Seating Chart

Please sit in your “assigned seat” & introduce yourself to the person sitting across from you.

A. Einstein M. Curie

M. Faraday P. Curie

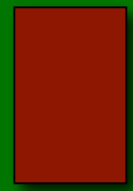
A. Arons E. Noether

R. Feynman G. Galilei

H. Hertz J. Maxwell

I. Newton M. Mayer

L. Alvarez G. Kalbfleisch



S. Hawking J. Redish

L. McDermott N. Bohr

M. Moe W. Moebs

E. Schroedinger W. Pauli

W. Heisenberg E. Fermi

E. Rutherford M. Born

C. Yang H. Weckbach

A. Michelson L. Boltzmann

G. Uhlenbeck G. Jones

Teaching Physics Interactively

Vince Coletta & Jeff Phillips

Loyola Marymount University

SCAAPT Spring Meeting

April 23, 2006

Overview

I Why teach interactively?

II Ways we teach physics interactively

III Our research

I Why teach interactively?

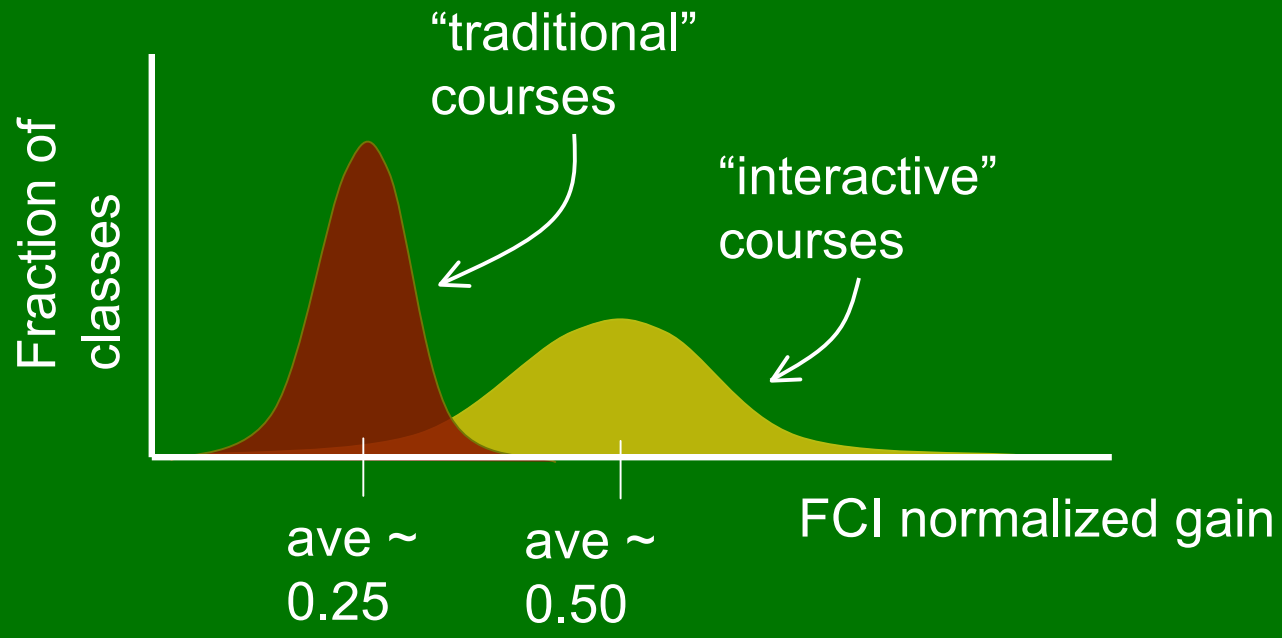
Measuring Understanding

- Pre & post instruction testing with concept-based standardized exams
- Normalized gain *G* allows us to compare learning of students starting at different levels.

$$G = \frac{\text{post\% – pre\%}}{\text{100 – pre\%}}$$

Ex: 20% → 60%
50% → 75%
80% → 90%
G = 0.5

Traditional Instruction Remains the Norm!



There are many different Interactive Engagement (IE) methods, all involving student response.

II Ways we teach physics interactively

Phillips:

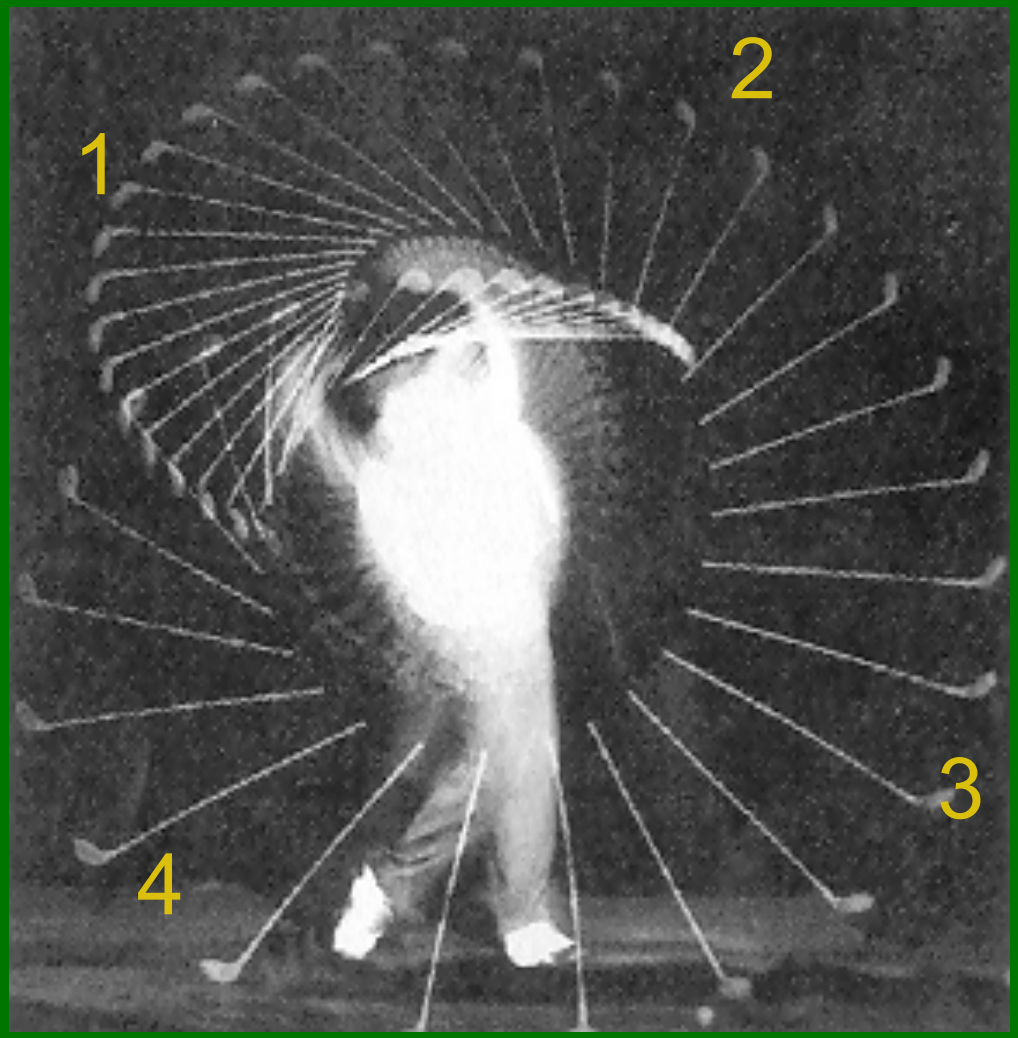
1. *Exploration phase-* Demonstrations or simulations provide data on which a model is built
2. *Testing phase-* Students study and refine models
3. *Application phase-* Context-rich scenarios are analyzed

Coletta:

1. Concepts – lecture, questions, discussion;
2. Group Problem solving; estimation problems

Concept Question

Where is the speed of the club head greatest?



Animated Concept Questions – vectors

Concept Question

David is surprised at the poor gas mileage he gets with his new car, a small Jeep with “monster” tires, which are the same as standard tires except that all dimensions are scaled up by a factor of two.

A) What is the ratio of the moment of inertia of a monster tire to the moment of inertia of a standard tire?

B) What is the ratio of the rotational energy of a monster tire to that of a standard tire when they are on cars that move at the same speed?

1) 2 **2**) 4 **3**) 8 **4**) 16 **5**) 32

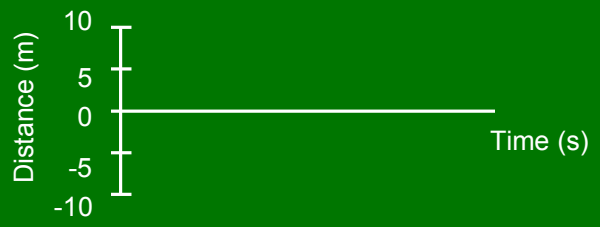
Running Man

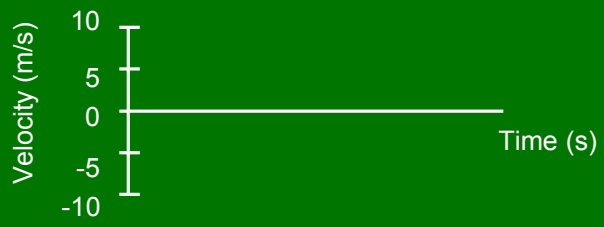
"Now that we've seen one representation of motion, motion diagrams, let's look some others- position, velocity and acceleration versus time graphs. To do this we'll use a simulation which lets us control a man, er…, a *model* of a man. In this simulation you can move the figure with your cursor and watch the corresponding graphs, or you can adjust the graphs via the sliders to the left of the graphs and watch the man dance.

First, take a few minutes to play. Well, let's say *investigate* to sound more scientific. Try both methods of moving the man- using the sliders and dragging him with your cursor. Use the playback features to look at how the motion and graphs correspond."

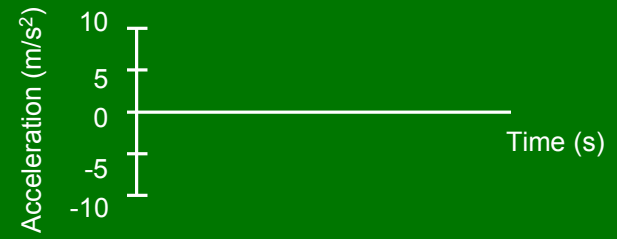
Running Man- Part 2

"Let's get more rigorous. What follows are several situations, you are to *first* make a prediction as to what the distance, velocity and acceleration graphs will look like for that description. Then, get your little guy to follow directions and show you the motion. Compare your predicted graphs to the ones given by the simulation and note any differences.





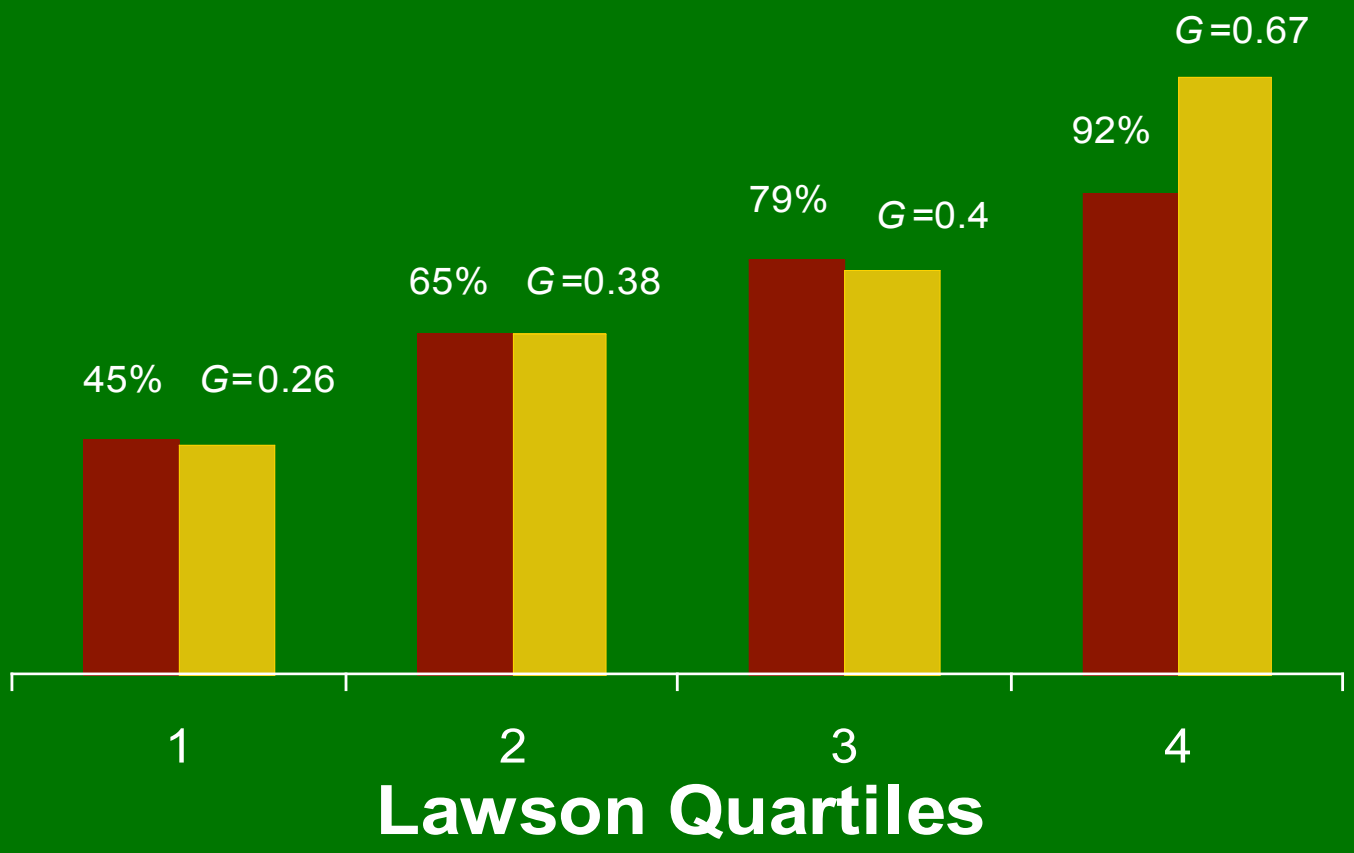
Scenario #2: The man starts close to the tree, stands still for a little while, then walks toward the house at a constant rate for a while, then slows gradually to a stop."



III Our Research

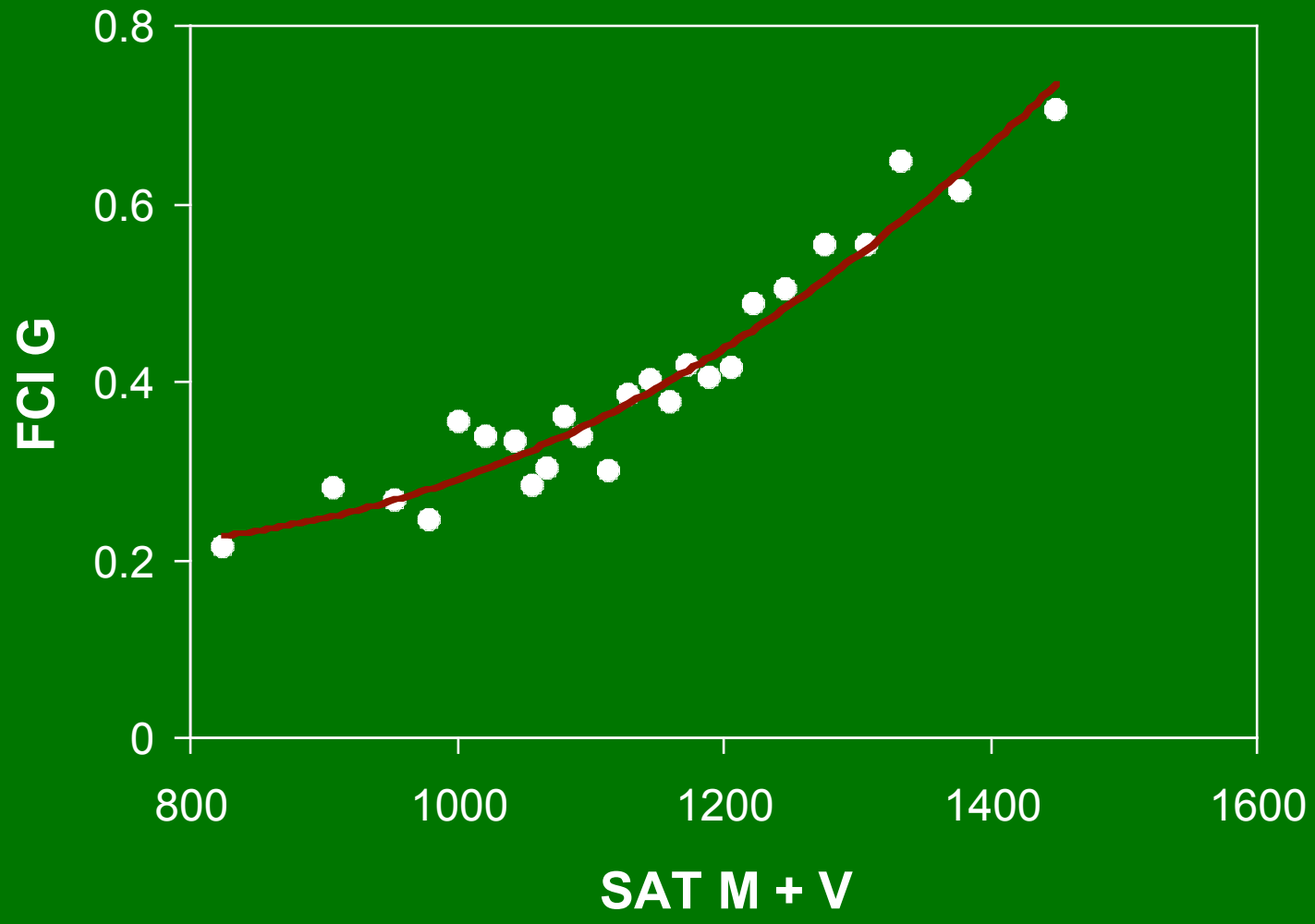
Individual Student FCI & Lawson Test Data

98 LMU students



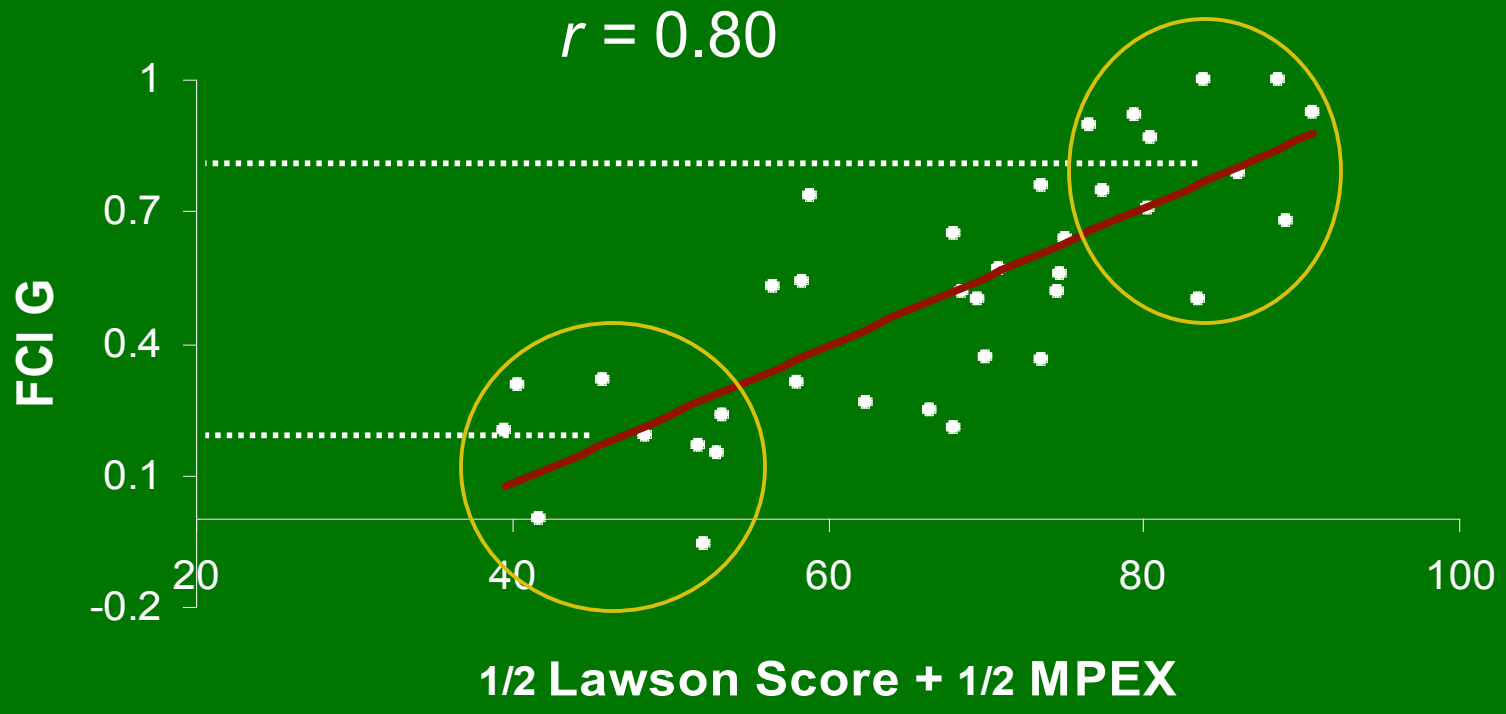
Conceptual Learning in Physics & SAT scores

628 students from LMU & Edward Little HS



Attitude as an Indicator

- MPEX is an indicator of attitude toward learning physics.
- MPEX scores correlate strongly with FCI *G*, but are uncorrelated with Lawson scores.
- Combined MPEX & Lawson % strongly correlates with FCI *G*.



Efforts to Improve Reasoning

- Reuven Feuerstein's Instrumental Enrichment
- Philip Adey's Thinking Science (a.k.a. **C**ognitive **A**cceleration through **S**cience **E**ducation)

“Interpreting FCI Scores: Normalized Gain, Pre-instruction Scores, & Scientific Reasoning Ability,” *American Journal of Physics*, December, 2005

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Thank you!