

FLIPPED TEACHING & FLEXIBLE LEARNING IN AN UNDERGRADUATE ENGINEERING COURSE



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TEACHING & LEARNING
RESEARCH INITIATIVE

NĀU I WHATU TE KĀKAHU, HE TĀNIKO TAKU

THRESHOLD CONCEPT THEORY

“In each academic discipline, there exist special concepts
- *threshold concepts* -
that once grasped, reveal new and previously inaccessible ways of thinking about a subject”.

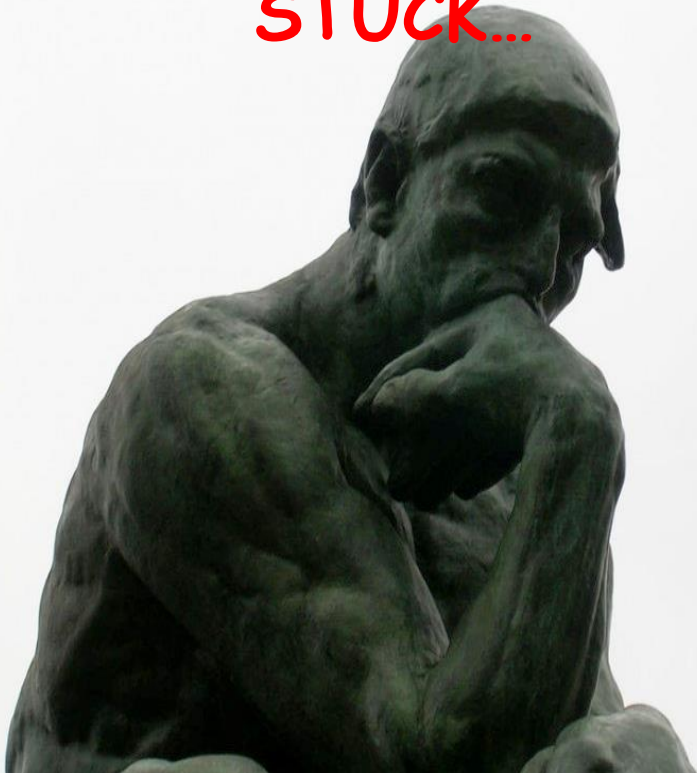
(Meyer & Land, 2003)

STUDENTS GET STUCK!



How can lecturers help students to *transition...*

FROM BEING
STUCK...



TO

MASTERING TCs



TRADITIONAL CLASS

First year Introduction to electronics engineering

Conceptually challenging

~150 students

2 lecturers (analog & digital)
6 weeks each

1 x 2hr face-to-face tutorial

1 x 3hr lab/week

2-3 lab demonstrators



2012: DE-CLUTTER THE CURRICULUM



IFAT

IMMEDIATE FEEDBACK ASSESSMENT TECHNIQUE (IF AT®)

Name _____

Test # _____

Subject _____

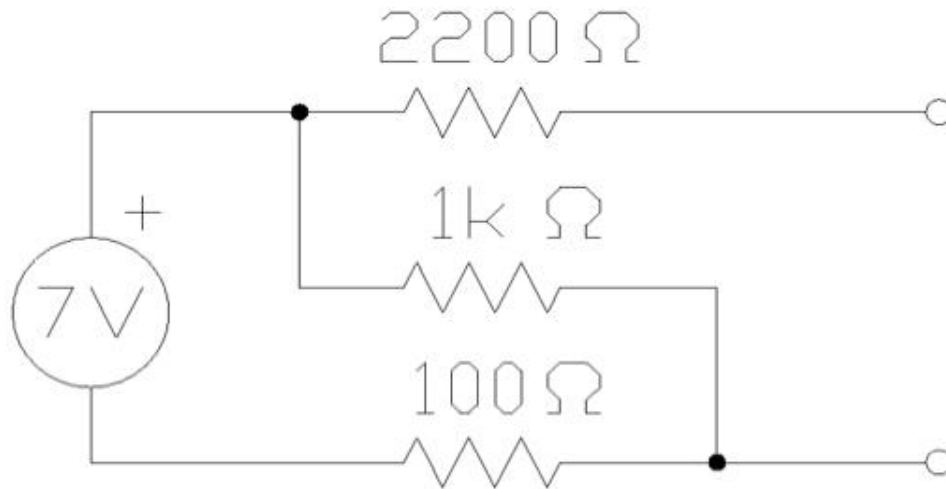
Total 32

SCRATCH OFF COVERING TO EXPOSE ANSWER

	A	B	C	D	E	Score	
1.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5	_____
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8.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1	_____
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10.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	2	<u>32</u>

2013: E-TUTORIALS

107. Thévenin 4b



What is the Thévenin equivalent resistance of this circuit?

Select an Answer

- 2290 Ohms
- 2300 Ohms
- 3200 Ohms
- 3500 Ohms

Reason for your Answer

Please give a reason for your answer...

Submit

Resource Links

Need some help? Try these links...

Section Links

[Hyperphysics - Current Law](#)

General Links

[Hyperphysics](#)

[Electronic-Tutorials.ws](#)

[All About Circuits](#)

[Electronics Club](#)

[MIT Electronics Videos](#)

SINCE SUMMER 2014...

FLIPPED CLASS

Reversal of traditional teaching

exposure to new material outside of class,

class time is used for the harder work of assimilating that knowledge through problem-solving, discussion or debates - Center for teaching, Vanderbilt University

Part/all of instruction through videos/other media

class time becomes dynamic, interactive learning environment

educator guides students to apply concepts and engage creatively in the subject matter - Flipped learning network

FLIPPED CLASS

In-class time is "re-purposed" for inquiry, application, and assessment

Students gain **responsibility** for their learning
(studying course material outside of class)

Instructors = **facilitators** of the learning process

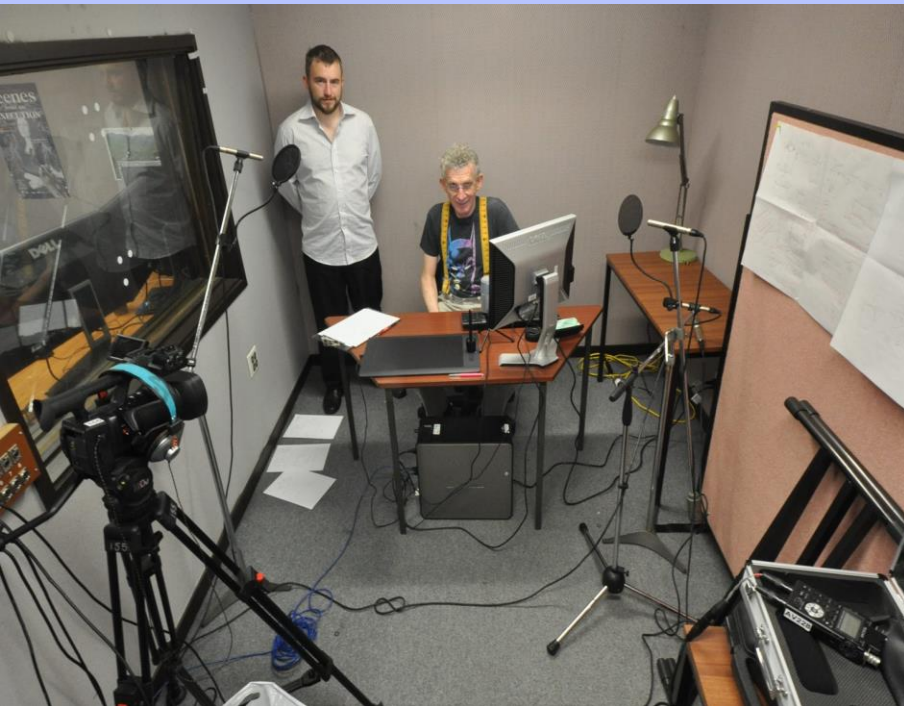
Goal = to cultivate deeper, richer **active** learning

Emphasis is on **higher-order thinking** skills and application to complex problems (through collaborative learning, case-based learning, peer instruction, problem based learning)

CYCLE 1: PREPARATIONS...

Looked at (what makes) good videos
(e.g., coherence, redundancy, spatial & temporal contiguity)

Recorded or borrowed ~60 videos @ ~8 minutes each
(3 months learning, planning, recording, watching YouTube)

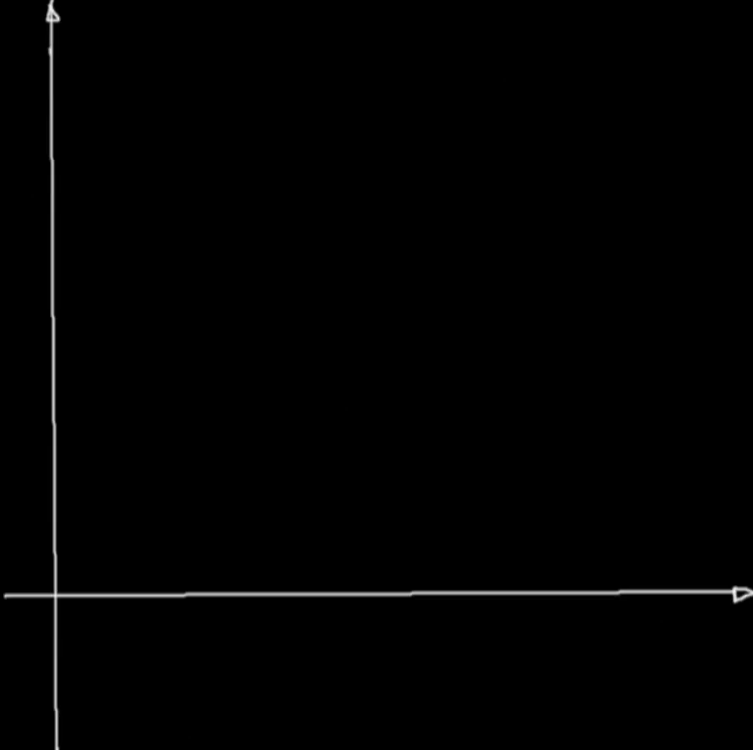
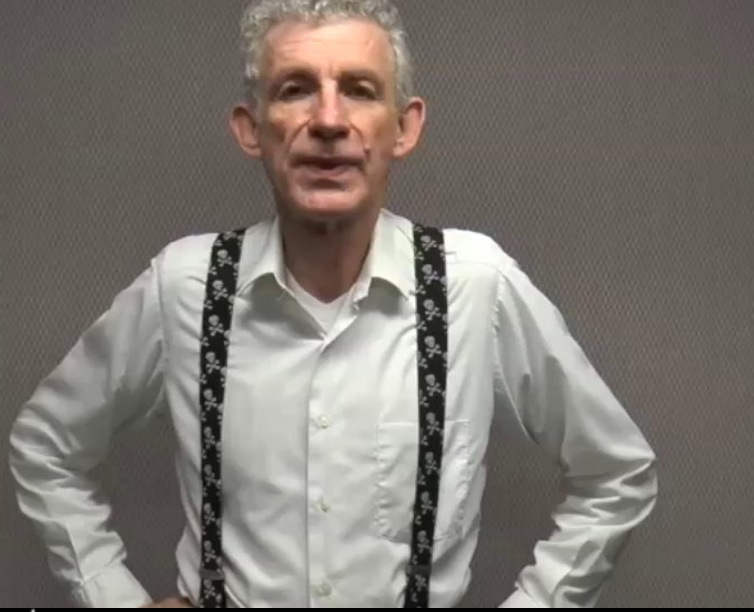


- Netlists
of circuits

- Recognising
elements in
series and parallel



$$V=IR$$



CYCLE 2

Monitored student video watching

Lecturer 1 - Lightboard based videos

Lecturer 2 - Panopto lecture videos

Continuous assessment

Revised problem solving questions



Week 4 – Worksheet – Rectifier Design

(Definitely worth doing in your lab book.)

The video at <https://www.youtube.com/watch?v=cyhzpEqXwdA> ("Diode Tutorial & How to build an AC to DC power supply", called "To-the-point diode/rectifier tutorial" on Moodle) has a great description of the simplest rectifiers and unregulated power supply circuits. It is NOT a good example of *design*, because it does not explain how to calculate the best values for components.

Design is the most important mental capacity for professionals. In this work sheet you will work in pairs to consider some design aspects of the rectifier circuit—how to calculate values before you build a circuit. We will consider the half-wave rectifier circuit that uses a single silicon diode. Your lab book might look like this as you proceed with this worksheet:

Example given

- Draw a half-wave rectifier circuit, namely a voltage source, a diode, and a load resistor; no capacitor for now.
- Sketch about 2 cycles of a 6 V_{RMS} AC waveform on a full-page set of axes. In NZ, the frequency is 50 Hz, so you want the x-axis to be about 40–50ms long. You will add various traces to this graph.
- Using the common "constant-voltage+switch model" of the diode, sketch the voltage you would expect to measure across a 1k Ω load resistor (*without a capacitor*) connected to the circuit. Remember that the forward voltage of a silicon diode is about 0.7V, as you will measure in the lab this week.
- Sketch the current you expect will be flowing in the loop.
- Consider an RC circuit consisting of 1k Ω // 2.2 μ F; what will be the exponential decay time constant for this circuit? If the capacitor started out charged to +10V, what would the capacitor voltage look like over time? Make a little sketch this, and put scales on your sketch.
- Now consider the rectifier circuit 1k Ω // 2.2 μ F connected. Sketch what you would expect to measure across the load resistor with the capacitor in parallel with the load resistor. Which parts of the waveform are "sine wave" shape, and which are "exponential" shape? Mark these on your plot.

So far everything you have done here is pretty much like the stuff in the video above.

Now we address the design question: *If it is important that the voltage across the resistor never falls below 6.5 V, how large a capacitor will be needed in the circuit?*


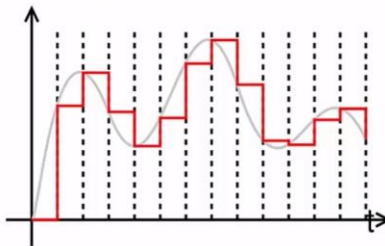
CYCLE 3

Revised problem solving questions

Monitored student video watching (stricter)

Lecturer 2 purpose made videos

Are steps a problem?



Not for sound as

- i) speakers will not operate fast enough to follow steps so sound coming out is a smoothed version of the steps
- ii) your ears can't hear above 20 kHz (can't sense the steps)

▶ 204 .307 1x Speed

THE CLASS

2015, Sem. A -> **PARTIAL FLIP (3 weeks)** lecturer-created

videos; +

group problem solving activities

2015, Sem. T -> **FULLY FLIPPED** - 50% lecturer-created

videos; + problem solving +

continuous assessment

2016, Sem. A -> **FULLY FLIPPED** - 100% lecturer-created

videos +, +

2016, Sem. T -> **FULLY FLIPPED** - 100% lecturer-created

WHAT THE FLIPPED CLASS LOOKED LIKE

3/week x 50 min. lectures replaced by videos

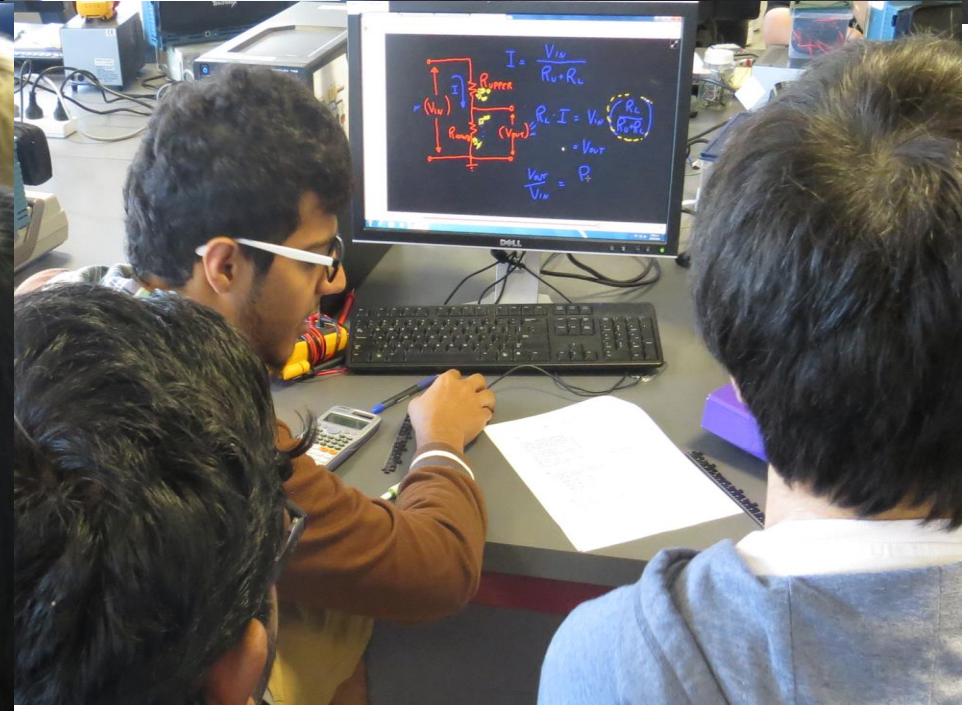
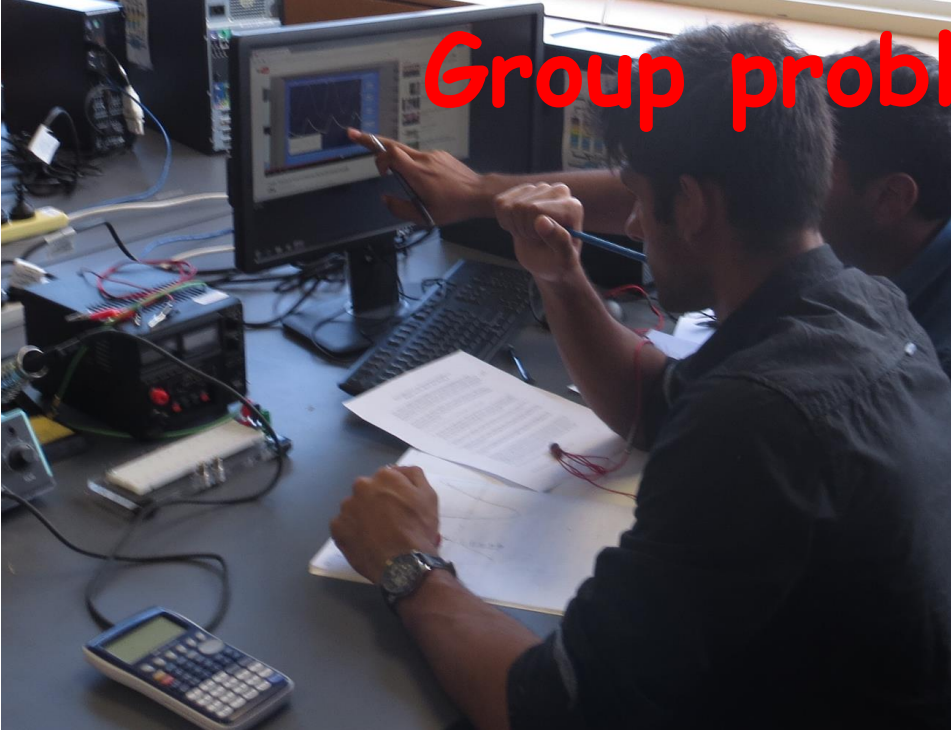
Lecture slot allocated for group problem-solving activities

Labs = 3 hours; in-class mini-lectures

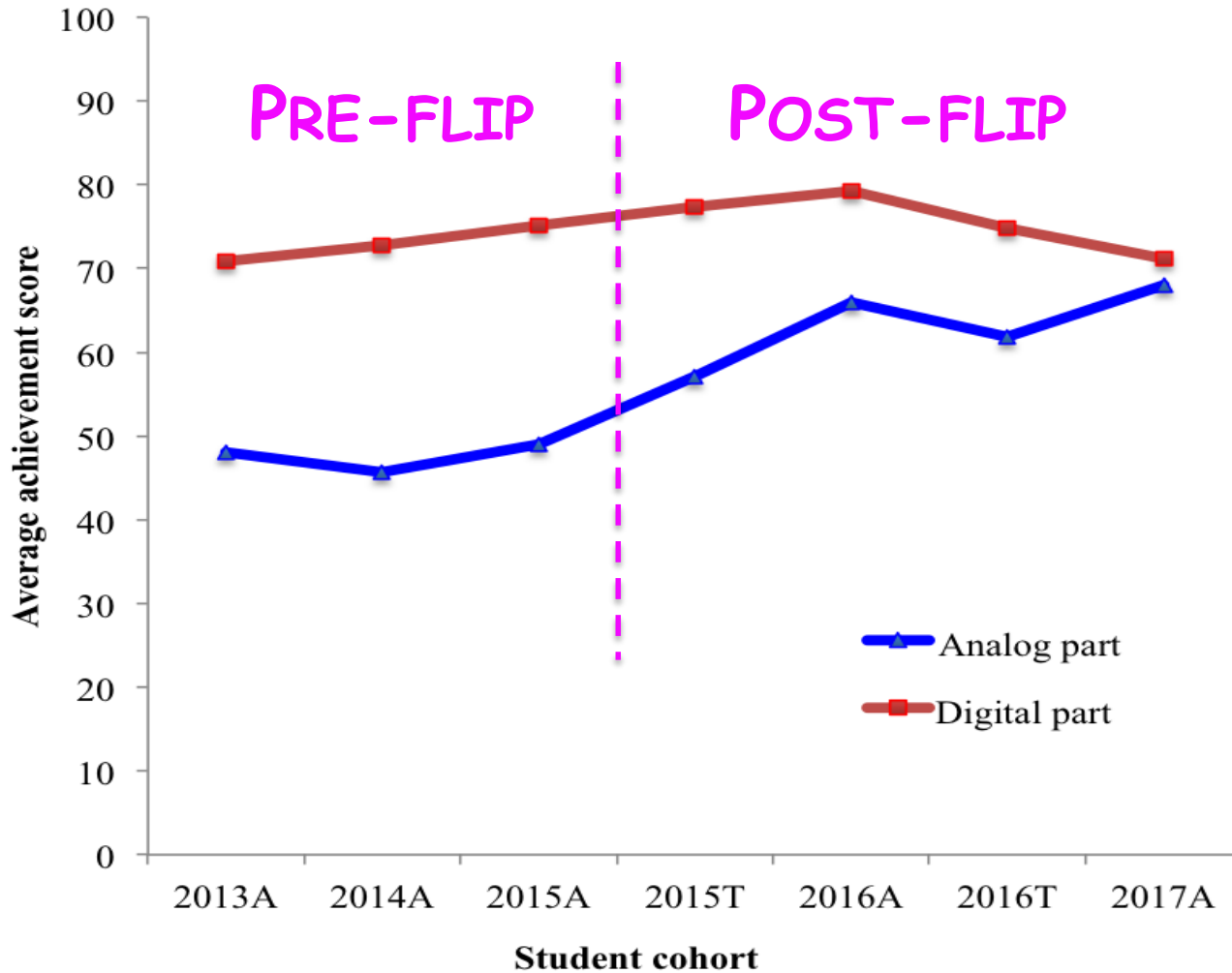
Continuous assessment; extra tutorials on demand



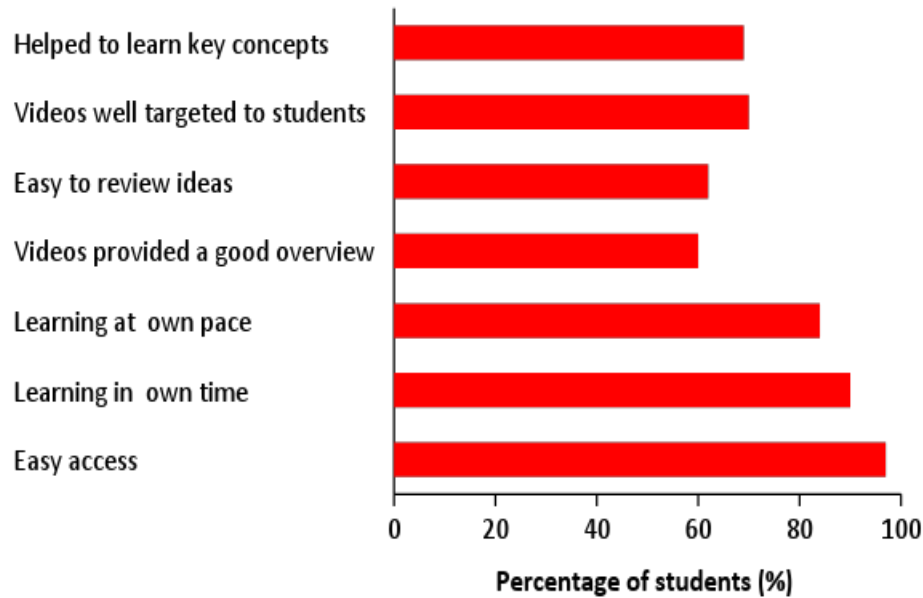
Group problem solving



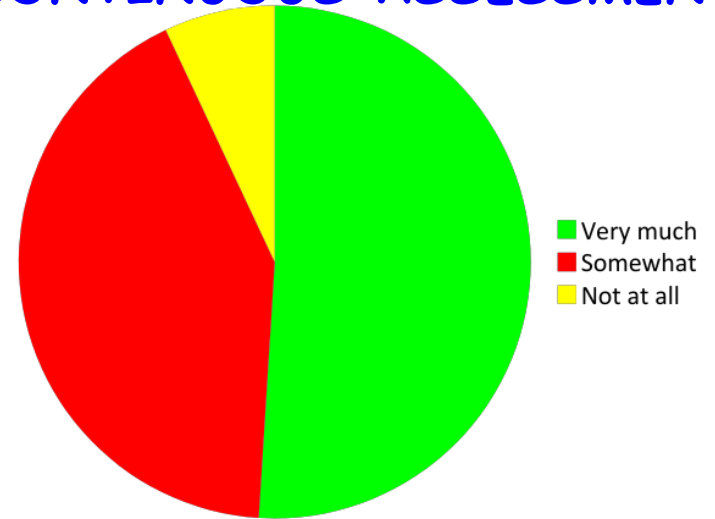
ACHIEVEMENT



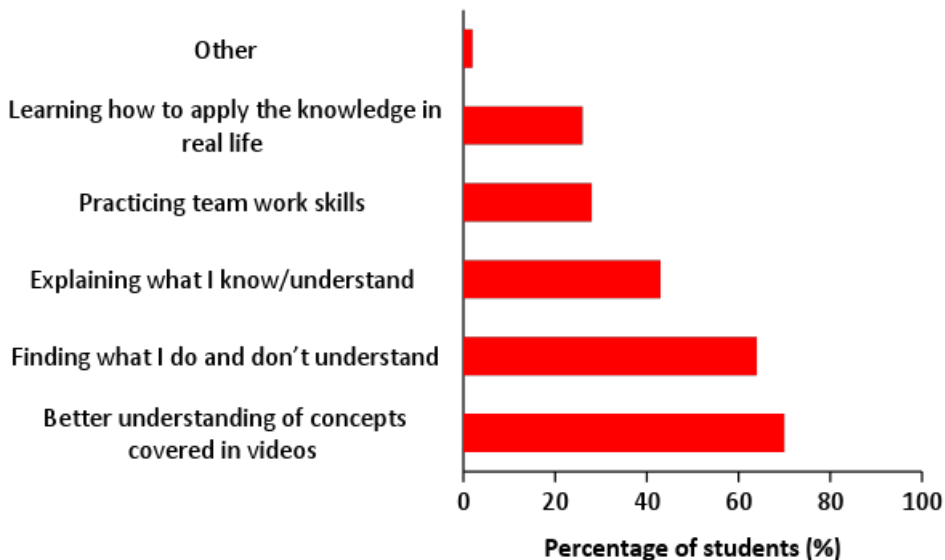
VALUE OF VIDEOS



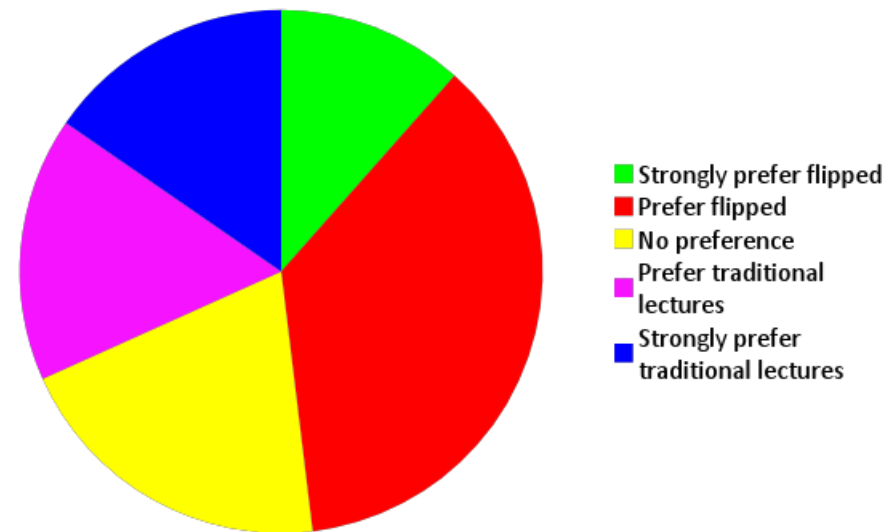
HOW HELPFUL CONTINUOUS ASSESSMENT



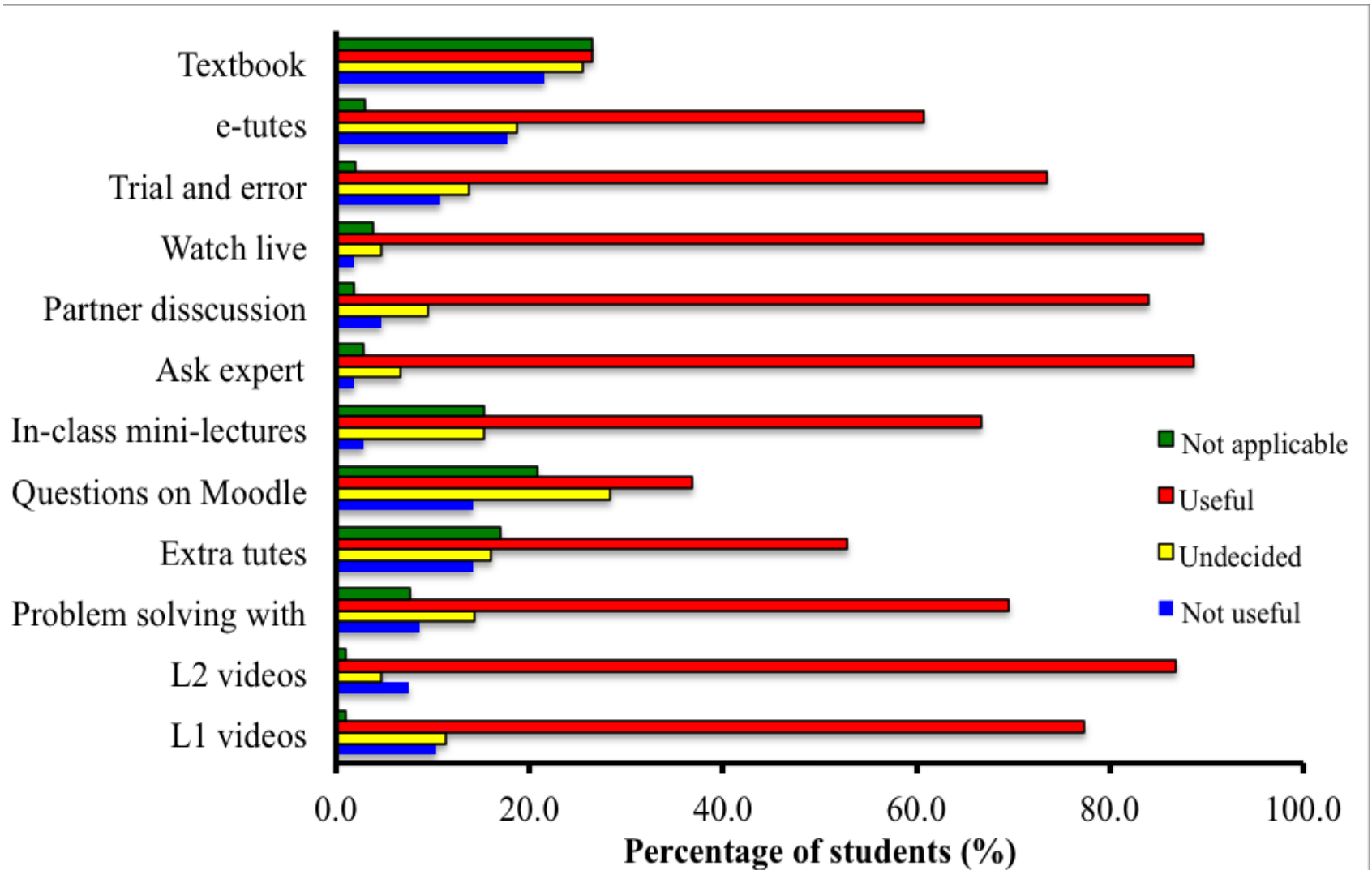
VALUE OF GROUP WORK



FLIPPED VS TRADITIONAL



WHAT HELPED LEARNING



STUDENTS' VIEWS

Videos

I did like having the [video] intro and the summary. The intro was good because when I watched the videos I just made a decision how much I already [knew]....

Mini-lecture format

I really like the lectures that are held in the labs so we can go through worksheets and we can get explanation of what to do on the whiteboard...

Working with a partner

...if we were a bit confused about something we would talk it over and then if I thought that I had a handle on it then I would explain my thoughts to him and he would think it over and go, "oh yeah that makes sense" or if there was a flaw in my thinking he'd point that out.

LECTURERS' REFLECTIONS

Students were more engaged and seemed to enjoy the paper more as a result.

Frequent tests were good - students had to keep up to date.

Students need guidance on which of the analog videos to watch as they seem a bit overwhelmed by the number of video clips available.

Problem solving worked well - students found some of it a bit challenging, but they help to complement the lectures.

IMPLICATIONS

CURRICULUM

Refine course content and structure

Ensure coherence of overall course design

Make incremental changes

PEDAGOGY

Short, educationally good quality videos are essential

Variety of learning supports

Changing lecturer role

IMPLICATIONS

ASSESSMENT

Continuous assessment

STUDENT LEARNING

Changing student role

Learning technical and non-technical skills

INSTITUTIONAL SUPPORT

Interdisciplinary collaboration

Time and incentive for lecturers

THANK YOU



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