Technological tools to support active learning

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Outline

• **Context**

• **Implementation**
  – Pre-reading quizzes
  – Pencasting
  – Clicker vote evaluation (EVAF)
  – Active engagement experimental demos
  – Workshops

• **Summary**
Context

Scottish undergraduate degree system:
Bachelors degree in 4 years
Masters degree in 5 years

First year calculus-based introductory physics courses
Newtonian mechanics (1st semester)
Modern physics (2nd semester)

250-300 students
80:20 male and female
75:25 British and non-British students
Mixed cohort (50:50 majors and non-majors)
Motivation: the Traditional Classroom

Private study time

Class time
Motivation: the Flipped Classroom

Class time

Private study time
Want more on detailed pedagogy, outcomes and evaluation? See here:

bit.ly/EdPhysFlip
What happens: Course Structure

Week $n - 1$
- Personal Reading

Online Reading Quiz

Week $n$
- Peer Instruction
- Lectures

Q6: “What I still don’t understand is…”

Week $n + 1$
- Hand-in Assignment
- Workshops

What I still don’t understand is…”
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**Question 5: Multiple Choice**  
Taking $g = 10 \text{ ms}^{-2}$, how long does it take a stone thrown vertically upwards at 5.0 $\text{ms}^{-1}$ to return to my hand?

- Correct
  - 0.5 s
  - **1.0 s**
  - 1.5 s
  - 2.0 s
  - 4.0 s

- Unanswered

Average Score: 1.78228 points  
Per cent Answered:
- 4.435%
- 89.113%
- 1.21%
- 2.419%
- 1.613%
- 1.21%

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**Question 6: Fill in the Blank**  
Please tell us what you found difficult or confusing about this week's reading. If you didn't find anything confusing, tell us what you found most interesting. (Note: you may find it easier to type out your response in a text editor (e.g., Notepad) then copy and paste it in to the quiz box.)

Correct Answers

- thinking to round or not (1 question)
- didn't realise there was so much additional material in the online version.
- I found most confusing the solving equations using differentiation and integration, since up until now that was a privilege reserved to the teacher.
- the detail the content goes into is definitely more intriguing than in school.
- making estimates about physical quantities was the most difficult part.
- no real difficulties I don't think
- all good so far
- I found the aside on negligible force and non-linear dynamics interesting.
- good to review what we have covered in school, it seems such a long time ago and I feel like I had forgotten most of it. looking at problems and using the strategy to solve it as introduced in the first section I feel is useful and will help me to visualise the situations better.
- just some badly worded questions
- some of the projectile motion took some time to grasp.
- I found the use of differentials in the explanation a bit hard but interesting
- I struggled with the new style of learning, but I'm sure I will adapt
- I think the most interesting is calculating the change in energy of objects moving and colliding

Per cent Answered:
- 0.403%
Just in Time Teaching

Smart pen

Ballpoint pen with integral digitiser and microphone. Captures penstrokes and audio recording in sync.

www.livescribe.com
### Responses Outline

Number of students with clickers = 325.
A bead is given a small push at position A and is constrained to slide around a frictionless circular wire in a vertical plane. Which best describes the direction of the acceleration when the bead is at the position B?

Date/Time: 2012-10-01 11:03:21 UTC
Lecturer: Ross Galloway
Show the original question
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**Impulse (pre-discussion)**

- Incorrect: 29.3%
- Correct: 50.0%
- Invalid: 0%

**Impulse (post-discussion)**

- Incorrect: 33.0%
- Correct: 33.0%
- Invalid: 0%
Active engagement experimental demos

Just showing a demonstration is not very effective

*Role of physics lecture demonstrations in conceptual learning*
Kelly Miller, Nathaniel Lasry, Kelvin Chu, and Eric Mazur (2013), PRST-PER

Prediction and interpretation is important
e.g. Predict-Observe-Explain approach

Summary

- None of these tools are vital
- But they bring some advantages
  - Convenience
  - Insight
  - Flexibility
  - Scalability
  - Repeatability
  - Responsiveness
- They make it easier to do ‘small group style’ in large group classes
For every $N$ hours you spend in Physics classes, how many hours do you spend in your own private study of Physics?

A) $\sim 0$
B) $\sim N/2$
C) $\sim N$
D) $\sim 2N$
E) $> 2N$
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The bar chart illustrates the distribution of hours of private study among students in two different educational methods: Traditional and Inverted.

- **~0 hours**: Approximately 25% of students in both methods study for this amount of time.
- **~N/2 hours**: A significant portion of students (45%) in the Traditional method study for this amount of time, while fewer students in the Inverted method do so.
- **~N hours**: A smaller fraction of students (20%) in the Traditional method study for this amount of time, compared to the Inverted method.
- **~2N hours**: A small percentage of students in both methods study for this amount of time.
- **>2N hours**: Only a very small fraction of students in both methods study for this amount of time.

Bars in blue represent the Traditional method, while bars in green represent the Inverted method.
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Hours of Private Study

- ~ 0
- ~ N/2
- ~ N
- ~ 2N
- > 2N

Fraction of Students

- Traditional
- Inverted