Flipped classroom learning in a large introductory undergraduate engineering course

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Despite all these purported advantages arising from blended teaching methods, the relation between usage of the blended learning environment and student’s performance is not clearly understood. (Birch & Williams, H.E.R., 2015)
• This is the concluding report
• 2 x $2^\pm$-year TLRI-funded programs
• Surprising & unsurprising observations
Why do this study?  
What’s new?

- Intensely-benchmarked large [electronics] class
- Strong Threshold-Concept (TC) emphasis

*For same contact-hours (read “effort” or “cost”), does flipping give better learning in large, multi-lab-stream, class?*

(Turns out it is all about the labs)
Quantitative Outcomes

- Textbook
- e-Tutes
- Trial and error
- Watch live demonstration
- Partner discussion
- Ask expert
- In-class mini lectures
- Questions on Moodle
- Extra Tutes
- Problem solving with partner
- L2 videos
- L1 videos

Percentage of students (%)

- Not applicable
- Useful
- Undecided
- Not useful
[our] videos helped me learn the key ideas in the course
Quantitative Outcomes (a telling one)

Did flipping help?

Did bi-weekly IFATs (tests) help?
(Mini-)Lectures vs Videos
Lectures vs Videos

Lecturer videos

Live mini-lectures
Lectures vs Videos

Lecturer videos

Live demonstrations!
Quote 1:
This is a really good way of running a class...
I like watching videos, it’s so much more helpful than just sitting in a lecture room...
For a video you can – you can take notes, and try pausing it if you have a question.
It’s sometimes easier to lose track [in a lecture], and also, you can make a list of questions...
...and just go to your professor and ask him.

Quote 2:
The ideal would be to have both [lectures and videos]
Surprising observations

- Public video content weak on TCs
- Worse-than-expected video “attendance”  
  → grades same
- Video non-attendance  
  → punished lab staff
- Solved the “phase problem”
- Not really good value (even ignoring the NRE)
Unsurprising observations

• Low video “attendance” at lectures
• Students want BOTH lectures & videos
• Esprit de corps low
• ESL/working students especially prefer videos
• High-Q (best practice) videos appreciated
[Optional] End, Thank you...
Quantitative Outcomes

When did you watch?
- Before Monday problem solving activities
- Before labs
- Both before Monday problem solving and before labs
- Other

Did you take notes?
- All the time
- Sometimes
- Never
**The Phase Problem**

- **Lectures:** 135-155 people, run once
- **Labs:** 30 people, 5 repeats/week
- **Lead time:** 3—10 days per individual!
The Full Monte

Traditional delivery (150)

Lectures
- V, I, R
- Kirch
- Theven & Cap
- L & Transformers
- Diode & DR
- Q & M
- Trans
- Amps

6 weeks

Labs
- Solder Meas
- R & Kirch
- Theven & CAP
- L & Transformers
- LEDs & Rectifier
- Diode DR

Phase delay-problem & lab rate limit causes "stand-alone labs" (no prep lectures) and "hanging lectures" (no associated labs)

Flipped delivery (n x 30)

Prelab classes
- V, I, R
- &Kirch
- Theven & Cap
- L & Transformers
- Diode & Rectifier
- Diode DR
- Q & M
- Trans

any 6 days

Labs
- R & Kirch
- Theven & CAP
- L & Transformers
- Diode DR
- FET switch

Flip removes phase-delay problem; no "stand-alone labs", which in turn leaves fewer or no "hanging lectures" & permits addition of extra labs.
The Full Monte

Traditional delivery (150)

- Lectures:
  - V, I, R
  - Kirch
  - Theven & Cap
  - L & Tfmrs
  - Diode & DR
  - Q & M
  - Trans
  - Amps

- Labs:
  - Solder
  - Meas
  - R & Kirch
  - Theven & CAP
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  - LEDs & Rect
  - Diode

6 weeks

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  - FET
  - switch

any 6 days

Flip removes phase-delay problem to "stand-alone labs", which in turn leaves fewer or no "hanging lectures" & permits addition of extra labs.

Happens 5 times
...that Outcome

• Sliced paper into 5 independent parts
• Could run 5 staff and rank them
Lightboard videos
V=IR
Sorden (2008) effective methods for educational multimedia:

- Worked example effect
- Completion problem effect
- Modality effects
- Contiguity effect
- Personalisation principle
- Redundancy principle
- Pre-training principle
- Pacing principle

Guo, Kim & Rubin (2014) advise on creating “engaging” videos:

- Plan for and make short videos (under 6 min.)
- Use “talking heads”/human representations
- Production value might not matter
- Pre-production is important
- Declarative vs procedural videos
How we made the videos

1st step: Pre-production
How we made the videos

2nd step: Filming in controlled conditions
How we made the videos

3rd step: Reducing control over conditions
How we made the videos

4th step: Post-production