Flipping The Math Classroom

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Traditional Classroom

Traditional Class

Come to class and listen to lecture and take notes.

Traditional Class

Some time allowed for class work and questions.

Traditional Class

Go home and attempt the homework (probably get stuck on the more difficult problems)

Traditional Class

Come to class and perhaps there is time to go over a couple of questions
Traditional Class

The class moves on to a different section. If you were lost, you had to get caught up.

Lectures from students’ perspective

Students often see lectures as dispensable, especially if they are mostly one way in their communication.

Do this?

Or this?

The Inverted Classroom

An inverted class takes events that used to take place outside of the classroom (e.g. homework), are now done in the classroom, while things traditionally done during class (e.g. the lecture) are done outside of class.
Why

WHAT THE STUDENTS DO BEFORE CLASS

Watch a video lecture before class

Valuable time together
Take video lecture quiz*

Do a few online homework problems

Do a few online homework problems

Print the concept workshop and bring to class.
Summary

Students will do the following:

1. Watch video lecture BEFORE class.
2. Take video lecture quiz* 
3. Do a few online homework problems
4. Print the concept workshop and bring to class.

When students come to class, they will form groups and work on the concept workshop.

*not for every course
Live Video

Work a few problems prior to class

Review students notes

WHAT DO WE DO IN CLASS?

What we do in class

• Concept workshop

Concept Workshop
What we do in class

- Concept workshop
- Graded Boardwork (Rubric)
- Activities

MTSTATPALS

The fact that the balls are dropped more than once from the same height will come up later.

Board work

Activities

“Regression on the Rebound”

What we do in class

- Concept workshop
- Graded Boardwork (Rubric)
- Activities
- Projects/Presentations
Projects/Presentations

- Project →
- Example Presentation:
  - Race Walking

Math in the Movies

The wizard of oz
[IMDb link]
The main triangle is an acute triangle, the sum of the square root of the sides is the square root of the third side. (Thanks to Shirley Fastow to suggest this movie).

23 [IMDb link]
A movie about German Workers/Soldiers. Notably, this was the 1939 version.

Textbook Activities

Collaborative Corner

Step-by-Step Solutions:

Rearranging linear equations.

Time: 26 minutes

Group size: 2

In general, there is more than one correct sequence of steps for solving an equation. This makes it important that you write your steps clearly and logically so that others can follow your approach.

ACTIVITY

1. Each group member should select a different one of the following equations and use a blank sheet of paper, perform the first step of the solution.

2. [Equation 1]
   
3. [Equation 2]
   
4. [Equation 3]

The BMI (Body Mass Index) is a statistic measure of an individual's weight in relation to his or her height. It is calculated by dividing the person's weight in pounds by the square of his or her height in inches. The BMI is calculated as follows:

BMI = \frac{W}{H^2}

Where: W is the person's weight in pounds, H is the person's height in inches.

The BMI categories are:

- Underweight: < 18.5
- Normal weight: 18.5 - 24.9
- overweight: 25.0 - 29.9
- Obese: > 30

Example:

1. Compute the body mass index for a person who is 5'10" tall weighing 180 lbs. Is this person's weight considered normal?

   BMI = \frac{180}{(5.8)^2} = 61.04
   
2. At the time that basketball legend Michael Jordan played for the Chicago Bulls in the 1990s and owed 0.09 lb. What was Michael Jordan's body mass index?

   BMI = \frac{200}{(6.2)^2} = 18.4
   
3. For a fixed height, body mass index is a function of a person's weight only. For example, let's consider a person 72 in. tall. If he or she weighs 120 lbs, what is his or her weight?

   BMI = \frac{120}{(6.0)^2} = 3.3

Group Activity

Computing Body Mass Index (BMI)

Estimated Time: 30 minutes

Group size: 2

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- Graded Boardwork (Rubric)
- Activities
- Projects/Presentations
- Math in the movies

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- Textbook Activities
What we do in class

• Concept workshop
• Graded Boardwork [Rubric]
• Activities
• Projects/Presentations
• Math in the movies
• Textbook Activities
• Interactive Java Applets

Java Applet

Advantages

Students can pause/rewind the lecture as often as needed

Advantages

Interacting with students (what we like best!)
Advantages

No strict time limit for covering material

Advantages

Students work at own pace
More like an “expected” pace.

Advantages

Students engaged with other students

Advantages

Releases instructor from the “tyranny of the content.” (Bowen)

Disadvantages/Issues

• Getting students to come prepared
• Time
• Bandwidth/Plug-ins
• Scapegoat for the unsuccessful
• If they replay the video, they get the same explanation
• Questions are delayed until class time
• Strange conversations

Students are now responsible for their first experience learning outside of class; this in fact is their homework.
The process

1. Identify the learning outcomes for the course. You should have at least 1 per section.

2. Create the in-class “experience.”

In-class Experience

Align the in-class experience with the learning outcomes.

Learning Outcomes

- Example: Students will demonstrate the ability to solve linear equations, inequalities, and compound inequalities, and to represent solutions in set, interval, and graphical notations.
The process

1. Identify the **learning outcomes** for the course. You should have at least 1 per section.
2. Create the in-class “experience.”
3. Create the out-of-class “experience.”

**ACROSS DISCIPLINES**

**Across Disciplines**

**Biology:** UC Irvine. Students in the inverted class had a higher improvement on final exam scores ($p < .001$) than the non-inverted counterparts. (Moravec, Williams, Aguilar-Roca, O’Dowd, 2010)

**Software Engineering:** Miami University of OH; students showed strong self-ratings of their ability to write application of software at high-levels of engagement.

**Across Disciplines**

**Math:** Students in a Linear Algebra course who were exposed to an inverted format had significantly higher success rates on final exam problems than the in-class lecture students (Talbert, 2012).

**Intro Economics:** Seminal work where the authors note that the inverted format allows an instructor to present a variety of learning options while maintaining control over course content. (Lage et al. 2000)

**Across Disciplines**

**Music:** Bowen (2006) recommended removing the recitation of content (the lecture) from the classroom.
Right for you?

Do you already have a highly interactive class where students come prepared?

Does your course content change often?

Do you already have content in a digital format?

Suggestions

- Don’t try to flip your entire class for next term. Just pick 3-4 lessons to flip.
- Don’t make the outside content too time consuming in the beginning.
- Do Feel free to use outside content (e.g. [http://ed.ted.com](http://ed.ted.com), [http://www.101qs.com/](http://www.101qs.com/))

Student reactions

“I think that it not only gives the students an opportunity to take responsibility to learn on their own but gives the teacher time to explain the trouble problems in class. I love the method!” –Anonymous student 1530 Fall 2007

Student reactions

“I think it's an excellent way to do a math course because you don't need help with listening to the lecture, but you do need help applying the concepts and working through the problems. I believe if the class he been done as a traditional course is taught then it would've been much more difficult to learn the subject matter.” –Anonymous student 1530 Fall 2007

Student reactions

• “I loved it. I learned very well that way because you can rewind the video and you can take as long as it takes you to get it. But in class you cannot rewind what the teacher just said and you have a limited amount of time to go over everything.” –Anonymous student 1010 Fall 2007

Student reactions

“I think that it was awesome!! I have never been able to comprehend math until it was taught this way.” –Anonymous student 1010 Fall 2007
Student reactions

“It was so fabulous that I sold everything I owned to become a stats teacher and follow in Dr. McD's footsteps.” — Nobody...yet!

Online format

• I use www.coursecompass.com (MyMathLab), but you could use any LMS (e.g. Blackboard, D2L, Moodle)
• Teaching Naked (or just Google “NPR Teach Naked”)

Useful Links

• http://mast.unco.edu/programs/vodcasting/
• http://vodcasting.ning.com/
• http://www.ted.com/talks/salman_khan_let_s_use_video_to_reinvent_education.html
• http://www.mathpickle.com/K-12/Videos.html
• http://projecteuler.net/
• http://khanacademy.org/
• http://lbvodcasting.com/

References and Software


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References

• Talbert, Robert (2012) "Inverted Classroom," Colleagues: Vol. 9: Iss. 1, Article 7. Available at: http://scholarworks.gvsu.edu/colleagues/vol9/iss1/7

• At M.I.T., Large Lectures Are Going the Way of the Blackboard http://www.nytimes.com/2009/01/13/us/13physics.html?_r=2&pagewanted=all

References and Software


Software/Hardware Used

- Software
  - Camtasia Studio, SnagIT, Winplot, Virtual TI

- Hardware
  - Tablet PC (Gateway and Dell)
  - Blue Snowball Microphone
  - AT2020 Microphone

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