Flipping The Math Classroom

By Dr. Scott McDaniel
Middle Tennessee State University
Scott.mcdaniel@mtsu.edu
MrMathTutor.wordpress.com

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

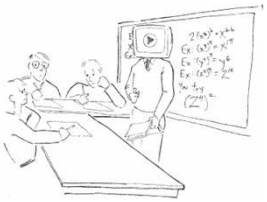
Come to class and perhaps there is time to go over a couple of questions

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.



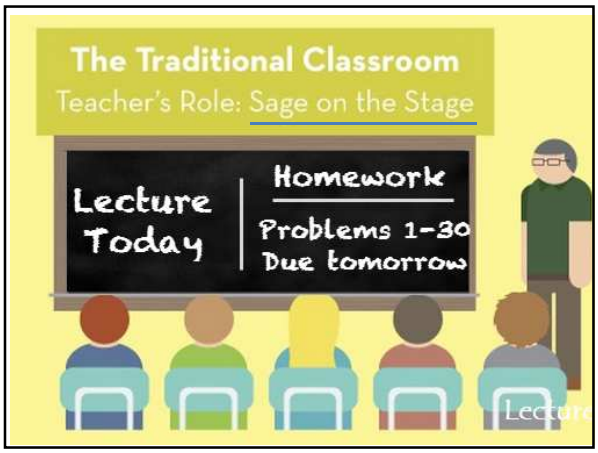
Do this?

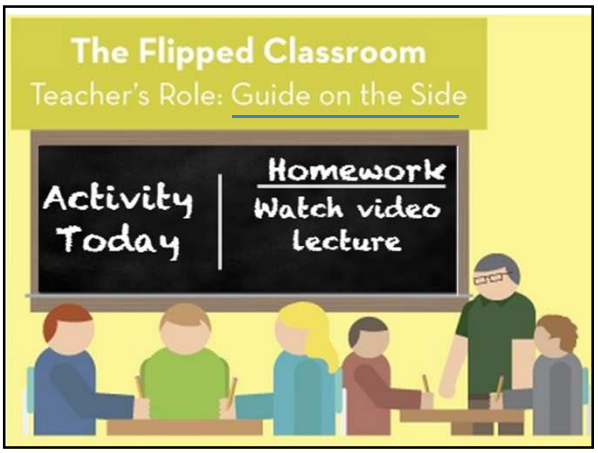
Or this?

THE INVERTED MODEL

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.





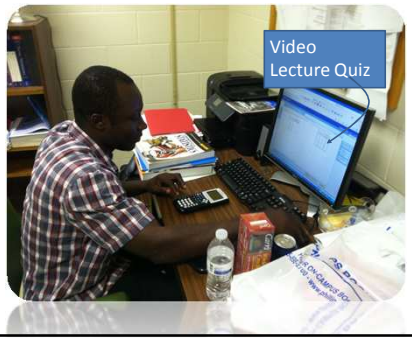
Why?

Valuable time together

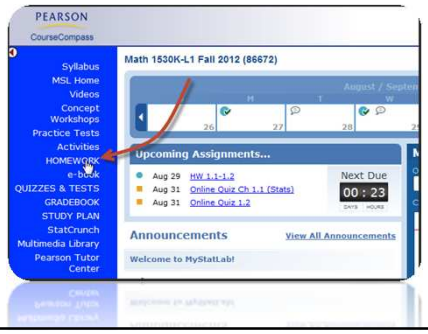
WHAT THE STUDENTS DO BEFORE CLASS

Watch a video lecture before class

Take video lecture quiz*



Do a few online homework problems



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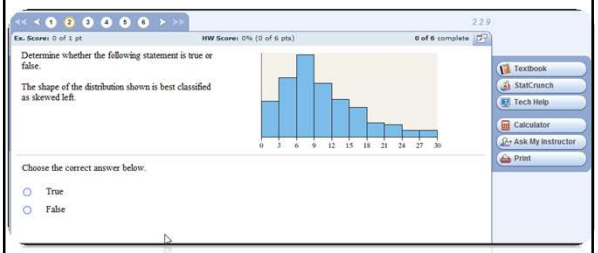
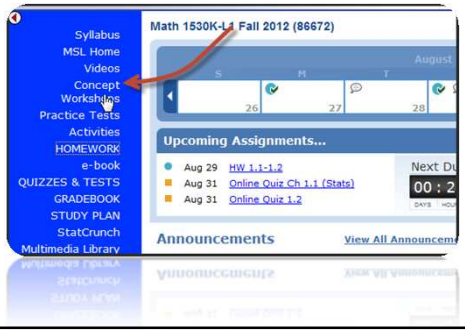


Print the concept workshop and bring to class.



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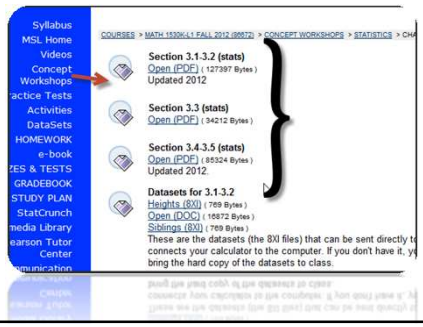
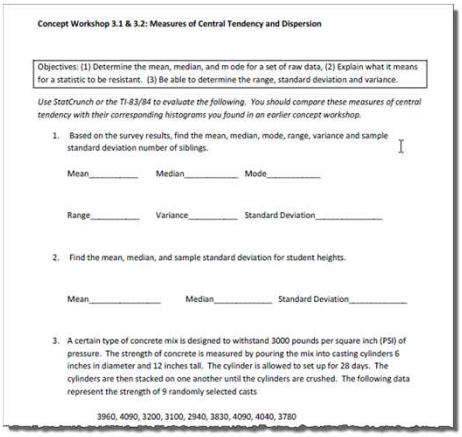




Concept Workshop 3.1 & 3.2: Measures of Central Tendency and Dispersion

Objectives: (1) Determine the mean, median, and m ode for a set of raw data, (2) Explain what it means for a statistic to be resistant. (3) Be able to determine the range, standard deviation and variance.

Use StatCrunch or the TI-83/84 to evaluate the following. You should compare these measures of central tendency with their corresponding histograms you found in an earlier concept workshop.

1. Based on the survey results, find the mean, median, mode, range, variance and sample standard deviation number of siblings.

   Mean_____ Median_____ Mode_____

   Range_____ Variance_____ Standard Deviation_____

2. Find the mean, median, and sample standard deviation for student heights.

   Mean_____ Median_____ Standard Deviation_____

3. A certain type of concrete mix is designed to withstand 3000 pounds per square inch (PSI) of pressure. The strength of concrete is measured by pouring the mix into casting cylinders 6 inches in diameter and 12 inches tall. The cylinder is allowed to set up for 28 days. The cylinders are then stacked on one another until the cylinders are crushed. The following data represent the strength of 9 randomly selected casts

   3960, 4090, 3200, 3100, 2940, 3830, 4090, 4040, 3780

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.

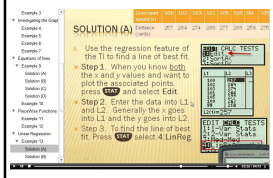
*not for every course

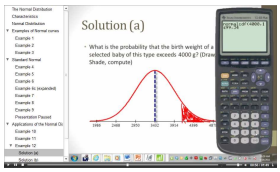
GETTING STUDENTS TO COME PREPARED

How to get students to come to class prepared

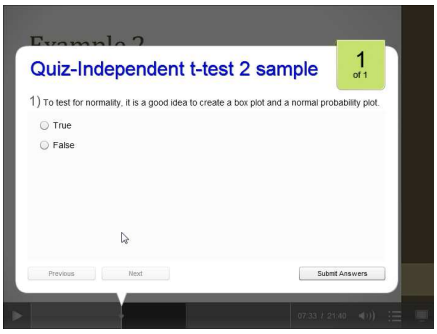
+

Video Lecture

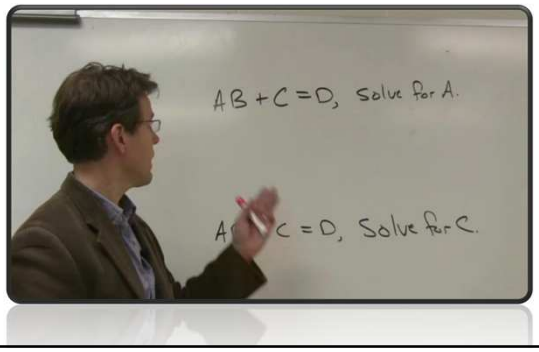




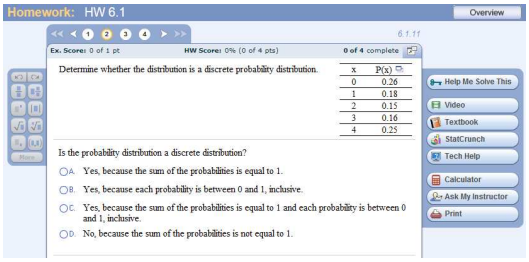
Embedded Quizzes



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)

Board work

What we do in class

- Concept workshop
- Graded Boardwork (Rubric)
- Activities

Activities

"Regression on the Rebound"

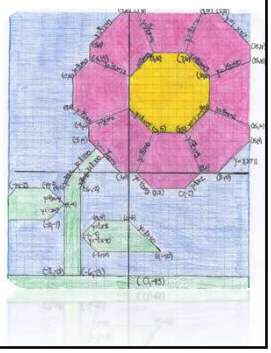
MTSTATPAL

What we do in class

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

Projects/Presentations

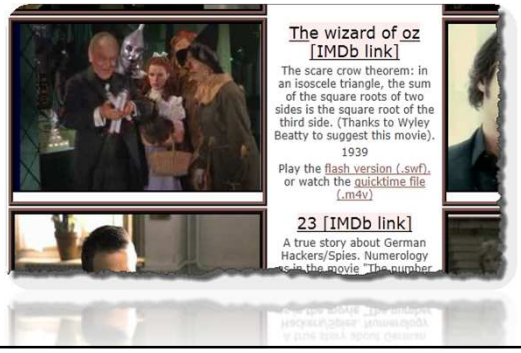
- Project →
- Example Presentation:
  - Race Walking



What we do in class

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

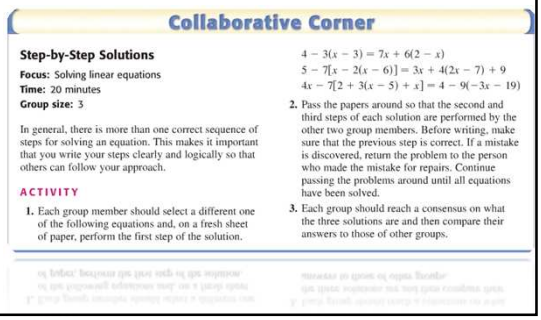
Math in the Movies



What we do in class

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

Textbook Activities



Collaborative Corner

Step-by-Step Solutions

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

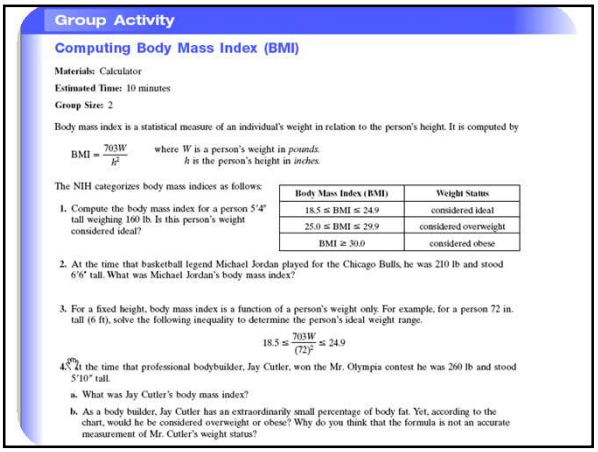
In general, there is more than one correct sequence of steps for solving an equation. This makes it important that you write your steps clearly and logically so that others can follow your approach.

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.

$$4 - 3(x - 3) = 7x + 6(2 - x)$$
$$5 - 7[x - 2(x - 6)] = 3x + 4(2x - 7) + 9$$
$$4x - 7[2 + 3(x - 5) + x] = 4 - 9(-3x - 19)$$

2. Pass 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 repairs. 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.



Group Activity

Computing Body Mass Index (BMI)

Materials: Calculator
Estimated Time: 10 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

$$\text{BMI} = \frac{703W}{h^2} \quad \text{where } W \text{ is a person's weight in } \textit{pounds}, \; h \text{ is the person's height in } \textit{inches}.$$

The NIH categorizes body mass indices as follows:

Body Mass Index (BMI)	Weight Status
$18.5 \le \text{BMI} \le 24.9$	considered ideal
$25.0 \le \text{BMI} \le 29.9$	considered overweight
$\text{BMI} \ge 30.0$	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 210 lb and stood 6'6" 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.

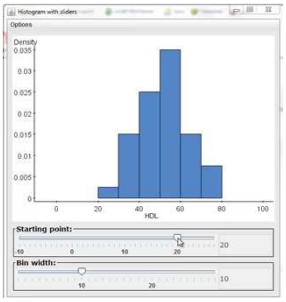
$$18.5 \le \frac{703W}{(72)^2} \le 24.9$$

4. At the time that professional bodybuilder, Jay Cutler, won the Mr. Olympia contest he was 260 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

Java Applet



Open

What we do in class

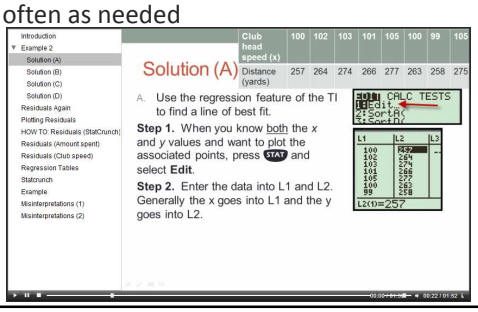
- Concept workshop
- Graded Boardwork (Rubric)
- Activities
- Projects/Presentations
- Math in the movies
- Textbook Activities
- Interactive Java Applets
- 3-Act Math

3-Act Math (Dan Meyer)

http://threeacts.mrmeyer.com
http://www.101qs.com

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

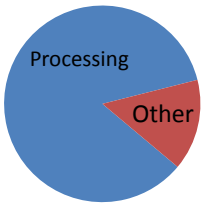
Students engaged with other students

Advantages

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

Advantages

Class time



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.

HOW DOES THE TEACHER MAKE THIS HAPPEN

The process

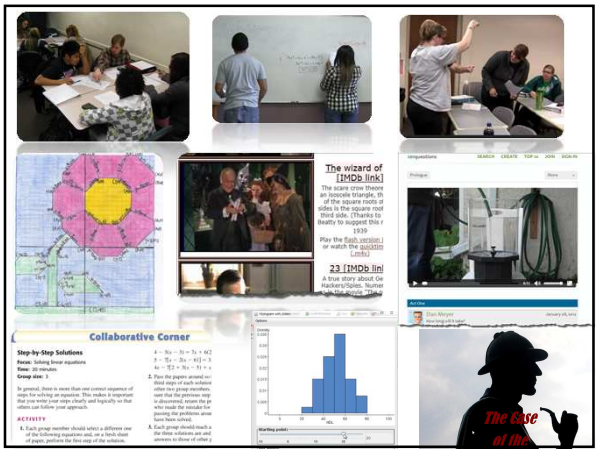
1. Identify the learning outcomes for the course. You should have at least 1 per section

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."

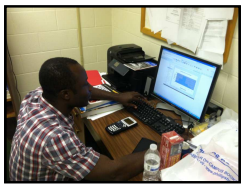


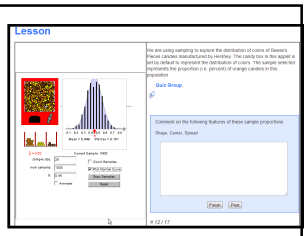
In-class Experience

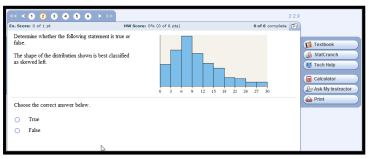
Align the in-class experience with the learning outcomes.

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://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")

http://www.npr.org/templates/story/story.php?storyId=111872191

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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- 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*
  - *AT2020 Microphone*

Contact

Dr. Scott McDaniel

Scott.mcdaniel@mtsu.edu

www.Mrmathtutor.wordpress.com