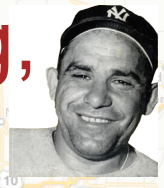
If You Don't Know Where You're Going, You Might Wind up Someplace Else



Where are we now ?

Where should we go next ?

How will we know if we get there ?

Mats Selen UIUC Physics

"What can PER Contribute to the Design of High Quality Distance Education?"

Distance education and "bricks & mortar" education are in a three legged race.

Either both win or both lose

Guiding this effort should be a PER priority

Where are we now ?

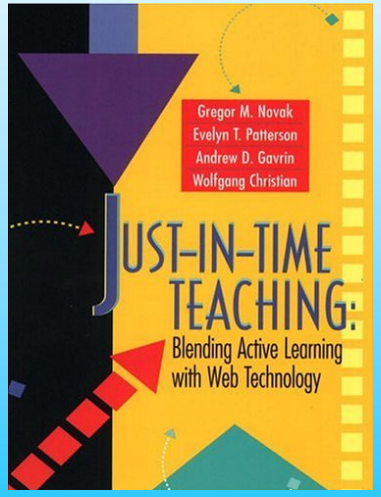
(My very limited perspective)

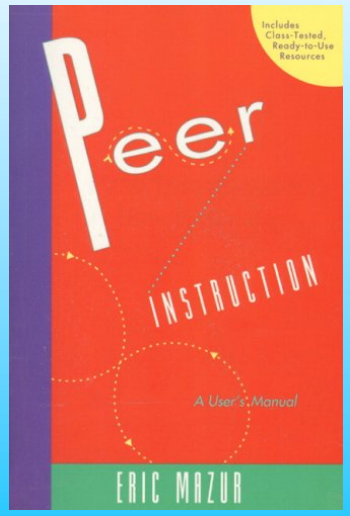
- In the age of amazing tools & technology !
  - Online Educational Content
    - MOOC's, Online Courses, Piazza…
    - Frameworks for Prelectures, JiTT, Homework, …
  - Low Cost Educational Hardware
    - clickers, IOLab, smartphones, Arduino, …
- If you can imagine it, you can have it
  - This doesn't mean that things are simple
    (this is good - makes our jobs interesting)

example…

Problem: Students are not engaged in large lecture classes.

Solution: Just in Time Teaching & Peer Instruction

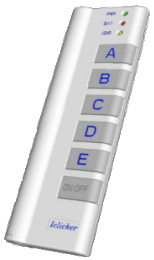




Problem: Large classes requires better clickers to implement Peer Instruction

Solution: Exploit new technology and build them

2002



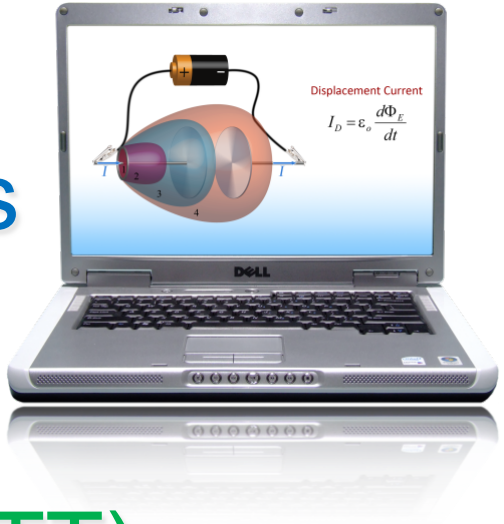
2012…

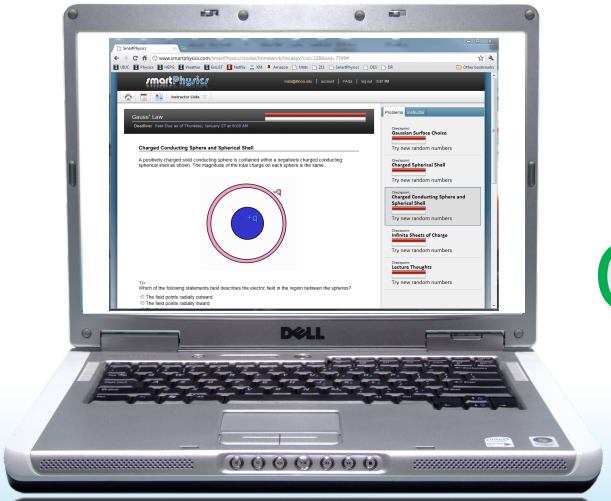
Problem: JiTT & peer instruction reveals that students come to class unprepared

Solution: Create prelectures and verify student preparation before class.

UIUC: Flipping intro physics since 2008

Pre Lectures

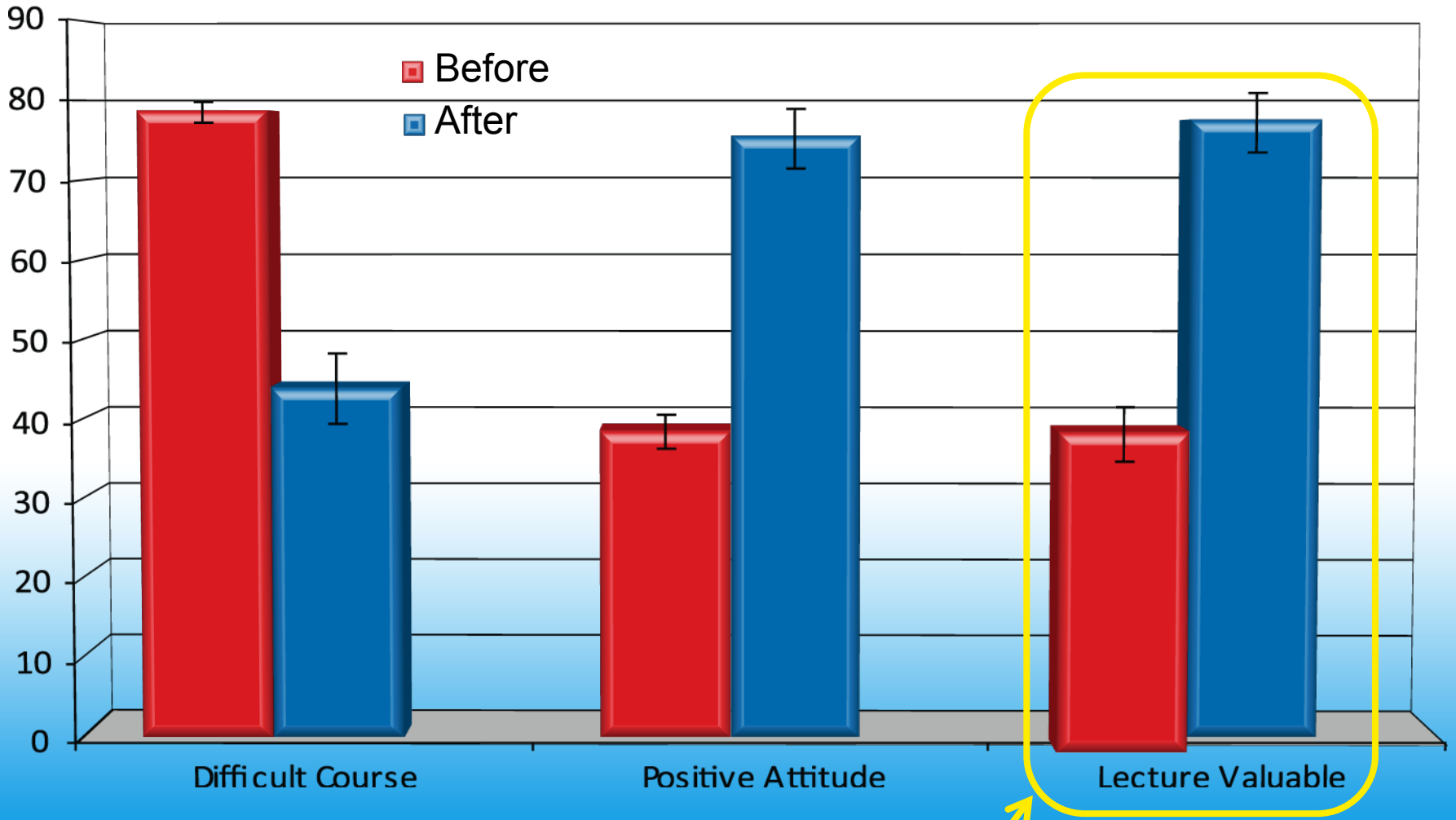




Checkpoints (JiTT)

Peer Instruction

Student Perception of Course

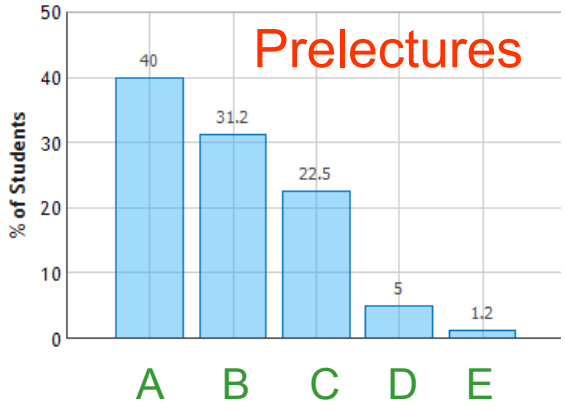


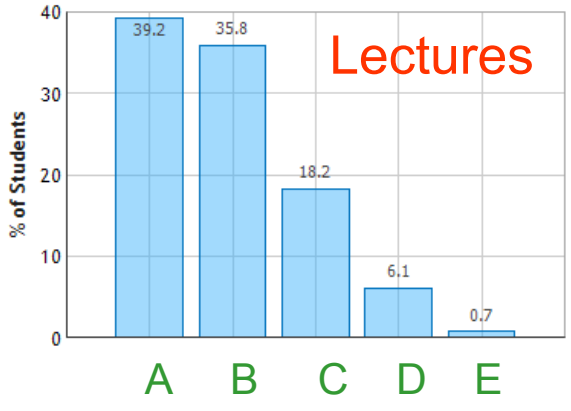
Am. J. Phys. 78, 755-759, 2010
Phys. Rev. ST Phys. Educ. Res. 6, 1-5, 2010

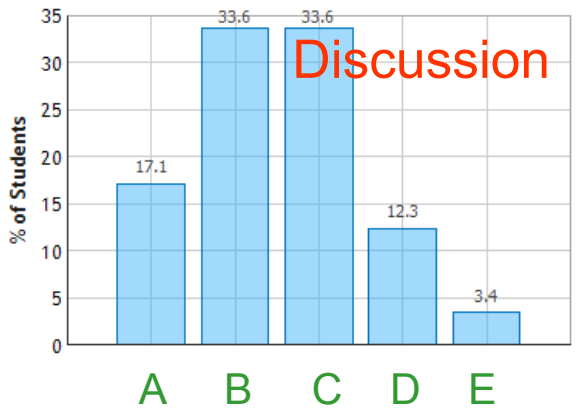
Three Legged Race !

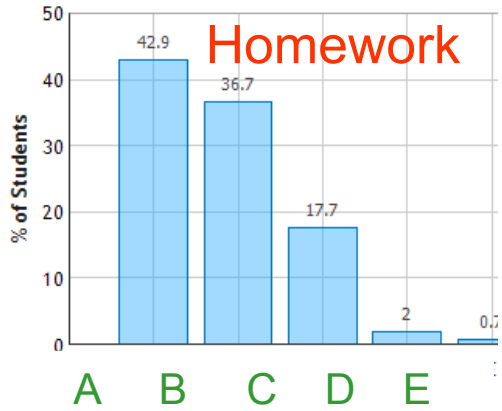
UIUC Intro Mechanics (950 students F13)

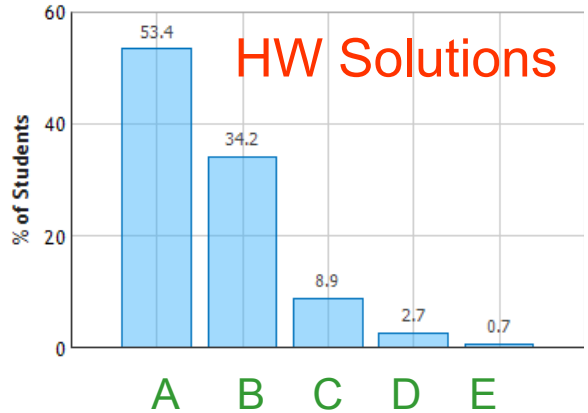
How important were _____ in helping you learn the material

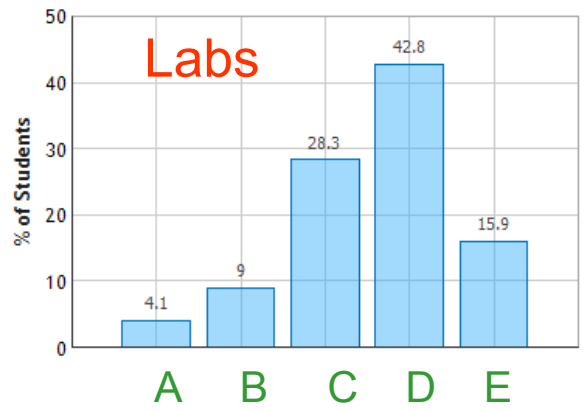












A: Essential, B: Very Important, C: Somewhat Important, D: Not very important, E: Useless

Problem: Our intro labs are not helping our students

Budget & space constraints: - Labs crowded

- Activities not well timed

Possible Solution: Interactive Online Labs (IOLab)

Students have their own devices

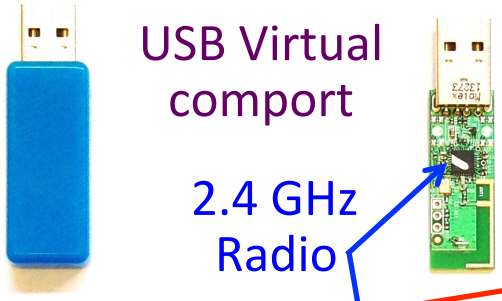
Lab activities can be done anywhere at any time.

Pedagogy !

Ideal approach for Distance Learning

IOLab

App for Mac & Win
(Open source API)



USB Virtual comport

2.4 GHz Radio

Microphone

(up to 4.8 kHz sampling)

Magnetometer

Buzzer

Light Intensity

Accelerometer

Gyroscope

MSP430 micro
("over the air" reprogrammable)

Expansion Connectors
6 x Analog in
1 x DAC out
6 x Digital I/O/PWM
Hi-Gain Amp
FTDI Header
(V_{bat}, $V_{3.3}$, gnd)

Temperature

Atmospheric Pressure

Wheel Encoder
(y, v_y, a_y)

Force Probe ($\pm F_y$)

Designed to be opened, messed with, & reprogrammed (open source firmware)

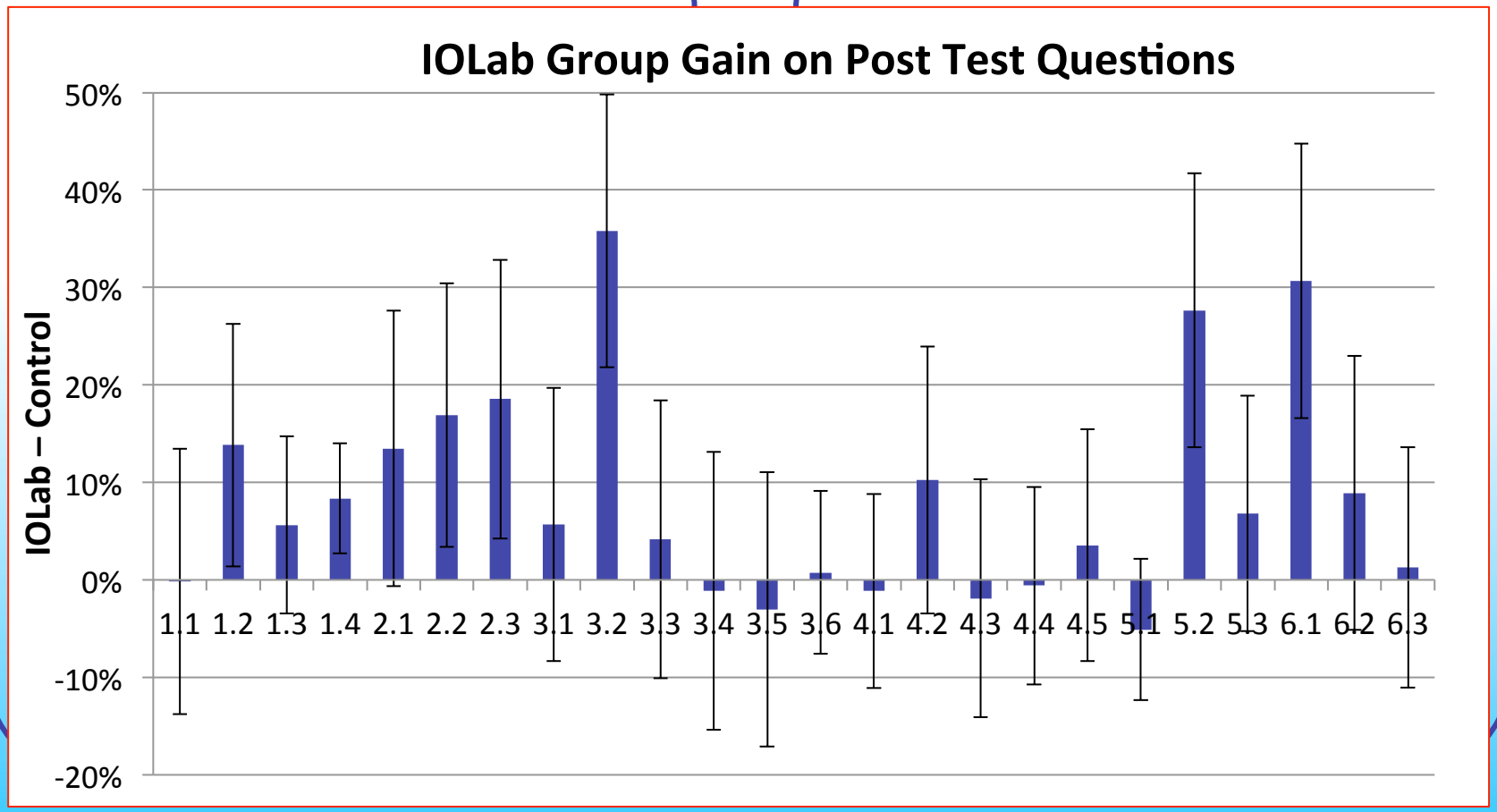
Example Activities

- Wheel, Force, Accel
  - Kinematics, Fdt = dP
  - Hooke's Law
  - SHM, F = ma
- Gyro, Accel, Magnetometer, Voltage
  - SHM, centripetal & tangential acceleration
  - Ω_y vs emf
- Sound & Light
  - FFT
  - Doppler

Clinical Study - 1D Kinematics

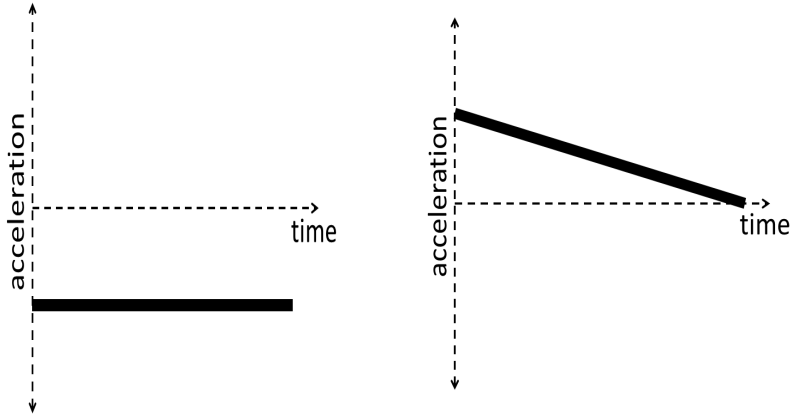
Control Group

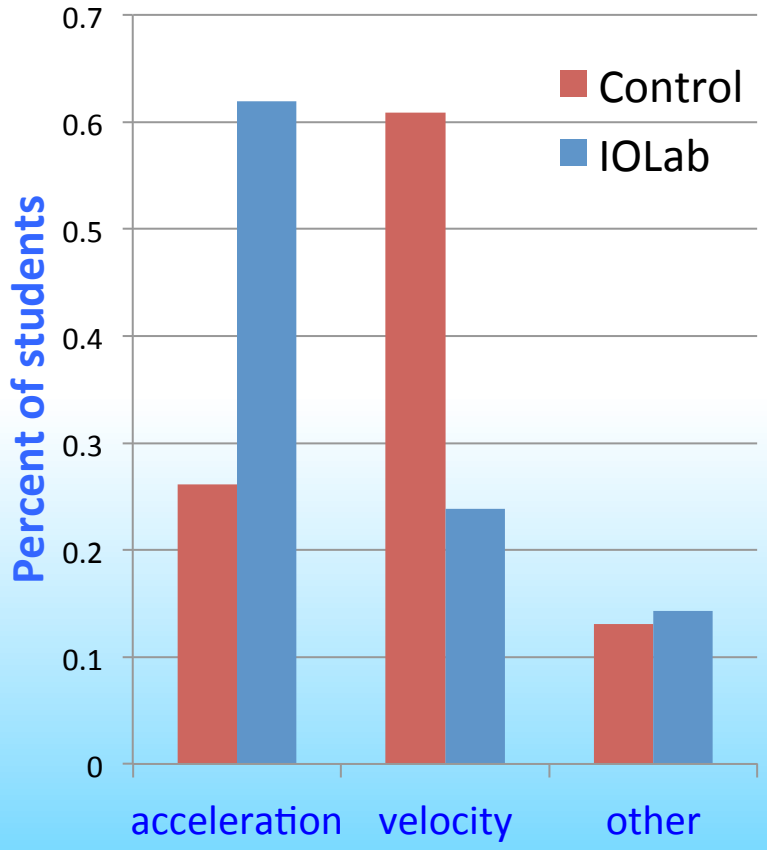
IOLab Group



Clinical Study - 1D Kinematics

*Choose **acceleration vs time** graph which corresponds to the motion:*
A car moves toward the right, slowing down at a steady rate.





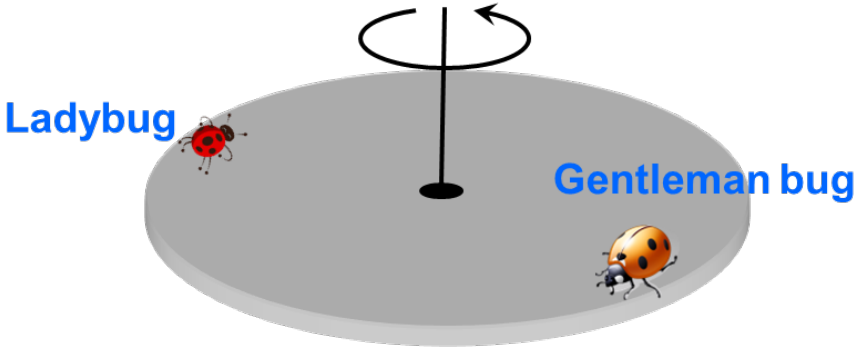
A hands-on “reality check” can pull students away from a strong distractor…

Parallel Developments

- Conceptual Assessment
  - Cover whole course
  - "Situational" concepts
  - Measure baseline (Fall/13 & Spring/14)
  - Use to evaluate impact of IOLab activities

- IOLab Activities
  - w/ Prelecture (smartPhysics delivery)
  - First trial Spring/14 (35 students)

A light bug and a heavy bug sit on the outer edge of a turntable that begins to turn faster & faster.



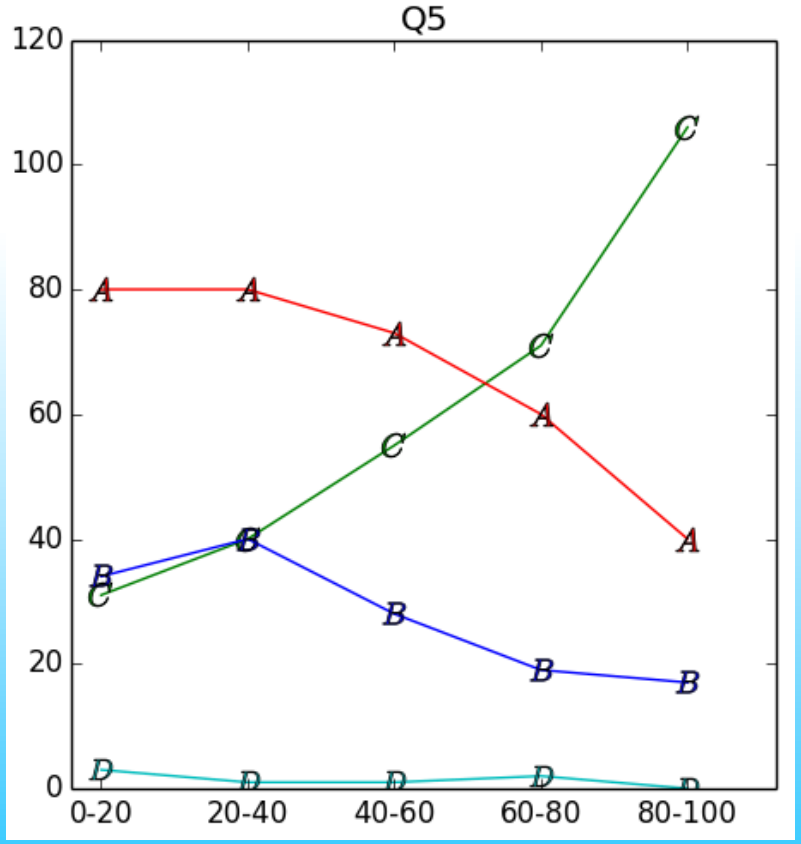
Which one falls off first?

A) The ladybug

B) The gentleman bug

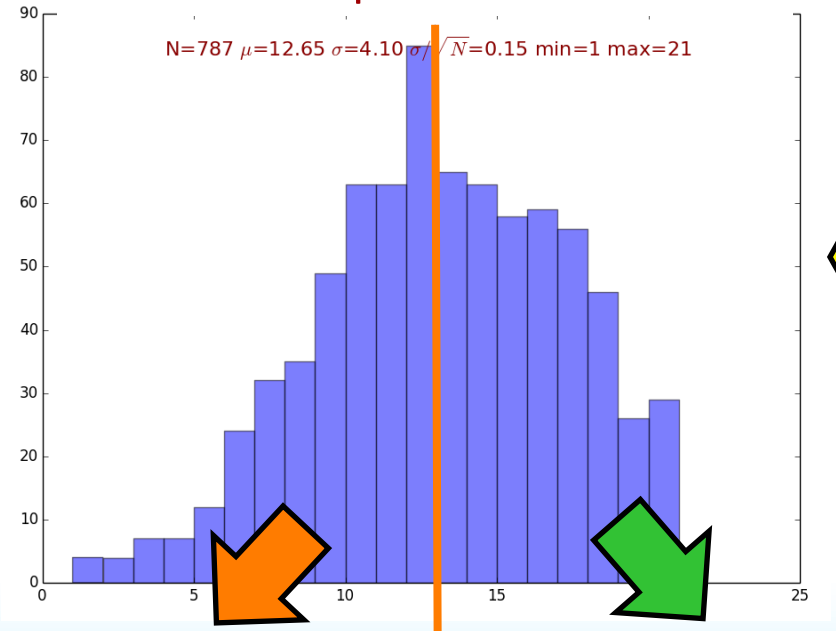
C) Both will fall off at the same time

D) Not enough information to determine



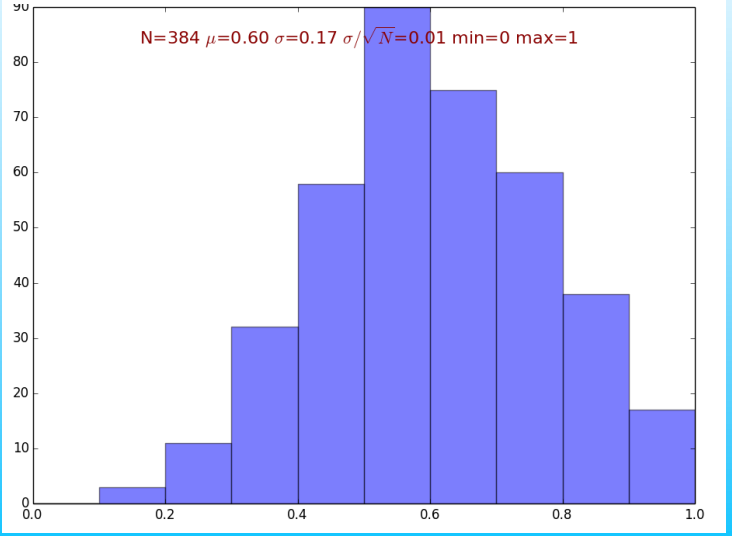
Katie Ansell BB-08, P1-53

Conceptual Score

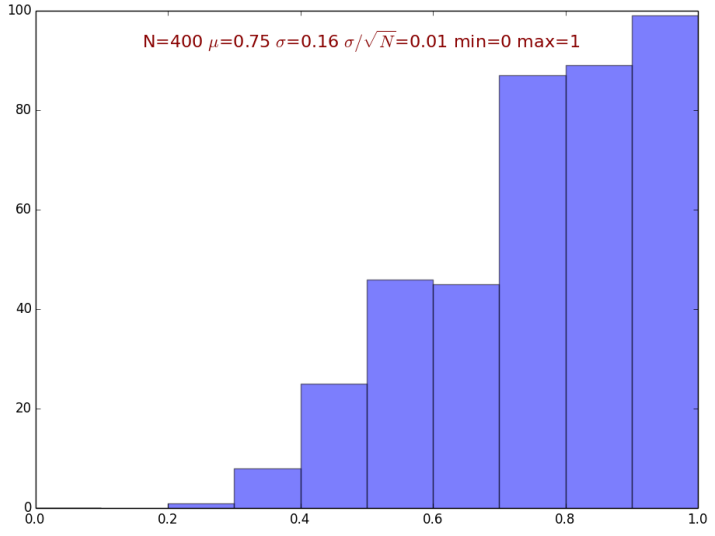


Can we improve this with hands-on activities ?

Exam (low conceptual)

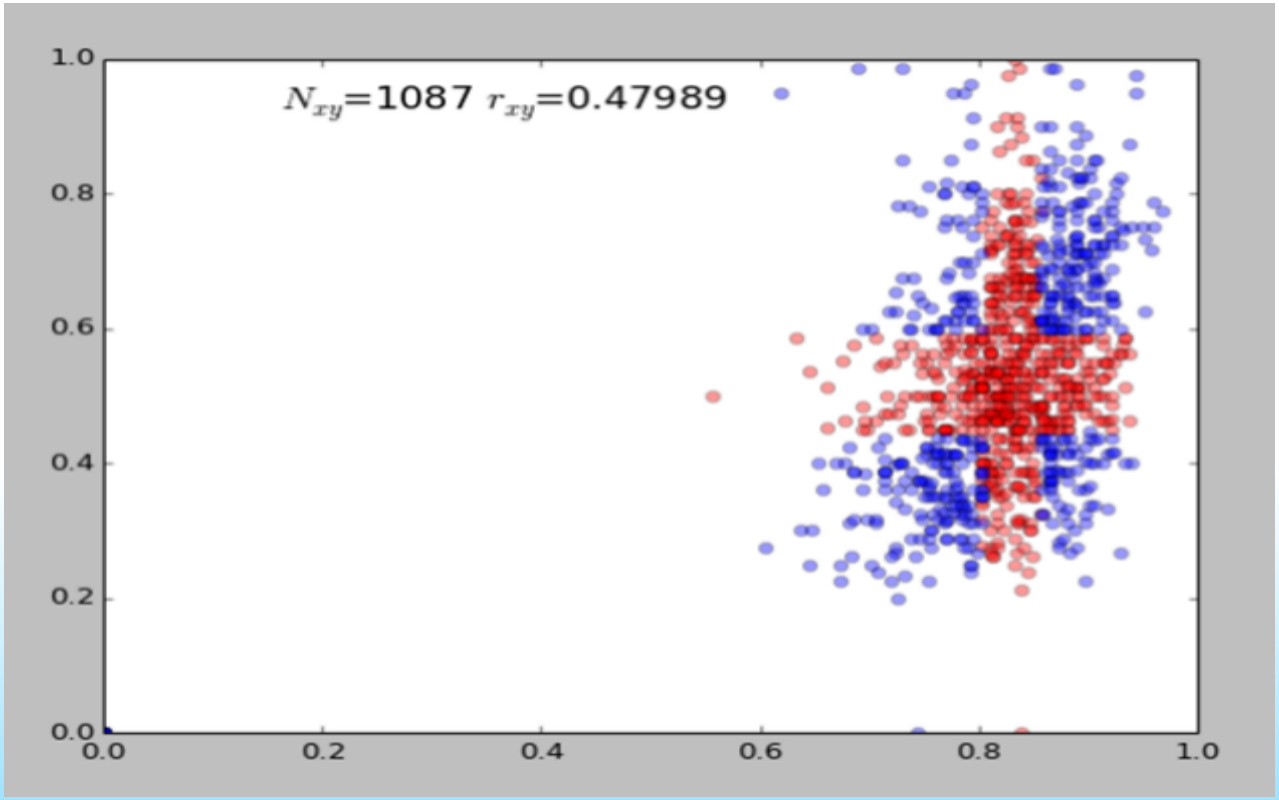


Exam (high conceptual)



Aside: Combine with Math Assessment

(Bill Evans, GA-04)



Concept Score

Math Score

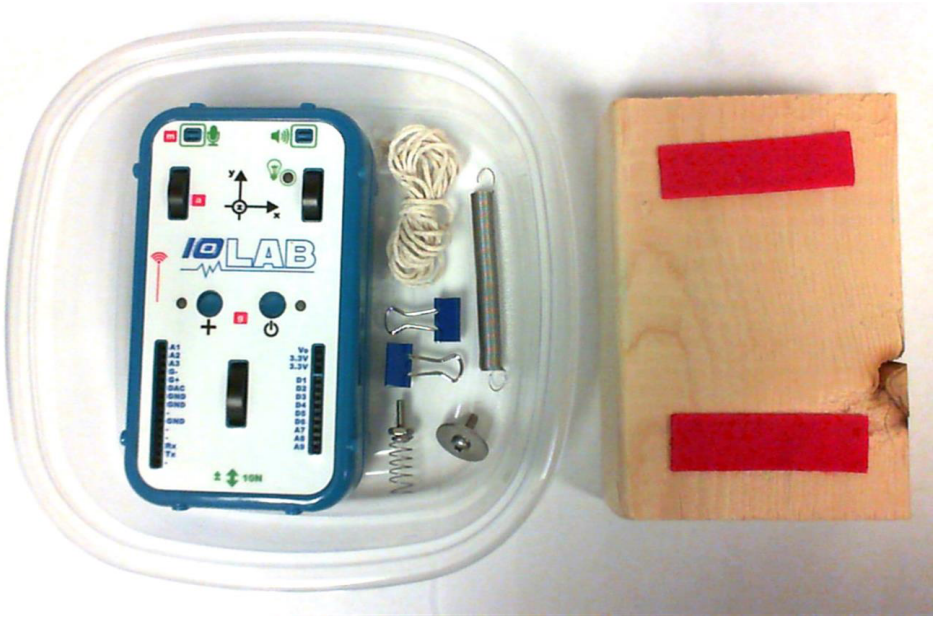
Able to study “off diagonal” populations

Parallel Developments

- Conceptual Assessment
  - Cover whole course
  - "Situational" concepts
  - Measure baseline (Fall/13 & Spring/14)
  - Use to evaluate impact of IOLab activities

- IOLab Activities
  - w/ Prelecture (smartPhysics delivery)
  - First trial Spring/14 (35 students)

Spring 2014 Pilot Study



About 35 students in Physics 211 received IOLab "kits".

They did hands on "dorm room" IOLab activities in addition to their smartPhysics Pre-Lectures.

See Katie Ansell's PERC poster (P1-53)
(also http://research.physics.illinois.edu/PER/Ansell/prelecture.html)

Example Lesson

Prelecture: Friction Review

Deadline: 100% until Tuesday, February 25 at 8:00 AM

Slide 5 of 9: **Activity Instructio**

Prelecture: Friction Review

Deadline: 100% until Tuesday, February 25 at 8:00 AM

Question

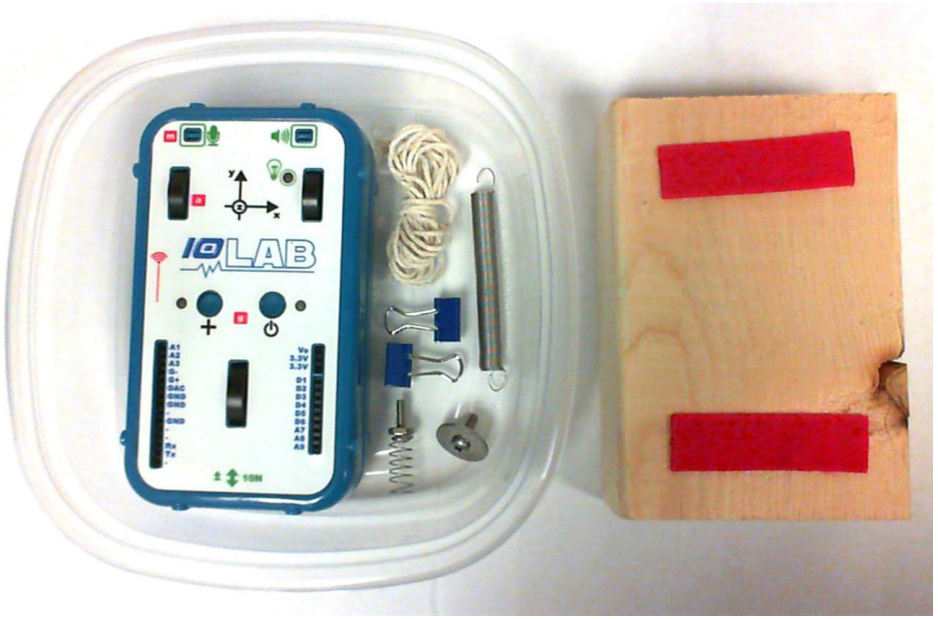
(Survey Question)

Try pushing the IOLab across your table or desk at a fast constant speed, and then a slow constant speed. How does the velocity of the IOLab affect the force measurement?

- The force is larger for faster speeds
- The force is larger for slower speeds
- The force does not depend on the speed

Submit

Spring 14 Results:



Lots of changes to IOLab app (mostly new features)

Some new features planned for smartPhysics

Student feedback: Liked activities, had fun, want more information, feedback & structure.

More elaborate clinical study planned at UIUC this fall

Several other studies at collaborating institutions

"What can PER Contribute to the Design of High Quality Distance Education?"

We are good at creating and assessing pedagogies that improve specific competencies

Moving forward we need to think bigger

A Grand Challenge for PER

- In context, define the outcomes of a successful post-secondary education

- Develop tools to assess how well we are achieving these outcomes.*

- Develop tools & pedagogy to improve achievement.

* "What gets measured gets done"

Peter Drucker, *The Practice of Management*, 1954.
(Father of "Management by Objectives")

Hardware Status

- We have 300 in hand now
- Manufacturing more this fall (first samples in a week ?)
- Should be for sale spring 2015