

Collaboration, Leadership, and Student Success

Lessons from a flipped classroom in Calculus

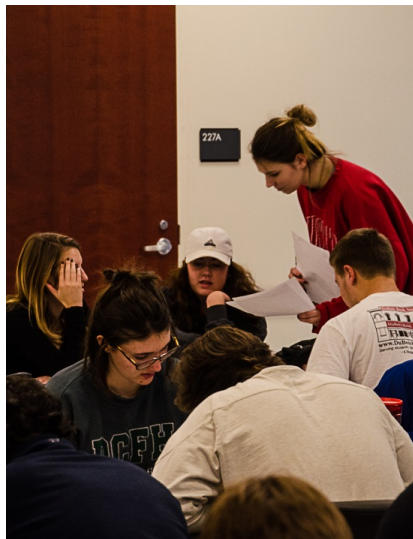
Trefor W Bazett, Crystal L Clough

Dept of Mathematical Sciences, University of Cincinnati



Overview

- ▶ About our course
- ▶ Why we decided to flip
- ▶ How we flipped the course
- ▶ TA for the day
- ▶ Qualitative Observations
- ▶ Quantitative Observations
- ▶ (Hopefully) lots of questions



About our course

Applied Calculus I/II:

- ▶ ~ 1000 students (bio & business)
- ▶ Weak mathematical foundations
- ▶ Fixed and negative mindsets about math "I'm bad at math", "I hate math"
- ▶ Focus on quantitative reasoning skills





Traditional vs Flipped Classroom

Traditional:

- 1) In Class: Foundational Knowledge
- 2) After Class: Work on Problems

Traditional vs Flipped Classroom

Traditional:

- 1) In Class: Foundational Knowledge
- 2) After Class: Work on Problems

Flipped:

- 1) Before Class: Foundational Knowledge
- 2) In Class: Work on Problems



Think - Pair - Share

What do you think your students should be doing when they are mastering the learning objectives?

Professional Skills Employers Want

1. **Ability to work in a team structure**
2. Ability to make decisions and solve problems (tie)
3. **Ability to communicate verbally with people inside and outside an organization**
4. Ability to plan, organize and prioritize work
5. Ability to obtain and process information
6. Ability to analyze quantitative data
7. Technical knowledge related to the job
8. Proficiency with computer software programs
9. Ability to create and/or edit written reports
10. Ability to sell and influence others

Source: National Association of Colleges and Employers, 2015

Video vs Lecture

Video vs Lecture

Advantages of videos:

- ▶ Pause, rewind, slow down, etc
- ▶ Students can engage when and how they like
- ▶ Immediate feedback from quizzes
- ▶ Can explore using nonlinear videos

Video vs Lecture

Advantages of videos:

- ▶ Pause, rewind, slow down, etc
- ▶ Students can engage when and how they like
- ▶ Immediate feedback from quizzes
- ▶ Can explore using nonlinear videos

Disadvantages of videos:

- ▶ Lack of social pressure to pay attention
- ▶ Clarifying questions can't be asked immediately

Video vs Lecture

Advantages of videos:

- ▶ Pause, rewind, slow down, etc
- ▶ Students can engage when and how they like
- ▶ Immediate feedback from quizzes
- ▶ Can explore using nonlinear videos

Disadvantages of videos:

- ▶ Lack of social pressure to pay attention
- ▶ Clarifying questions can't be asked immediately

Student behaviour:

- ▶ Vast majority of students are watching the videos
- ▶ Survey data is overwhelmingly positive - they like them

The Logistics Problem



- ▶ about 45-65 students in groups of 4
- ▶ no assistants
- ▶ one instructor talking to one group is high value, but inefficient

A Solution: TA for the Day!

The students take turns being their own TAs.

A Solution: TA for the Day!

The students take turns being their own TAs.

- ▶ each is assigned a day of class or a topic
- ▶ TAs are sent class material beforehand and work before class
- ▶ TA **must** come to prof and go over problems before class

A Solution: TA for the Day!

The students take turns being their own TAs.

- ▶ each is assigned a day of class or a topic
- ▶ TAs are sent class material beforehand and work before class
- ▶ TA **must** come to prof and go over problems before class
- ▶ in class, TA assists their classmates on the day's problems



Benefits of TA for the day

Major benefits:

1. Solves the logistical problem (high student: teacher ratio)
2. Develop professional skills

Benefits of TA for the day

Major benefits:

1. Solves the logistical problem (high student: teacher ratio)
2. Develop professional skills

Extra benefits:

1. Get to see every student in office hours once!
2. Combats fixed mindset, every student experiences being the expert
3. Student appreciation for our jobs goes up
4. Appreciation for a broader notion of what it means to "understand" mathematics

Downsides of TA for the day

1. Instructor time spent on preclass meetings (benefit?)
2. Can cause anxiety for students
3. Students can be very unhelpful to their peers

What students said

- ▶ Our Course Evaluations are littered with positive comments about flipped classrooms, very few negatives

Survey Data (from flipped sections):

- ▶ 90% would prefer "Flipped" vs "Traditional Lecture".
- ▶ 97% think TA for the day is helpful to their learning
- ▶ 93% think TA for the day is a valuable addition to the course

Student Quotes about TA for the day

- ▶ It was cool to be able to walk around and help people because you could see common mistakes people made, and then explaining to them the right way really expanded your knowledge on the topic.

Student Quotes about TA for the day

- ▶ It was cool to be able to walk around and help people because you could see common mistakes people made, and then explaining to them the right way really expanded your knowledge on the topic.

- ▶ Honestly, having a peer that is able to explain a subject in a way that they know we will understand (because they were recently just as lost as we seem to be in class) just makes for a more enjoyable learning experience and it creates an atmosphere that is more conducive to actual retention.

- ▶ I discovered that I have difficulty explaining things to people. I understand the benefit of being able to do so however, and now I will try to integrate that into my learning process

- ▶ I discovered that I have difficulty explaining things to people. I understand the benefit of being able to do so however, and now I will try to integrate that into my learning process

- ▶ Being TA for the day can be a little stressful, but going and meeting with Trefor for his office hours makes understanding the material easier and therefore it's easier to explain the material in class.

Performance Data

Applied Calculus I, Fall 2016:

| | Flipped | Non Flipped |
|--------------------|---------|-------------|
| Final Course Grade | 78 | 71 |
| Final Exam Grade | 79 | 73 |
| DFW rate | 20 | 33 |

$n = 979$, 6 sections flipped, 12 sections traditional lecture

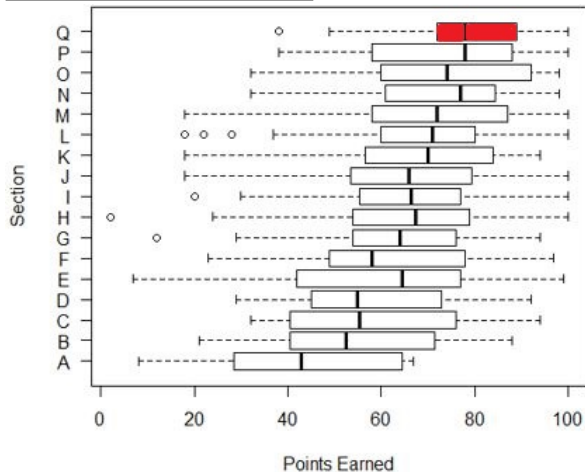
Applied Calculus II, Spring 2017:

| | Flipped | Non Flipped |
|------------------|---------|-------------|
| Midterms Average | 83 | 78 |

$n = 474$, 5 sections flipped, 4 sections traditional lecture

Performance Data

Calculus II, Spring 2017:



Major caveat: only a single section (in red) used the above model in this course

Downsides to flipping

- ▶ It's a lot of work! But mainly in the first year

Downsides to flipping

- ▶ It's a lot of work! But mainly in the first year

- ▶ Partners help a lot

Downsides to flipping

- ▶ It's a lot of work! But mainly in the first year
- ▶ Partners help a lot
- ▶ A very small minority of students really don't like it

Final thoughts

Final thoughts

- ▶ Student performance, student engagement, and student attitudes all very good

Final thoughts

- ▶ Student performance, student engagement, and student attitudes all very good

- ▶ We cherish the increased connection with our students

Final thoughts

- ▶ Student performance, student engagement, and student attitudes all very good
- ▶ We cherish the increased connection with our students
- ▶ Understanding students better makes us better teachers

Final thoughts

- ▶ Student performance, student engagement, and student attitudes all very good
- ▶ We cherish the increased connection with our students
- ▶ Understanding students better makes us better teachers
- ▶ In short: students (mainly) love it and we (mainly) love it

Thank you for participating!

trefor.bazett@uc.edu
crystal.clough@uc.edu