

## Results Report

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“Flipping Calculus for the Modern Learner”

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The goal of this experiment was to create a flipped classroom for a Calculus I course. I have been angling toward having students do more exploration while outside the classroom to leave more time for interactive work time while in the classroom. Through the use of the iPad Pro and Swivl Robot, I was able to capture classroom lectures in order to produce a YouTube channel of videos. During the fall semester, I reengineered lectures so that they would be more conducive to this video format and recorded them in front of a live class audience. The resulting YouTube channel was then to be given to the spring semester students to use as their lectures and we would then work on primarily worksheets in class.

First, let's talk about the bad news. To cut to the quick, the experiment failed as originally designed. The technology I used was able to create very good quality videos with excellent audio. The issue is that it wouldn't always accomplish this. The built in microphone would not always be used and the result was an audio track that was lower quality than I had hoped for. When the built in microphone did work, my presentation was well captured and even student questions seemed to be picked up well. When the microphone didn't work, it defaulted to the microphone on the iPad.

The biggest issue is that I was never aware which microphone it was using. Most of the time even when the audio was being captured by the iPad, the videos were of decent quality.

Another issues was that the lighting in the room would sometimes affect the visibility of writing on the white board due to glare, so there was also a learning phase when it came setting it up in that aspect as well. The camera would have very little glare one day and then the next day there would be portions of the board that were nearly impossible to read.

The biggest obstacle encountered, however, wasn't with the technology. When I tried to implement a flipped classroom in the spring semester, the student's did not take well to it. Student's were given clear instructions on what to read/watch before each class period, but would show up with little if any understanding of what they had read. A (surprisingly honest) straw poll showed that more than 80% of them did no advanced study prior to class. This poll was taken because of a shockingly low amount of student interactions during discussions and also an obvious lack of understanding of the material on worksheets. Once I knew that this was the case, I tried for about a week to encourage the students to do the reading, but it seemed they didn't buy into this methodology and showed up ready to hear a lecture.

After a month or so of the class' lack of enthusiasm for the model and the technological hiccups, I abandoned the flipped model and returned to a traditional lecture format. The class was very non-cohesive before the switch. After the switch,

I was able to develop a much better classroom environment with more discussion and interaction.

The technology did prove useful when giving review sessions outside of the normal class schedule. Some students were unable to attend these review sessions due to work or other commitments and this allowed them to still view these sessions. One session lasted over an hour and half with students asking lots of great questions. With the technology, I was able to capture this in its entirety and post in YouTube for students to view. Both students who did attend and those who did not attend said that they found this video especially useful.

The biggest lesson I learned is that students aren't naturally inclined to switch their learning methodology. I am unsure if a fall semester section would have been more receptive to the change or not. It is possible that first semester college students would be more willing to try something different.

If I were to try a flipped classroom again, I would definitely make sure to do more research in advance about ways to make the experience work. I feel as if I had the pieces needed for the students to succeed, but I was unsuccessful in facilitating a culture that made use of those materials.

However, this tale does have a somewhat happy ending. While I was unable to meet the goal of the original experiment, I have been able to bring all of the technology into play in my current Calculus courses as well as all many other courses. The iPad Pro has proven very useful in my teaching overall. I use it for recording solutions to quizzes given in class that I post online. I can also use it to handwrite notes and comments on images of student work that they send me via

cell phone pictures. This has proven to be a big win for everyone. Mathematics is a very difficult discipline to typeset. It can be done very professionally using specific scientific word processing programs, but it can be, at times, quite time and labor costly as it requires basically a computer code language to generate any non-trivial expressions. Mathematicians can email this code with little issue between one another, but not many undergraduate students, and especially very few freshman, would be able to parse the information. The iPad Pro allows me to take their handwritten work, circle what is wrong and annotate on the image just as if I had a real pen on real paper. This has opened up a vastly larger ability for me to help students electronically. In the past, I would often tell students in email what I could based on the limitations of just typing and encourage them to come see me in office hours for further discussion. Now, I can give as much feedback as I want with minimally more effort than if they were sitting in front of me.

In addition, I have used these innovations very successfully in my online Calculus section. As students submit work electronically, the ability to annotate that work electronically and send it back to them in a time manner has been invaluable. This has allowed me to make the experiences more similar to a traditional course.

In closing, I think it is important to reiterate that a lot of success has come from this experiment. It is just unfortunate that it wasn't in the goals I had set out to meet. I greatly appreciate the opportunity to learn these lessons and the support I received from the Reinert Center. (Which I should have used more.)