

Inverted Classroom—
Retool your lessons.



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Traditional Classroom

- [Open](#)

Traditional Class

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



Outline

- I. The Traditional Classroom
- II. The Inverted Classroom
- III. What do we do in class?
- IV. How does the teacher make this happen
- V. Evidence of effectiveness
- VI. Student feedback

Traditional Class

1. Come to class and listen to lecture and take notes.



Traditional Class

4. Come to class and perhaps there is time to go over a couple of questions



THE TRADITIONAL CLASSROOM

Traditional Class

2. Some time allowed for class work and questions.



Traditional Class

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



Lectures

- Students often see lectures as dispensable, especially if they are mostly one way in their communication.
- It is more efficient to get it out of a book or from the Internet than to get up, get dressed, find a parking space, and run to class.



WHAT THE STUDENTS DO BEFORE CLASS

THE INVERTED MODEL

Valuable time together

- Most important time together?
- When students have questions
- When does this occur?
- When listening to a lecture?
 - When trying to apply the principles?

The Inverted Class

1. Watch a video lecture before class



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.

Lecture vs. Process

	Lecture-based teaching	Process-based teaching
Class time	First Exposure (Students first hear or observe facts, ideas)	Process (student applies, analyzes, argues, solves problems using first-exposure material)
Student Study Time	Process	First exposure (Video Lectures)

(Walvoord, 1998)

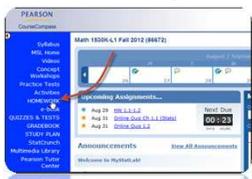
The Inverted Class

2. Take video lecture quiz*



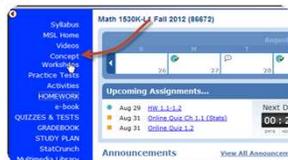
The Inverted Class

3. Do a few online homework problems



The Inverted Class

4. Print the concept workshop and bring to class.



First Experience Homework

- How to get students to come to class prepared
- Created video lectures using Camtasia and a Tablet PC
 - Required them to do a few problems from MML
 - Embed quizzes in the videos. (Or do a 1 question VL Quiz.)
 - Go around and review their notes.

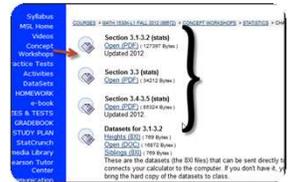
The Inverted Class

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The Inverted Class

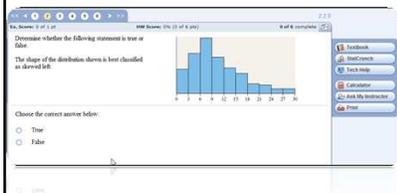
4. Print the concept workshop and bring to class.



WHAT DO WE DO IN CLASS?

The Inverted Class

3. Do a few online homework problems



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

What we do in class

- Concept workshop

Concept Workshops and in-class activities

- [Example 1](#) (College Algebra—Linear Functions)
- [Example 2](#) (College Algebra—Quadratic Functions)
- [Tell me what you know](#)—Quad/Rational

[Stats Activity 1](#) (M&Ms)
[Stats Activity 2](#) (Sampling Variability-computer sim)
[Stats Activity 3](#) (Ghostbusters-video)

Boardwork?



Boardwork [Video 1](#)

MTSTATPAL



Concept Workshop



Concept workshop [Video 1](#)

What we do in class

- Concept workshop
- Graded Boardwork ([Rubric](#))
- Activities

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What we do in class

- Concept workshop
- Graded Boardwork ([Rubric](#))

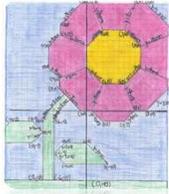
Activities

- "Regression on the Rebound"



Projects/Presentations

- Project →
- Example Presentation:
 - [Race Walking](#)



What we do in class

- Concept workshop
- Graded Boardwork [\(Rubric\)](#)
- Activities
- Projects/Presentations
- Math in the movies

Textbook Activities

Collaborative Corner

Step-by-Step Solutions

Focus: Solving linear equations
Time: 20 minutes
Group size: 3

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, on a fresh sheet of paper, perform the first step of the solution.
2. Place the papers around so that the second and third steps of each solution are performed by the other two group members. Before writing, make sure that the previous step is correct. If a mistake is discovered, return the problem to the person who made the mistake for repair. Continue passing the problems around until all equations have been solved.
3. Each group should reach a consensus on what the three solutions are and then compare their answers to those of other groups.

Java Applet

Math in the Movies

The wizard of oz
[\[IMDb link\]](#)

The scarecrow theorem: In an isosceles triangle, the sum of the square roots of two sides is the square root of the third side. (Thanks to Wxyxy Beatty to suggest this movie).
 1939

Play the flash version [\(.swf\)](#), or watch the [quicktime file \(.m4v\)](#).

23 [\[IMDb link\]](#)

A true story about German Hackers/Spies. Numerology is in the movie "The number".

Group Activity

Computing Body Mass Index (BMI)

Materials: Calculator
Estimated Time: 30 minutes
Group Size: 2

Body mass index is a statistical measure of an individual's weight in relation to the person's height. It is computed by $BMI = \frac{20000}{h^2} W$ where W is a person's weight in pounds and h is the person's height in inches.

The NIH categorizes body mass indices as follows:

Body Mass Index (BMI)	Weight Name
$18.5 \leq BMI < 24.9$	considered ideal
$25.0 \leq BMI < 29.9$	considered overweight
$BMI \geq 30.0$	considered obese

1. Compute the body mass index for a person 5'4" tall weighing 160 lb. Is this person's weight considered ideal?
2. At the time that basketball legend Michael Jordan played for the Chicago Bulls, he was 200 lb and stood 6'9" tall. What was Michael Jordan's body mass index?
3. For a fixed height, body mass index is a function of a person's weight only. For example, for a person 72 in. tall (6 ft), solve the following inequality to determine the person's ideal weight range: $18.5 \leq \frac{20000}{72^2} W < 24.9$
4. At the time that professional bodybuilder, Jay Cutler, won the Mr. Olympia contest he was 200 lb and stood 5'10" tall.
 - a. What was Jay Cutler's body mass index?
 - b. As a body builder, Jay Cutler has an extraordinarily small percentage of body fat. Yet, according to the chart, would he be considered overweight or obese? Why do you think that the formula is not an accurate measurement of Mr. Cutler's weight status?

What we do in class

- Concept workshop
- Graded Boardwork [\(Rubric\)](#)
- Activities
- Projects/Presentations
- Math in the movies
- Textbook Activities
- Interactive Java Applets
- 3-Act Math

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- <http://threeacts.mrmeyer.com/>
- http://www.livebinders.com/play/play_or_edit?id=330579

Advantages

- Students can pause/rewind the lecture as often as needed

Advantages

- Students work at own pace
- More like an "expected" pace.

Advantages

- Can spend a greater proportion of class time doing the critical thinking and actively analyze/synthesize problems that are based on the assigned videos.
- Class time is used mostly for the "Processing" part of learning (Walvoord, 1998).

Advantages

- Interacting with students (what we like best!)
 - Can spot struggling students, who are more comfortable asking questions
 - Students can get immediate feedback

Advantages

- Students engaged with other students
 - Reinforces concepts when talking about it

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.

Advantages

- No strict time limit for covering material

Advantages

- Releases instructor from the "tyranny of the content." (Bowen)

HOW DOES THE TEACHER MAKE THIS HAPPEN

The process

1. Identify the [learning outcomes](#) for the course. You should have at least 1 per section

In-class Experience

- This in-class experience may include the following:
 - Concept workshop
 - Graded Boardwork ([Rubric](#))
 - Activities
 - Projects/Presentations
 - Math in the movies
 - Textbook Activities
 - Java applets

Out-of-class Experience

- Can include:
 - Video Lecture
 - Reading
 - Java applet exploration
 - Working through some basic problems

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.

In-class Experience

- Align the in-class experience with the learning outcomes.

The Video Lecture

- Camtasia
 - Allows one to easily add audio and publish as SWF/mp4
 - Can be used with Tablet PC to easily audio-annotate.
 - [Example 1](#) (CA 2.1) | [Example 2](#) (Stats Normal) | [Example 3](#) (CA 8.3)
 - Live Video (next slide)

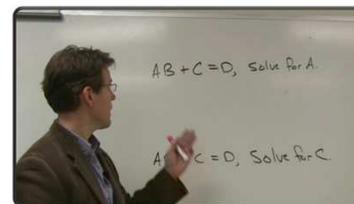
The process

1. Identify the [learning outcomes](#) for the course. You should have at least 1 per section.
2. Create the in-class “experience.”

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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.”

Live [Video](#)



ACROSS DISCIPLINES

Across Disciplines

- **Music:** Bowen (2006) recommended removing the recitation of content (the lecture) from the classroom.

Get in groups (or at least in pairs)

Now with your group, discuss how you might be able to use the inverted model in your classes. Can you think of 1-2 topics that you could “flip” and have students’ first exposure to the material come BEFORE class. What challenges do you foresee?

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.

Right for you?

- Do you already have a highly interactive class where students come prepared?
- Does your course content change often?
- If you don’t lecture during class, are there activities you can do in the classroom that will engage the student?
- Do you already have content in a digital format?

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*”

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)

Suggestions

- Don’t try to flip your entire class for next term. Just pick 3-4 lessons to flip.
- Feel free to use outside content (e.g. <http://ed.ted.com>)
– *Power of simple words*
- Don’t make the outside content too time consuming in the beginning.

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

Online format

- I use www.coursecompass.com (MyMathLab), but you could use any LMS (e.g. Blackboard, D2L, Moodle)
- If time allows, you will be shown how this is set up in coursecompass.
- Teaching Naked (or just Google "NPR Teach Naked")
<http://www.npr.org/templates/story/story.php?storyId=111872191>

References and Software

- Foertsch, J., Moses, G., & Strikwerda, J. I Litzkow, M.(2002). Reversing the lecture/homework paradigm using eTEACH web-based streaming video software. *Journal of Engineering Education*, 91(3), 267–274.
- Finkel, D. (2000). *Teaching with Your Mouth Shut Portsmouth, NH: Boynton/Cook Publishers, Inc.*

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

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://ibvodcasting.com/>

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- Bowen, J. (2006). Teaching Naked: Why removing technology from your classroom will improve student learning. *The National Teaching and Learning Forum*, 16 (1).
- Lage, M., Platt, G., & Treglia, M. (2000). Inverting the classroom: a gateway to creating an inclusive learning environment. *Journal of Economic Education*, 31 (30-43).
- Gannod, Gerald, C., Burge, Janet, E., Helmick, Michael, T. (2007). Using the Inverted Classroom to Teach Software Engineering. *Technical Report MU-SEAS-CSA-2007-001*, Miami University Department of Computer Science and Systems Analysis, School of Engineering and Applied Science.
- Moravec, M., Williams A, Aguilar-Roca N, O'Dowd DK (2010). Learn before lecture: a strategy that improves learning outcomes in a large introductory biology class. *CBE Life Sci Educ* 9, 473–481. doi:10.1187/cbe.10

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!

References and Software

- Walvoord, B. E., & Anderson, V. J. (1998). *Effective Grading: A Tool for Learning and Assessment Sanfrancisco: Jossey-Bass Inc.*
- Walvoord, B., & Pool, K. (1998). Enhancing Pedagogical Productivity. *New Directions for Higher Education*, 1998(103), 35-48.
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- 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/13p_hysics.html?_r=2&pagewanted=all&

References and Software

- Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, 2(2-3), 87-105. [pdf Full Text](#)
- Pseudoteaching:
<http://fnoschese.wordpress.com/2011/02/21/pt-pseudoteaching-mit-physics/>

Software/Hardware Used

- **Software**
 - Camtasia Studio, Snagit, Winplot, Virtual TI,
- **Hardware**
 - Tablet PC (Gateway and Dell)
 - Blue Snowball Microphone

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