“Flipping” method of teaching physics and other technical subjects

JOHN GOREE

THE UNIVERSITY OF IOWA

Polls:
Polls:

Do you sometimes teach by
- writing on board?
- projector to show slides (powerpoint, etc.)?

Polls:

Do you sometimes feel there’s too much material to cover to allow:
- enough examples
- enough review
- a lot of discussion
Traditional lecture

Prof. Ricardo Gomez, Caltech, 1975

Flipping – what is it?

Before class  
During class  
After class
Flipping – what is it?

Before class  
During class  
After class
Two questions instructors ask about flipping:

**What is it?**
- short videos replace lectures
- class time used instead for discussion, examples, demonstrations

**Doesn’t it take a lot of time?**
for easy migration, use what’s familiar:
- your old slides or handwritten notes
- the same classroom
- hosting on Blackboard (or similar)

it’s ok to start with *partial* flipping

There are many ways to do flipping

**I will describe only one approach:**
- Not a radical change in teaching
  *so it’s sure to work*
- Not an intense time-pressured experience for students
  *so they’re happy*
There are many ways to do flipping

I will describe only one approach:

• Not a radical change in teaching
  so it’s sure to work

• Not an intense time-pressured experience for students
  so they’re happy

The videos themselves help,
but the main impact is from
increased discussion & examples

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Example flip videos

Approach #1: flip video using pdf handwritten notes
Approach #2: flip video using **PowerPoint**

**Flip video – before lecture 34**

PHYS: 1400 (029:008) Basic Physics

Prof. John Goree
The University of Iowa

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Approach #3: **Whiteboard** screencast
(requires tablet device)

**Projectile at an angle**

credit: khanacademy.org
Compare to a video capture of a classroom lecture

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Problems that flipping solves

What to do during class?

With flipping, you have more time. What to do with it?
What to do during class?

With flipping, you have more time. What to do with it?

Examples & discussion:

- Problem solving
- Demonstrations or simulations
- Peer instruction

An activity agenda, instead of lecture notes

Agenda that I followed in a class

(first page)
An activity agenda, instead of lecture notes

Agenda that I followed in a class

(first page)
An activity agenda, instead of lecture notes

Agenda that I followed in a class
(first page)

Another approach: in-class homework
best in a room with large tables

Mark Andersland
Engineering
Univ. of Iowa
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Outline

• Flipping - what is it?
• Problems flipping solves
• Good practices
• How to do it:
  • Hosting, equipment and software
Good Practices

Video length (minutes):
- 4-6 general education
- 5-7 intermediate course
- > 10 never

Not a whole lecture, like this:

Which is more tempting to watch?

Understanding Forensic Pathology - Lecture by Dr. Michael ...

Medical School Pathology, Chapter 25 - YouTube
Good Practices

Quizzes, to coerce students to view videos.

Ways to quiz:
In class:
• Clickers
• Paper
Good Practices

Quizzes, to coerce students to view videos.

Ways to quiz:
- In class:
  - Clickers
  - Paper
- As part of the video:
  - Flash or HTML5

Example paper quiz question for Electronics (an intermediate course for physics majors)

Which is true for an ideal op-amp:

<table>
<thead>
<tr>
<th>Voltages at the two inputs</th>
<th>The output voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) same</td>
<td>responds to the input currents</td>
</tr>
<tr>
<td>(b) different</td>
<td>responds to the input currents</td>
</tr>
<tr>
<td>(c) same</td>
<td>responds to the input voltages</td>
</tr>
<tr>
<td>(d) different</td>
<td>responds to the input voltages</td>
</tr>
</tbody>
</table>
Good Practices

Next 5 slides:

clicker quiz slides (Basic Physics -- a general education class)
The number of nuclei in a sample are plotted vs time.

At which data point is the time equal to the half-life?
**Clicker quiz: you ARE NOT allowed to discuss this with neighbor**

Which is correct regarding radiation PET imaging in medicine?

<table>
<thead>
<tr>
<th>Kinds of radiation detected</th>
<th>How it is produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Alpha and gamma ray</td>
<td>$\text{p} + \bar{\text{p}}$</td>
</tr>
<tr>
<td>B Alpha and gamma ray</td>
<td>$\text{e}^- + \text{e}^+$</td>
</tr>
<tr>
<td>C Alpha ray only</td>
<td>$\text{p} + \bar{\text{p}}$</td>
</tr>
<tr>
<td>D Alpha ray only</td>
<td>$\text{e}^- + \text{e}^+$</td>
</tr>
<tr>
<td>E Beta and alpha rays</td>
<td>$\text{p} + \bar{\text{p}}$</td>
</tr>
<tr>
<td>F Beta and alpha rays</td>
<td>$\text{e}^- + \text{e}^+$</td>
</tr>
<tr>
<td>G Gamma ray only</td>
<td>$\text{p} + \bar{\text{p}}$</td>
</tr>
<tr>
<td>H Gamma ray only</td>
<td>$\text{e}^- + \text{e}^+$</td>
</tr>
</tbody>
</table>
Before that quiz, students viewed a video with this:

Positron emission tomography (PET) imaging in medicine:
- An isotope F$^{18}$ that emits positrons is introduced into the patient.
- Positrons annihilate with electrons in the patient’s body:
  \[ e^+ + e^- \rightarrow 2\gamma \]

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Good Practices

Verify students are viewing videos

Example:
with PDF of handwritten notes
Good Practices

Guiding the eye amongst the clutter

Example: with PowerPoint

Good Practices

Showing something from a previous page
Good Practices

**Movie players**

Tell students: if the video looks bad

- try a different browser

  ![Safari](safari.png) ![Chrome](chrome.png)

- download video & try a different player.
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Outcomes
Outcomes

Student learning:
  improved

Student satisfaction:
  improved, or not, depending on:
  - what you do in the class
  - how much more time you demand

Student Satisfaction

Basic Physics – partially flipped
Student Satisfaction

Basic Physics – partially flipped

“Love the flip video.”

“Flip videos are interesting.”

“I liked the flip video because it helped me to connect what we learned in class to real-life applications.”

“The flip vids prepare me for class.”

Four students liked videos

“Flip videos could be improved a little bit to make them more beneficial when it comes to class material.”

“The flip videos weren’t very helpful.”

Two didn’t
Student Satisfaction

Electronics – fully flipped

Poll, at midterm, which do students prefer (N = 9):

- 8 continue with flip videos
- 0 switch to traditional lectures
- 1 no preference

Comment re. increased discussion & examples during class:

“extremely beneficial”

Student Learning

Electronics

Midterm exam statistics

Average score increased $p = 0.02$

- 76% fully flipped 2015 (N = 9)
- 56% traditional 2014 (N = 21)
Student Satisfaction

Not every instructor achieves improved satisfaction:

Missildine et al., *Journal of Nursing Education* (2013)

Experiment, comparing:
- flipping, classtime used for
  - case studies
  - simulations of clinical practice
- traditional lecture.

Results: with flipping,

- Exam scores were *higher* ($p = 0.003$)
- Students were *less satisfied* ($p < 0.001$)
  (They perceived they had to do *more work.*)
End

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- Flipping - what is it?
- Problems flipping solves
- Good practices
- How to do it:
  - Hosting, equipment and software

Hosting

Blackboard, ICON, or similar
- Password protected
- Track student viewing
Equipment

Camera

Microphone

Mic quality is crucial

This is where you are
Equipment

**USB microphone** (built-in mic is not recommended)

![USB microphone image](image1.png)

Price: $129.00

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Equipment

**Camera atop computer monitor:**

- built-in (FREE)
- USB (typically $60)

![Built-in camera](image2.png)

![USB camera](image3.png)
Equipment

**Tablet device** - only if you want to “whiteboard”

![Wacom Intuos Pen and Touch Small Tablet](image)

Price: $101.00

Software

**Lecture capture:**

- Camtasia: $180
- Panopto: FREE UI license
Software

Lecture capture:

- Camtasia: $180
- Panopto: FREE UI license

Screen shots & cropping

- Microsoft Paint: FREE

Drawing (for whiteboarding with tablet):

- SmoothDraw: FREE
How to learn Camtasia

Camtasia Studio 8 Tutorials
You can explore, create and share faster than ever before with Camtasia Studio 8. Whether you're a new or existing user, our tutorials are here to help you get the most out of your Camtasia Studio experience.

Getting Started
The very basics of using Camtasia Studio 8. This series starts by preparing you for sharing a finished video project. (Includes a sample script and recording to use.)

<table>
<thead>
<tr>
<th>Title</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>01: Prepare, Script, Audio</td>
<td>2:28</td>
</tr>
<tr>
<td>02: Record Your Screen</td>
<td>2:35</td>
</tr>
<tr>
<td>03: Saving Files and Project Management</td>
<td>2:49</td>
</tr>
<tr>
<td>04: Explore the Editor</td>
<td>5:10</td>
</tr>
<tr>
<td>05: Apply SmartFocus to Zoom and Pan</td>
<td>5:49</td>
</tr>
</tbody>
</table>

www.techsmith.com/tutorial-camtasia-8.html
Summary

**Outcome**
- Improves student learning & satisfaction

**What is Flipping?**
- Short videos viewed before class.
- Discussion or other activity during class.

**How much time does it take?**
For easy migration, use what’s familiar:

- your old handwritten notes or slides
- the same classroom
- hosting with Blackboard, ICON, or similar

**End**