

How do we engage students with derivations and proofs in large classes?

OLT National Teaching Fellowship

*ANZMC8 2014*

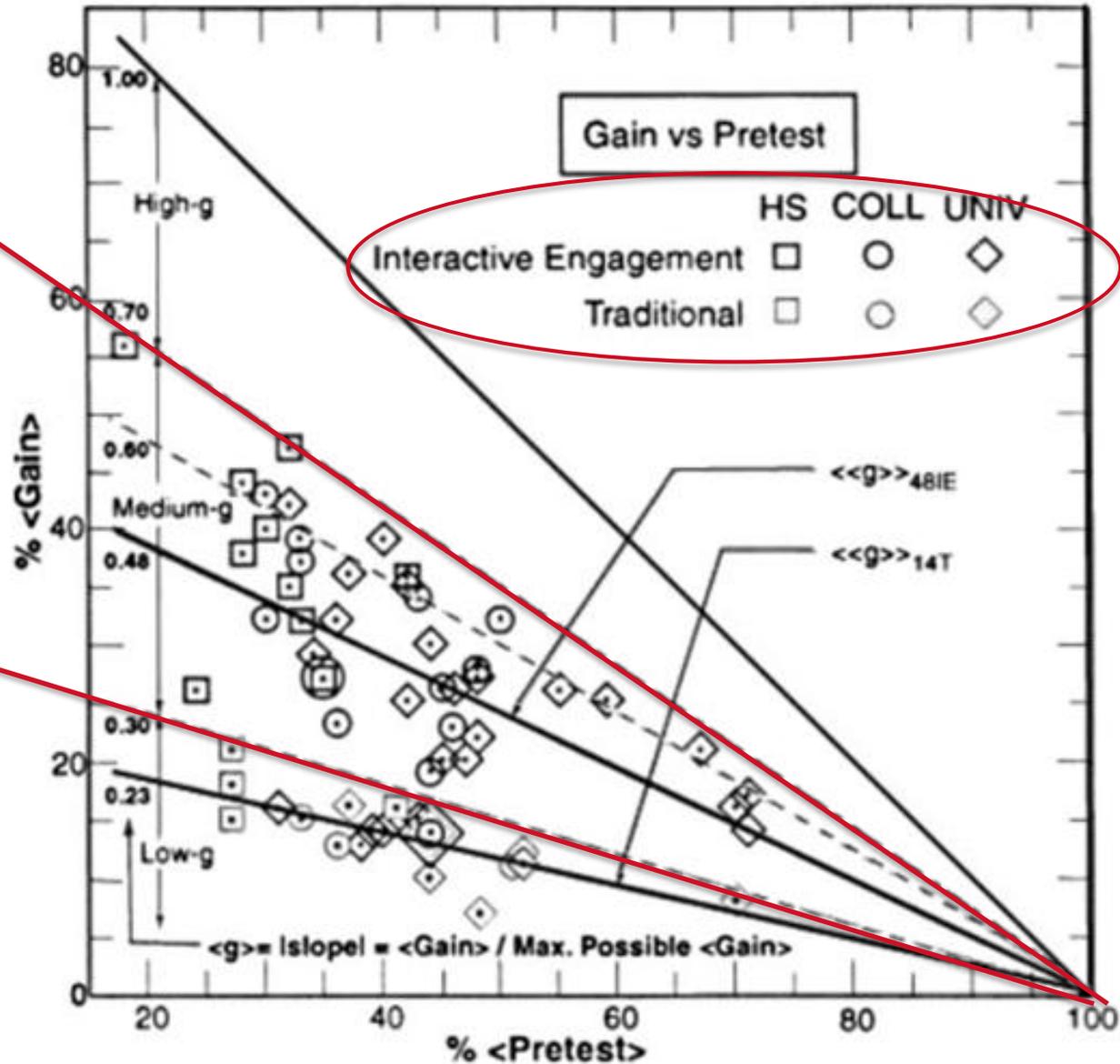
Manjula Sharma

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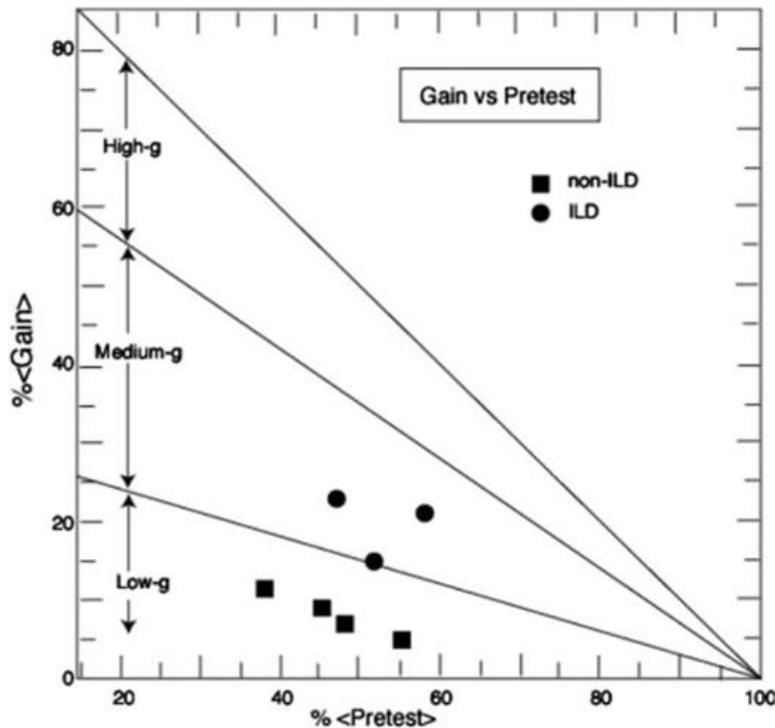


THE UNIVERSITY OF  
SYDNEY



**Hake Plot**  
Interactive-engagement vs. traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses  
Richard Hake  
1998 American Journal of Physics v66 p64-74

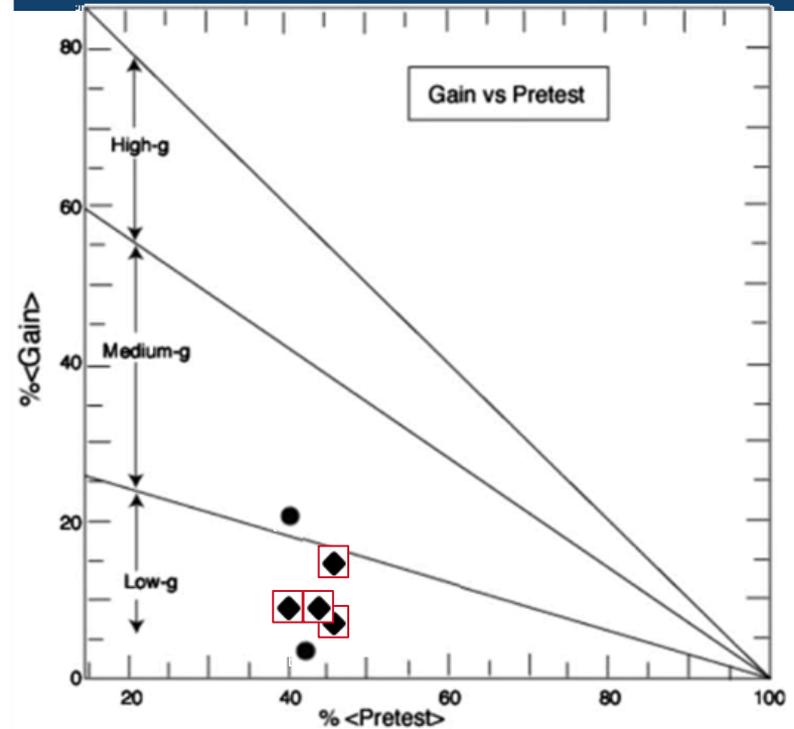
# Historic data Physics gains



## FMCE

Georgiou, H., and **Sharma, M. D.** (in press, 2014) Does using active learning in thermodynamics lectures improve students' conceptual understanding and learning experiences?, *European Journal of Physics*.

**Sharma, M. D.**, Johnston, I. D., Johnston, H, Varvell, K., Robertson, G., Hopkins, A., Stewart, C. Cooper, I. and Thornton, R. (2010) Use of interactive lecture demonstrations: A ten year study. *Phys. Rev. ST Phys. Educ. Res.* 6(2), 020119.



## Thermal

# Framing ... OLT Fellowship

We set out to work with colleagues who lecture.

- Those who have not engaged yet.  
Peer Review of Teaching (PRT) Program
- Those who have  already enacted change.
- Those who are  interested in enacting change but do not have  time or resources.

*PRT Program-early career lecturers*

*Initial workshop-set objectives*

*HG/MS observe one lecture - objective*

*Coffee/feedback*

*HG/MS observe another lecture*

*Coffee/feedback*

*Forum in Nov*

*Observe 2 lectures given by others*

*Data on templates, lecture recordings,*

*Theory*



Discipline	n	Comments
Biology	3	
Physics	11	Ad hoc local mentoring Demonstrations
Chemistry	9	Chemistry mentors assigned Worksheets
Mathematics	5	
SMB	1	
Others	3	

*ITL program with Faculty based peer review*

## People who lecture

1. Universities value research so participants would engage superficially.
2. People will teach as taught and will not see why they need to change.



# Changing techniques - chemistry

*<sup>AW</sup> I want to be interactive and engage students and I don't know how to do it. As a first time lecturer I don't know how long to wait, whether chatter is good or bad. I don't know how to interpret class behaviour. I need to know if I am on the right track.*

*<sup>AD</sup> I had never thought that I should think about how I lecture in this way. I always think about the content and spend time organising demos, examples and what I am going to say when - pacing is difficult.*

*RZ I have lectured in Masters courses ... first time lecturing large 1<sup>st</sup> years. I have received help and materials from someone who is regarded as a good lecturer and is teaching the other streams. I am **aware that students are not following derivations and I don't know why are included in lectures.** ... It is too high a risk to change and I don't know what to change ... and how to change. I am willing to spend time. I have already spent lots of time.*

***I am committed to my students learning... my child***

# Changing structure - physics

*SA I was taught in a transmission mode which made me uncomfortable. ... I am very excited because there are lots of things I can try. ... I would have been doing the same things for a long time. ...*

## Observation and feedback

*I have used worksheets which made me rearrange content. Half of the content was integrated into discussions on worksheet questions ... very important ... rather than stating as a fact.*

## WORKSHEETS IN PHYSICS

- › **Objectives:** “To add material to lecture that is not in the textbook into the lecture”, “make students more engaged”
- › **Observations:** very low attendance in lectures, students seemed to be distracted (checking phones, ipads), lecture time spent deriving various equations (which need to be derived) but derivations not examinable, lecturer spent much of the time writing on board with questioning
- › **Implementation:** Worksheets widely used in chemistry were implemented in this physics class
- › **Demonstration:** Worksheet – simply print ‘worked example’
- › **Conclusions:** Use of worksheet lead to rearrangement of content; half of the content was integrated into discussions based on worksheet problems. There was more impact; rather than statement of equations as facts, students engaged more with conceptual nature of derivations. Students were making notes, performing calculations and showed higher levels of general engagement

## SMARTPEN IN MATHS

- › **Objectives:** “To excite students (or to keep attention throughout the lecture)”, “to keep attendance high”, “to teach efficiently/good explanation”, “to involve the students in the lecture’
- › **Observations:** Students writing for most of lecture; student’s engagement was fairly high but dropped towards the end; some issues with audio-visual (document projector); students enjoyed ‘off-script’ interaction by lecturer.
- › **Implementation:** Smartpen as a way of removing ‘non-essential’ content from lectures to free up lecture time for more active learning
- › **Demonstration:** Maths example link
- › **Conclusions:** Students provided very positive feedback, possible adoption across other units of study



Demonstrate PDF

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## SOCRATIVE IN CHEMISTRY

- › **Objectives:** “to ascertain how well the students are engaging and understanding concepts”, “to improve engagement of students”, “to make the lecture enjoyable so that even students who ‘leave’ chemistry will remember some concepts”
- › **Observations:** most students were engaged with worksheets (ensured they collected them and filled in correct answers), but some waited for group members or lecturer to provide answers without attempting it first themselves, small number of students feed back to lecturer, lecturer moved through lecture theatre to provide assistance to students (but is limited due to time and the large awkward space)
- › **Implementation:** [Socrative](#) (web-based personal response system)
- › **Demonstration:** Slides to follow (log in to [Socrative.com](#) as a student and type in **Room Number XXXXX**)
- › **Conclusions:** Use of Socrative already in chemistry with some success.

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## Lecture as a delivery mode

3. Largely, only one thing occurs – transmission
4. Interactivity = student engagement

# Take home message

*Replace lectures with another delivery mode and problems with university teaching will magically disappear.*

...online...

...flipped...

...blended...

...small group/class teaching...

...no new lecture theatres...

... ipad/laptop...

# Colleagues from



Flinders University



Dr Helen Georgiou

Xing Wang, Matthew Hill, Dr Alex Yeung

Universities, staff, students, colleagues

SaMnet, IISME, SUPER, networks ...



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