Flipped Classroom: 
Is this JUST the next Buzz… ?
Beyond the BUZZ: What is KNOWN to Improve Learning

- Active Learning
- Problem-Based Learning
- Real-World Applications
- Supplemental Instruction
- Tutoring/Individual Instruction
But HOW to get them into MY class?

- Active Learning
- Problem-Based Learning
- Real-World Applications
- Supplemental Instruction
- Tutoring/Individual Instruction
Pre-Flip: Good, Solid Traditional Class

50 Min. MWF Lecture

1-2 Hr MWF HW (most students were studying alone)

3 Hour Hands On Lab

2007: ECE 5/6340
Numerical EM
2009: ECE 3300
Intro Electromagnetics
2014: ECE 1250
Freshman ECE Circuits

HW Problem Solving
2007: FLIPPED Class

Pre-Class Video Lecture

In-Class Problem Solving, ?, Discussion

Post-Class HW

3 Hour Hands On Lab
2007: FLIPPED Class BOUGHT TIME

Pre-Class Video Lecture  In-Class Problem Solving, ?, Discussion

3 Hour Hands On Lab
FLIPPING Buys an Extra PROFESSOR HOUR a DAY:

In the Classroom:

- Active Learning
- Problem-Based Learning
- Real-World Applications
- Supplemental Instruction
- Peer Tutoring/Semi-Individual Instruction
A Day in the Flipped Classroom

Video Lecture Before Class

Students watch video lectures night before. Most watch 1 time, some up to 3 times. Repeat segments as needed. Take notes.
A Day in the Flipped Classroom

In Class

Whatever you Do, Do NOT Lecture …
Question of the day:
WHAT is the Electric Field???
Coulomb’s Law
Point, Line, Surface, Volume charge distributions
Rectangular, Cylindrical, Spherical Coordinate systems
Question of the day:
WHAT is the Electric Field???

Students:
‘It goes from two charges, like from positive to negative’
…. Math … textbook pictures … equations …

And then … Students / Teacher raise questions …
How do you measure it? What does it do? How do we know it is there? What can we use it for?
Bloom’s Taxonomy (Updated)

http://ww2.odu.edu/educ/roverbau/Bloom/blooms_taxonomy.htm
Problem 4.10  Three point charges, each with $q = 3 \text{ nC}$, are located at the corners of a triangle in the $x$-$y$ plane, with one corner at the origin, another at $(2 \text{ cm}, 0, 0)$, and the third at $(0, 2 \text{ cm}, 0)$. Find the force acting on the charge located at the origin.

- Define an Origin.
- Write vector $\mathbf{R}_s$ from origin to Source (charge)
- Write vector $\mathbf{R}_p$ from origin to Field Point
- Find vector from source to point ($\mathbf{R}_{sp} = \mathbf{R}_p - \mathbf{R}_s$)
- Apply Coulomb’s Law
- Sum or Integrate to find $\mathbf{E}$ at the point $P$
Small Group Problem Solving (2-4min)
Questions Arise!

NOW they know what they don’t know …

Let’s talk about it. (Problem Solving Strategy)
And then do it again….
Small Group Problem Solving (2-4min)

Problem 4.12  A line of charge with uniform density $\rho_l = 8 \text{ (\mu C/m)}$ exists in air along the $z$-axis between $z = 0$ and $z = 5 \text{ cm}$. Find $E$ at $(0, 10 \text{ cm}, 0)$.

It's a harder problem this time…

What's the same, What is different?
**Table 3-2**: Coordinate transformation relations.

<table>
<thead>
<tr>
<th>Transformation</th>
<th>Coordinate Variables</th>
<th>Unit Vectors</th>
<th>Vector Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartesian to Cylindrical</td>
<td>$z = z$</td>
<td>$\hat{z} = \hat{z}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$x = r \cos \phi$</td>
<td>$\hat{x} = \hat{r} \cos \phi - \hat{\phi} \sin \phi$</td>
<td>$A_r = A_x \cos \phi + A_y \sin \phi$</td>
</tr>
<tr>
<td></td>
<td>$y = r \sin \phi$</td>
<td>$\hat{y} = \hat{r} \sin \phi + \hat{\phi} \cos \phi$</td>
<td>$A_\phi = -A_x \sin \phi + A_y \cos \phi$</td>
</tr>
<tr>
<td></td>
<td>$z = z$</td>
<td>$\hat{z} = \hat{z}$</td>
<td>$A_z = A_z$</td>
</tr>
<tr>
<td>Cylindrical to Cartesian</td>
<td>$x = r \cos \phi$</td>
<td>$\hat{x} = \hat{r} \cos \phi - \hat{\phi} \sin \phi$</td>
<td>$A_x = A_r \cos \phi - A_\phi \sin \phi$</td>
</tr>
<tr>
<td></td>
<td>$y = r \sin \phi$</td>
<td>$\hat{y} = \hat{r} \sin \phi + \hat{\phi} \cos \phi$</td>
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<td>$z = z$</td>
<td>$\hat{z} = \hat{z}$</td>
<td>$A_z = A_z$</td>
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</tbody>
</table>

**Going Beyond ‘Equation Shopping’…**

Point out other familiar resources (textbook), how to use them (apply), when to use them (analyze), where they came from (Evaluate)
And the favorite part of my day … Applications
(What Can You Create with this stuff? (5-10 min)
A Day in the Flipped Classroom

After Class

- Students Clean up Question of the Day (notes for exam)
- Finish homework (most problems were ‘set up’ in class, hard parts discussed).
- Many students re-watch all or parts of lecture videos.
- And … watch videos for tomorrow.
The Flipped Classroom – Most Students LIKE it

Video lectures
Easy to watch, Appealing, Repeat what you miss, Go at your own speed, On my own schedule, Make the book easier to understand
‘Feel like you are at my shoulder’

In class
Better understanding, answer questions, helps me understand the homework, like the ‘real stuff’
‘I don’t feel stupid asking questions’

Special needs
Hearing Impaired: Close Captioning
ESL: Can speed up/ slow down the videos
Gender? ‘My first woman professor in engineering … ‘
Course Evaluations:  
ECE3300 Intro to Electromagnetics

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<thead>
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<tbody>
<tr>
<td>Pre</td>
<td>Yr1</td>
<td>Yr2</td>
<td>Yr3</td>
<td>Yr4</td>
<td></td>
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<tr>
<td>Overall this was an effective course</td>
<td>4.98</td>
<td>5.68</td>
<td>5.61</td>
<td>5.5</td>
<td>5.48</td>
</tr>
<tr>
<td>Overall this was an effective instructor</td>
<td>5.13</td>
<td>5.85</td>
<td>5.82</td>
<td>5.4</td>
<td>5.57</td>
</tr>
</tbody>
</table>

In 2011 evaluations were changed.
In 2011 students were confused about if they were evaluating the instructor or TA.
This was fixed in 2012, but still different from pre-2011
Did They Learn More???

Many MORE & HIGHER LEVEL Questions in Class

Fewer E students

Covered More Material (Applications)

Testing Higher Level Thinking Skills

Exam Grades Did not Change Statistically

http://ww2.odu.edu/educ/roverbau/Bloom/blooms_taxonomy.htm
WHAT is the Electric Field??

\[
\vec{F}_{12} = \frac{\vec{r}_1 \times \vec{r}_2}{4\pi \epsilon R^2} \quad \vec{F}_{21} = \frac{\vec{r}_2 \times \vec{r}_1}{4\pi \epsilon R^2}
\]

$E_c$ Point 2 = $\frac{1}{4\pi \epsilon R^2} \cdot \hat{R}_{12}$

Tablet PC
YouTube
Class Website

1-2 Hr / Lecture
To Record & Upload
Beyond the Buzz: FLIPPING Buys TIME for Good Teaching

In the Classroom:
- Active Learning
- Problem-Based Learning
- Real-World Applications
- Supplemental Instruction
- Peer Tutoring/Semi-Individual Instruction
May 19-23, 2014
Lunch Time Flip & Chips
Flipped Crash Course
**Part 1: Building a Foundation for the Flip**

<table>
<thead>
<tr>
<th>Module</th>
<th>Date</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>01</td>
<td>12-8-13</td>
<td>Flipping Through the Literature</td>
</tr>
<tr>
<td>02</td>
<td>12-29-13</td>
<td>Flipping is Active</td>
</tr>
<tr>
<td>03</td>
<td>1-12-14</td>
<td>Flipping Activities</td>
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<tr>
<td>04</td>
<td>1-26-14</td>
<td>Creating Video Examples</td>
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</tbody>
</table>

**Part 2: Planning the Flip**

<table>
<thead>
<tr>
<th>Module</th>
<th>Date</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>05</td>
<td>2-9-14</td>
<td>Designing One Flipped Lecture</td>
</tr>
<tr>
<td>06</td>
<td>2-23-14</td>
<td>Creating a Flipped Lecture</td>
</tr>
<tr>
<td>07</td>
<td>3-9-14</td>
<td>Designing the Face-to-Face</td>
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<tr>
<td></td>
<td></td>
<td>Classroom Activities</td>
</tr>
<tr>
<td>08</td>
<td>3-16-14</td>
<td>Flipping For Real! (One Lecture)</td>
</tr>
<tr>
<td>09</td>
<td>3-30-14</td>
<td>Assessing the Flipped Classroom</td>
</tr>
</tbody>
</table>

May 19-23, 2014
Lunch Time
Flip & Chips
Flipped Crash Course
The Flipped Classroom
Beyond the Buzz …
Teach-Flip.utah.edu

Dr. Cynthia Furse
Electrical & Computer Engineering
Follow the LEARNING …
The Flipped Classroom – What you Gain

• TIME!! You are ‘vitably’ with your students all/most of the time…. Answering their questions by video at 1am ….

• Engagement / Active Learning / Motivation
  • Every student ‘every’ minute

• Time & Skills for Applications / Design

Higher level thinking skills
  • More / better questions, making associations
  • Creative ‘what if’ thinking
  • Bringing ideas from outside of class

• Positive cohort class environment
The Flipped Classroom – Teachers LIKE

Video lectures
- ReUse / Optimize Lecture content
- Minimize later class prep
- 2X time with my students
- Easy solution for students who miss class.

In class
- I can be there at the highest value learning points
- Determine quickly what students are confused about and hopefully (!) fix it.
- Lots of great questions!
- Time to talk about applications.
The Flipped Classroom: What Can Go Wrong?

Video lectures
80-85% watch videos before class (what about the rest?)
‘Class is really confusing if you haven’t watched the videos’
Format? Accessibility? Content?

In class
Balancing time between discussion (applications, intuitive understanding) and homework set up
‘Do more/less of the homework in class’

Professor
Bottom Line:
Is Flipping Better than the Traditional Classroom?

Data is Early, Spotty, and not always consistent....
Follow the LEARNING ...

FACTS

QUESTIONS

PRACTICE

PROBLEM-SOLVING STRATEGY

ENGINEERS: DESIGN ANALYZE APPLY
Follow the LEARNING …

TRADITIONAL CLASSROOM

FACTS

QUESTIONS

PRACTICE

PROBLEM-SOLVING STRATEGY

ENGINEERS:
DESIGN
ANALYZE
APPLY

The Professor is in …
Follow the LEARNING ...
Data Starting to Come In: Do Students LEARN Better?

Comparing the Effectiveness of an Inverted Classroom to a Traditional Classroom in an Upper-Division Engineering Course

Gregory S. Mason, Teodora Rutar Shuman, and Kathleen E. Cook

- Students Learn as well or better, depending on content
- Inverted class covered more content
- Inverted class covered design more effectively
- Students spent same amount of time or less studying outside of class (other studies say ‘more’)
- Flip depends on grade level/study skills