipped classrooms in business calculus courses.

Introduction

The purpose of this study is to (1) determine tools and strategies to make videos and implement the videos in a calculus course and (2) compare the grades of students enrolled in a traditional calculus class vs flipped calculus classes to determine if the flipped classroom is more effective than the traditional classroom in terms of grades. The instructor is the same for all three classes and is the author of this paper.

Creating the videos

The flipped classroom requires the material be "taught" outside of the traditional classroom. This can mean students are required to read a passage, learn a topic, or watch a video about the lesson, all outside of the classroom meeting time. Then, when the class meets, the class time is spent working to understand the material on a deeper level. The use of videos is one means to implement the flipped classroom. In mathematics, videos can help a student hear and see the concepts explained and to have the examples demonstrated. This can be more effective than having students read from the textbook before class.

In this study, videos were used as the primary tool to disseminate the course content. There are many websites that offer detailed and accurate mathematics videos that one could use in their classrooms. However, in this study, the instructor found that making her own videos to be more effective and efficient, though both types of videos were used in the study.

When the instructor first started to create videos, many different mediums were tried. One type of video that was created did not have the instructor visually present, but the voice and writing on the screen were of the instructor. The tools used to create these videos include an iPad with various apps (Educreations, Explain Everything, ZoomNotes, Notability, Whiteboard). Some were more effective than others. The instructor found that Explain Everything, along with a note app, such as ZoomNotes, to be an effective means to creating videos without the instructor visually present. However, the instructor personally felt those videos to be less natural and wanted to be seen in the videos as well.

The second type of video that was created filmed the instructor teaching the topic and providing examples. Though these videos contained the same content as the first type of videos, these videos felt more natural and easier to create. The tools used to create these videos included Camtasia software, camera on a Mac and a whiteboard or chalkboard.

There were many other tools used along the way, such as various stylus pens for the iPad, tethering the iPad to the computer to screen capture, recording tools to help the camera focus and move with the instructor, and many different apps. However, those mentioned earlier were the tools that eventually became the easiest and most effective. As with any technology tool, the availability and the growth of technology changes with each day, so the instructor found that the technology should not be the focus of the flipped classroom, but a means to achieve the classroom and learning environment you want.

Study: Implementation of the Flipped Classroom

The study began in Spring 2016 with three Calculus with Business Application courses. The same instructor taught the three courses. Two of the three courses were taught as completely flipped classrooms, which meant all new material was given at home for the students to watch and take notes. The students would then return to class to work in groups on questions and projects with the assistance of the teacher. The other course was taught in a traditional lecture setting, with opportunity for questions, working on examples in class and individual instruction. There was a total of 84 students in the flipped classroom and 51 students in the traditional course.

The class meetings at St. John's University are two days a week, for 85 minutes each. The course time for the flipped classes was broken down as 20-45-20 minutes, with the first 20 minutes for review of the new material and video, 45 minutes for group work and 20 minutes for recap. The review portion was not re-teaching of the content but a time for the class to share what they learned on the videos. The teacher would then give a more complicated example then the ones on the videos and would emphasize the key objectives for the course that day. The 45 minutes of group work is the portion of the class where the instructor has the opportunity to walk around, help students, individualize instruction and find out where students need more

assistance. This group work included problem sets with each group assigned questions they were to put on the board, or poster board, and explain to the class; or problem sets where students had to work on varying levels of complex questions, bringing the students to a deeper level of understanding and comprehension.

The last 20 minutes of class was spent reviewing the examples and project, having students explain their work and understanding, or a check for understanding though a digital poll or exit card. Ideally this is the planned time allotted for each class. Overall this was the format of the flipped class.

The traditional class met for 85 minutes as well. The first 20 minutes was spent reviewing homework questions from the previous night. The next 45 minutes was spent with the instructor lecturing with the following 10 minutes spent with an example for the class to try on their own. The instructor would walk around and help if anyone needed assistance. The final 10 minutes were spent working on another example and recapping the topic covered that day.

Results

The three courses were given the same pretest, three exams, final exam and posttest. On the first exam, the flipped class averaged a 74.61 while the traditional class had an average of 74.52. This exam covered the topics of limits, continuity and the limit definition of the derivative. The second exam covered varying techniques of the derivative and applications, such as product rule, quotient rule, chain rule, first and second derivative tests for relative extrema, function analysis, business applications such as marginal revenue and cost, and maximizing profit and revenue. This exam showed more of disparity in grades than the first examination. The flipped class averaged an 81.54 and the traditional class averaged a 79.04. Similarly, exam 3 also showed a difference in grades. The flipped class averaged an 85.87 while the traditional averaged 82.72. The third exam covered topics of integration, techniques of integration such as u-substitution, initial value conditions, area between two curves, Lorenz curve, marginal propensity to consume and save, and partial differentiation. The final exam averages were a 78.93 for the flipped and a 77.04 for the traditional. In all cases, the flipped courses averaged greater than the traditional course. Though this isn't a statistically significant of a difference, the grades were higher for the flipped class.

In a similar manner, the pretest and posttests showed an increase in favor of the flipped classroom. The same test was given for both the pre and posttest, with a total of 20 points being awarded. The pretest scores for the flipped classes averages a 4.42 out of 20, where the traditional class averaged a 5.13 out of 20. However, the posttest grades for the flipped classes averages a 15.22 out of 20, while the traditional averaged a 14.35. This makes the total increase for the flipped class to be 10.28 points with 9.33 being the increase for the traditional. From these scores, it appears the traditional students entered the course with a better foundation, but ended the course

below the level of those in the flipped classroom. However, just as in the case with the examinations, the differences are not statistically significant.

The attitudes of the students in the flipped class were also recorded as well. This information was gathered through a survey at the end of the course. Students in the flipped classroom found the learning format to be helpful because they were able to learn from the videos at their own pace, they enjoyed the active learning format of the course and the one-to-one feedback they received. The students did not like the videos without the teacher visually present and they requested the length of the videos to be short in length. The videos given were around 8 to 12 minutes in duration. When asked for suggestions, students requested optional videos on additional topics, interactive videos and notes to be transcribed into a document file or on the video.

The instructor also felt the videos with the instructor visually present to be easier to create and upload onto YouTube. The instructor felt the flipped class moved at a quicker pace than the traditional class and she found the flipped class to be beneficial in reaching each student and to identify the individual obstacles they were facing.

Conclusions

The flipped classroom format is a successful teaching tool and allows for active learning and differentiating instruction in the college mathematics classroom. The grades may not be significantly different between the traditional and flipped classes, but one can say for certainty that the flipped class isn't worse than the traditional. It creates a different learning environment, one that allows students to actively be a part of their learning. The grades are slightly better in the flipped classrooms and the attitudes of the students in the flipped sections were positive with the students enjoying the active learning environment.