

# Enhancing a Partially Flipped Classroom with Inquiry Based Learning



Ranthyony A.C. Edmonds | PhD Candidate Mathematics | University of Iowa

## Abstract

Flipped instruction and inquiry based learning are often discussed as two distinct instructional techniques. However, the flipped classroom model can be enhanced by IBL. In a higher education setting, disadvantages of a flipped classroom model include resistance from instructors due to the perceived amount of time to create instructional videos and materials. Students can grow frustrated at the amount of instruction received out of class, embodied by the response, "I am not paying tuition to teach myself!" Partially flipped instruction addresses these concerns by incorporating both traditional and inverted instruction, and is still a technique that can facilitate an inquiry based learning environment. It can also alleviate the amount of time spent on additional materials by instructors while still holding students accountable for their own learning outside of class.

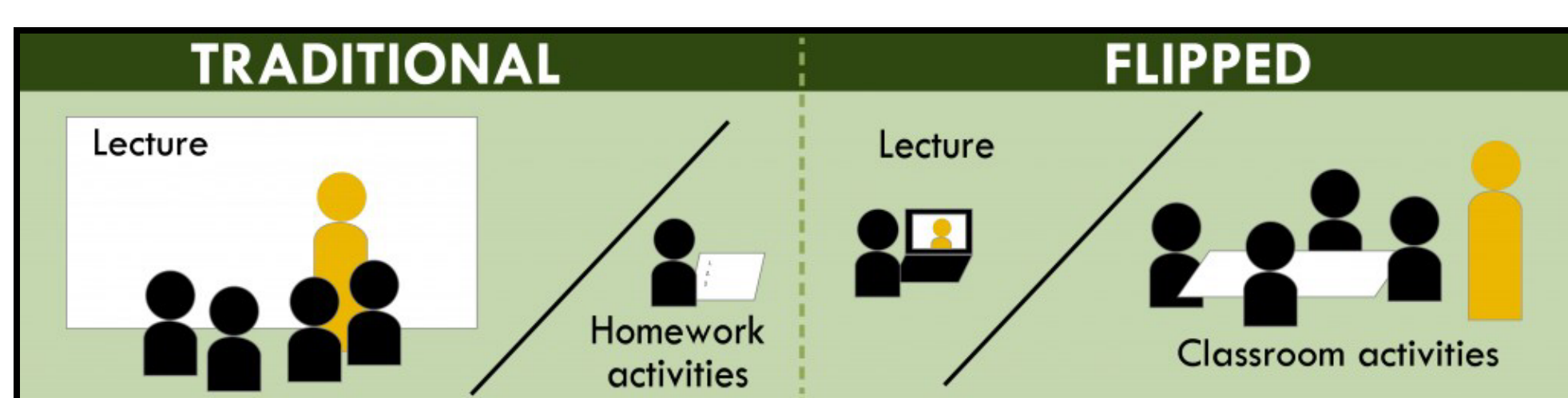
This poster describes a partially flipped model developed for a college trigonometry course in the Spring of 2017 at the University of Iowa, and reflection on how that model was enhanced by IBL. The main features of the model are instructional videos, created with Doceri for iPad, viewed outside of class once a week by students, coupled with a short assessment based on that instruction. The following 'flipped' period involved individual and/or group activities that expanded upon concepts introduced in the videos. These activities included games and worksheets, with the latter being the primary way that IBL was incorporated. Canvas by Instructure was used heavily throughout the course. Results include quantitative data with regards to assessments and a qualitative survey given to students about their experience in the course.

## Partially Flipped Model

### COURSE FORMAT

#### Monday: Flipped Day

- **Assessment:** Video Quiz (due at beginning of class)
- Review/Questions (5-10 minutes)
- In-Class Activity (40-45 minutes)



#### Wednesday

- **Assessment:** Online Homework (due at 11:59 pm)
- Homework Questions (5-10 minutes)
- Lecture (40-45 minutes)

#### Friday

- **Assessment:** Quiz (20 minutes)
- Lecture (30 minutes)

## Methodology

### MATERIALS

- Supplies: Miniature dry erase board classroom set, Chalk
- Equipment: iPad Pro 12.9", Overhead Projector, Apple Pencil
- Apps: Doceri for iPad, Notability, GoodNotes, YouTube

### INSTRUCTIONAL VIDEOS

- 15 instructional videos were created using the Doceri App and Apple Pencil on an iPad Pro
- PDF slides of videos were created with Doceri
- Some were pulled from YouTube
- Average length: 9:52
- Featured introductory content only

### VIDEO QUIZZES

- 10 points each, Worth 1/3 of total quiz grade
- Submitted online before class or handed in physically at beginning of class
- Format: True/False, Multiple Choice, Fill in the Blank, Plot, Graph, Short Answer
- Average length: 6 questions

### ACTIVITIES

- 11 total flipped periods: 6 periods of group worksheets, 1 period each of the following: Indirect Measurement Activity, Speed 'Equating', Jeopardy, Top Chef, Trashketball
- 4 periods incorporated IBL: 2 periods of worksheets featuring guided discovery questions, 1 period with Indirect Measurement Activity, 1 period of Top Chef

### SURVEY

A survey was created with 17 questions requiring responses using a likert scale of agree, neutral, and disagree. The questions addressed each of the following:

- 1) Students' perception of the utility of the flipped instructional period and videos/slides on course assessments
- 2) Students' attitudes towards the partially flipped format
- 3) Students' perception of their own learning after the flipped instructional period and after viewing the video/slides

There were also 3 open response questions:

- 1) What, if anything, did you like about the partially flipped format of the course?
- 2) What, if anything, did you dislike about the partially flipped format of the course?
- 3) If you could offer one suggestion for change in the format of the course, what would it be?

## Results

### QUANTITATIVE DATA

- Video Quiz Average: 7.98/10
- Semester Passing Rate for Video Quiz: 88.55% (percent of class scoring at least 7/10)
- 20/24 students with final grade of 70% and above



### Video Quiz Results

Assessment	Class Average	High Score	Low Score (excluding 0)	Submissions	Scores of 7 or Above
Video Quiz 1	9.905	10	8	23	23
Video Quiz 2	7.92	10	4	23	18
Video Quiz 3	8.03	10	2	22	18
Video Quiz 4	7.6	10	4	20	19
Video Quiz 5	7.7	10	5	22	17
Video Quiz 6	7.88	10	2	23	15
Video Quiz 7	8.25	10	7.5	21	21
Video Quiz 8	8	10	6	21	20
Video Quiz 9	7.33	10	7	19	19
Video Quiz 10	7	10	7	19	19
Video Quiz 11	8.14	10	5	16	13

### QUALITATIVE DATA

- 21/24 students completed the final survey

### Final Survey Results

Survey Questions	Agree	Neutral	Disagree
I prefer in-class activities to lecture based instruction	6	11	4
I prefer a mix of in-class activities and lecture based instruction	16	4	1
The format of this class is enjoyable	13	5	3
I would enroll in another course that uses videos outside of class	16	2	3
I recommend that faculty who teach other math courses develop videos for students to view outside of class	18	0	3
I prefer lecture based instruction to in-class activities	8	8	5
Watching the videos helps me understand concepts that are new to me	18	1	2
I feel confident about the material after watching the video and/or viewing the video slides	9	9	2
The in-class work helps me learn the course content	18	2	1
I felt confident about the video content after completing the in-class activities on Monday	13	5	3
It is helpful to work through problems on Monday when other students and the instructor are available to answer questions	16	5	0
Watching the videos helps me complete the in-class activities	15	5	1
I used the videos and/or slides of the videos to prepare for quizzes	11	6	4
I used the videos and/or slides of the videos to prepare for exams	9	5	7
Watching the videos and/or viewing the slides of the videos helps me complete the video quizzes	18	2	1
The in-class activities helps me do the homework	15	3	3
I would watch the instructional videos and/or view the slides of the videos if I did not have to complete a video quiz afterward	10	3	8

### SELECT STUDENT COMMENTS

#### QUESTION 1: What did you like about the partially flipped format?

- "I like the fact that I can actually ask questions if I need to! It's very unusual/new to me to be allowed to do so. I also like how much more personal the classroom feels. (The "Food Wars" game was fun too...)"
- "It was a nice change from the standard lectures that are typical of a math course here at the UI. It was definitely more engaging."
- "Video quizzes were actually good with the new concepts, it layed out the big idea and helped me understand it better."

#### QUESTION 2: What did you dislike about the partially flipped format?

- "Since we are just learning it, we might not understand a concept completely or might have questions that cannot be answered until after the video quiz, so the video quiz grades can hurt you."
- "Sometimes the group activities made me nervous but sometimes they were fun—like jeopardy. Probably good to get out of comfort zone."
- "The video quizzes meant there was an extra assignment to complete each week."

#### QUESTION 3: What are some suggestions for changes to course format?

- "If possible do the video quiz in class the following day that way the teacher can answer a few questions and if everyone is struggling on a concept it can be reviewed before the quiz. Also no WileyPlus."
- "Make homework due on the day of the [in-class] quiz!"
- "More in-class examples! They're good learning tools."

## Reflections

### INSTRUCTIONAL VIDEOS

- Enjoyed using Doceri; will upgrade to Desktop version in future
- Students appreciated having a PDF version of video slides
- Will make videos available at least 1 week in advance in future

### ASSESSMENT

- Online HW system did not align well with course format
- Online quizzes required great attention to detail to account for user input errors and variation
- Next will design in-class activities first, video quiz, then video
- Will count participation in flipped period as part of HW grade

### INQUIRY BASED LEARNING

- Worksheets that incorporated guided discovery were inconsistent throughout semester; encountered more resistance and hesitation from students during these periods
- Next want each flipped period to incorporate IBL through guided discovery, physical manipulatives, games, and/or short projects
- Will redesign all activities to accommodate guided discovery questions and so that they can be completed within 30 minutes to allow time for student presentations and class discussions
- Should implement at least one team project homework

## Literature Cited

1. Carney, D., Ormes, N., Swanson, R. *Partially Flipped Linear Algebra: A Team-Based Approach*, Problems, Resources, and Issues in Mathematics Undergraduate Studies. 25, 641-654. (2015).
2. Washerman, N., Quint C., Norris S., Carr T., *Exploring Flipped Classroom Instruction in Calculus III*, International Journal of Science and Math Education. 15, 545-568 (2017).
3. Thai, N., Weber B., Valcke, M. *The impact of a flipped classroom design on learning performance in higher education: Looking for the best "blend" of lectures and guiding questions with feedback*, Computers & Education. 107, 113-126 (2017).
4. Zheng, W., Becker, T., Ding, X. *The Effects of "Flipped Classroom" Concept on the Effectiveness of Teaching*. Proceedings, The 2014 ASEE North Midwest Section Conference, Iowa City, IA. October 16-17. (2014)

## Acknowledgements

I would like to thank the Center for the Integration of Research Teaching and Learning (CIRTL) at the University of Iowa. In particular, I would like to thank Dr. Erin Barnes, their program coordinator, for her invaluable mentorship during throughout this Teaching as Research (TAR) Project.

I would also like to thank the Graduate Teaching Fellows Program through the University of Iowa's Center for Teaching for their support and feedback during this capstone project.