Session R13: Focus Session:
Adopting PER-Based Teaching Methods and Materials

Sustaining Educational Innovations

Evidence and Approaches at CU Boulder

American Physical Society
April Meeting
Denver, CO
May 2009

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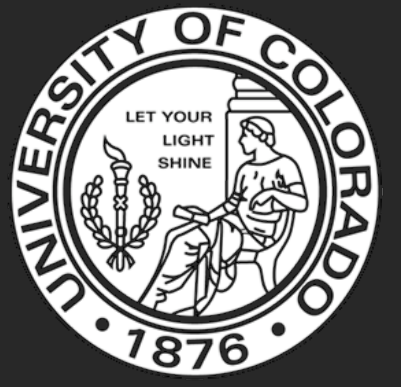
University of Colorado at Boulder



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Lauren Kost
Charles Baily
Ben Spike
+recently graduated: 4 with PhD, 1 with MSc.

School of Ed collaborators:

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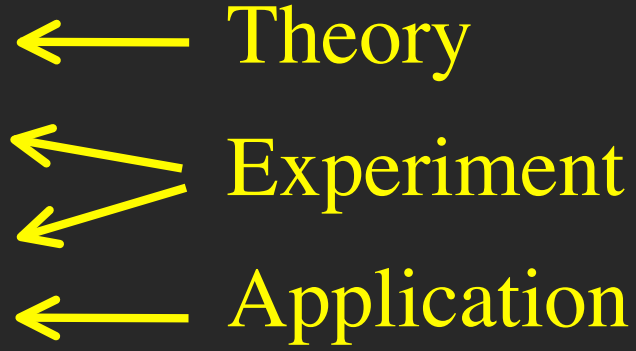
Overview of PER

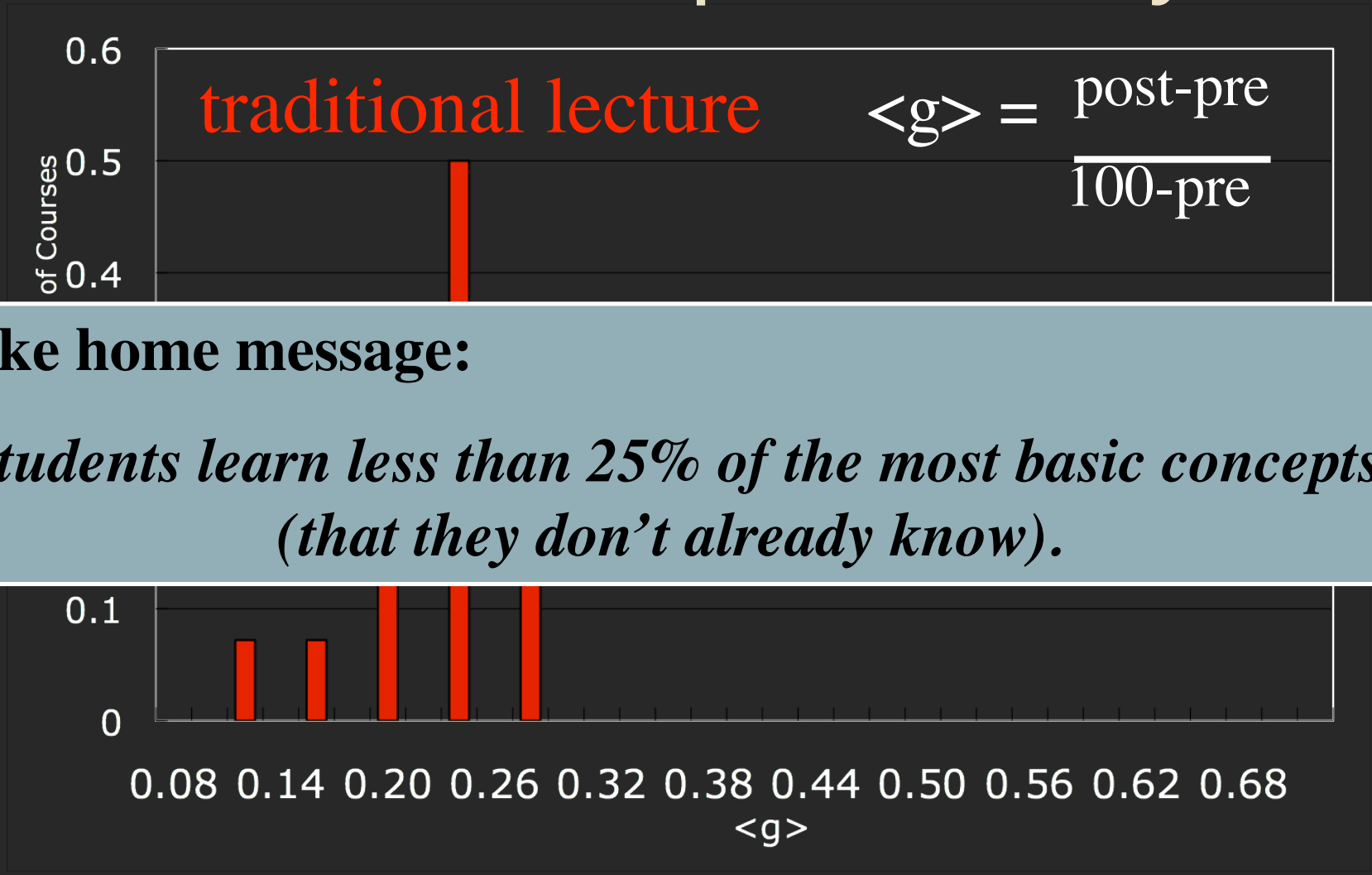
- Investigating education scientifically
- Far more to our classes than what is traditionally evaluated

- Physics education research has something to say about this
  - Models of student learning
  - Tools for measurements
  - evidence of impact
  - curricula / approaches



PER Theoretic Background

Force Concept Inventory



Take home message:

Students learn less than 25% of the most basic concepts (that they don't already know).

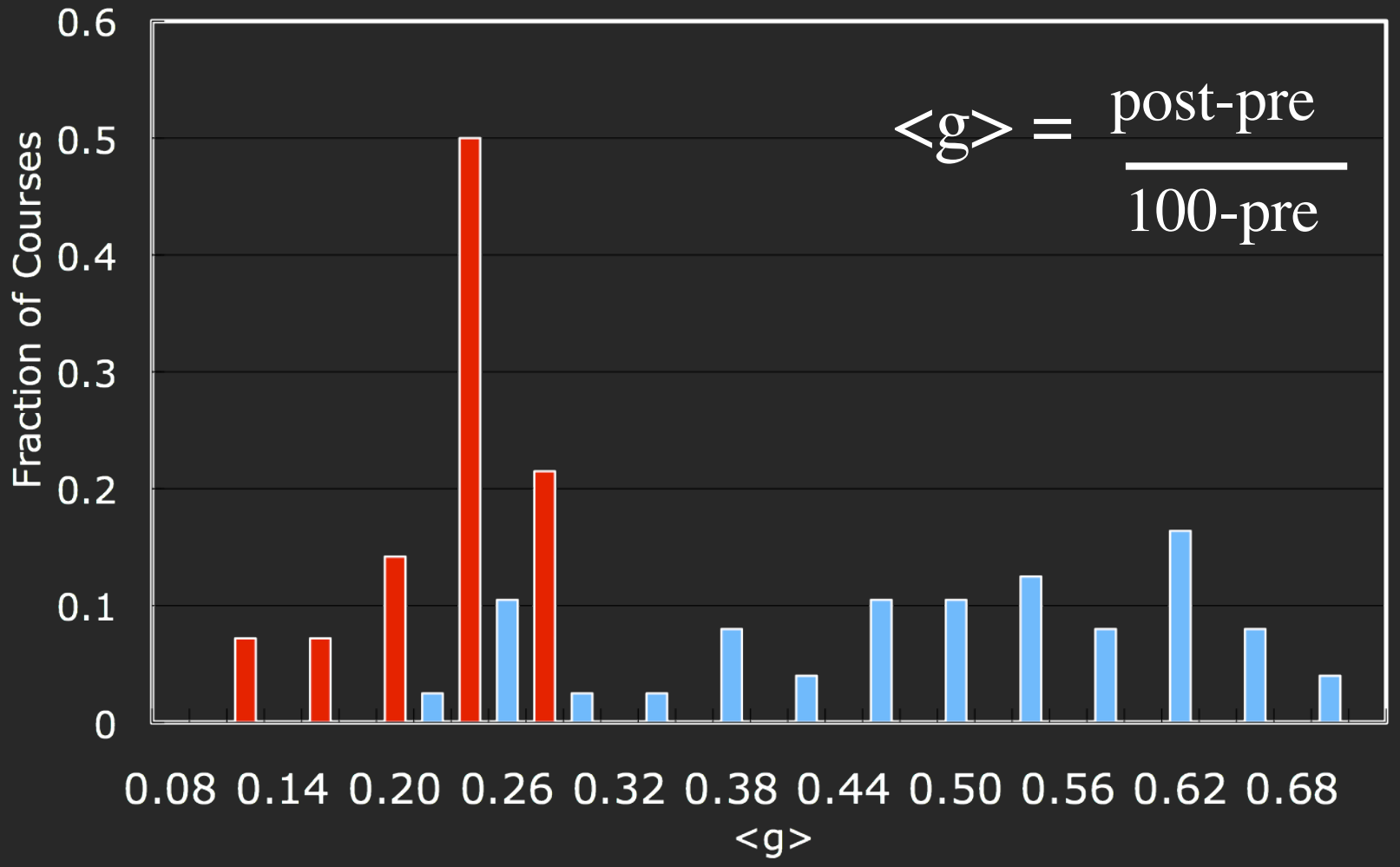
R. Hake, "…A six-thousand-student survey…" AJP **66**, 64-74 ('98).

Many PER curricular innovations

by actively engaging students…

Back to the FCI

traditional lecture interactive engagement



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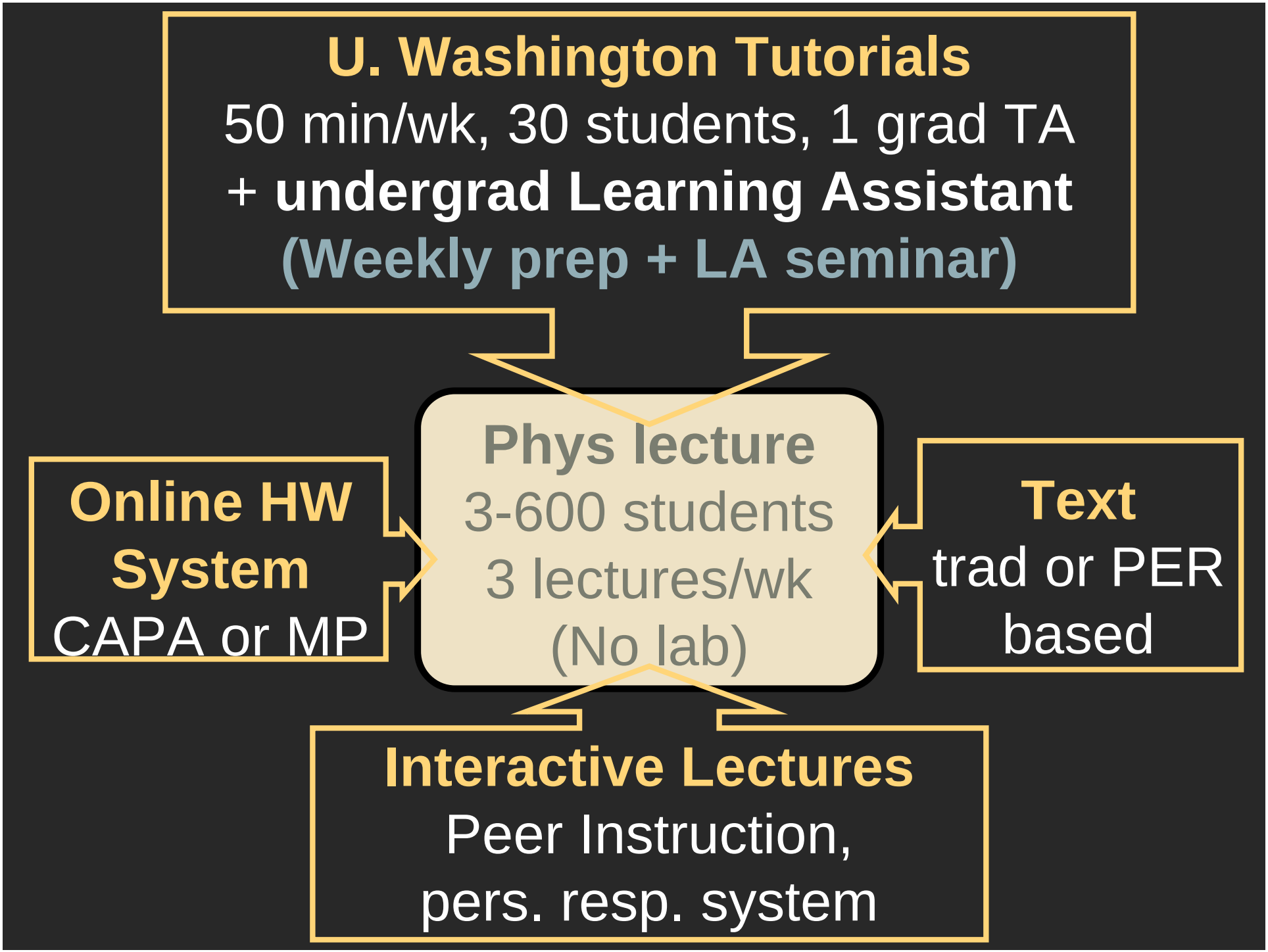
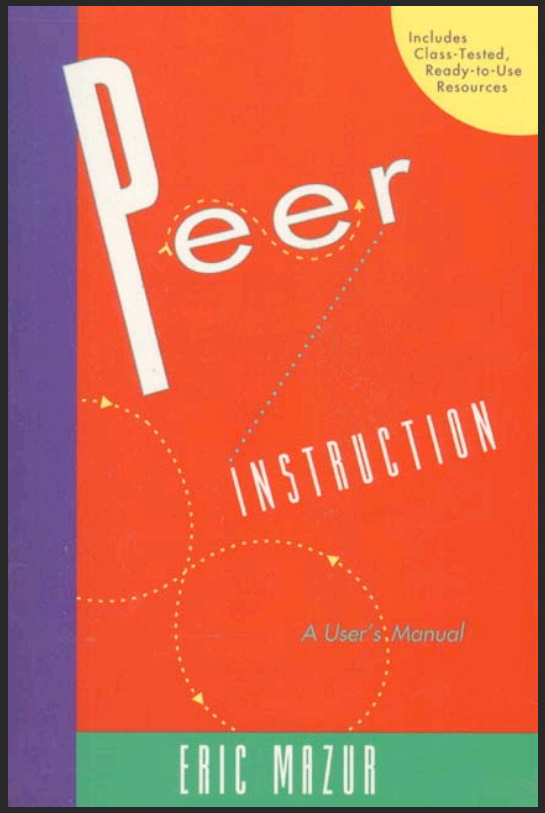
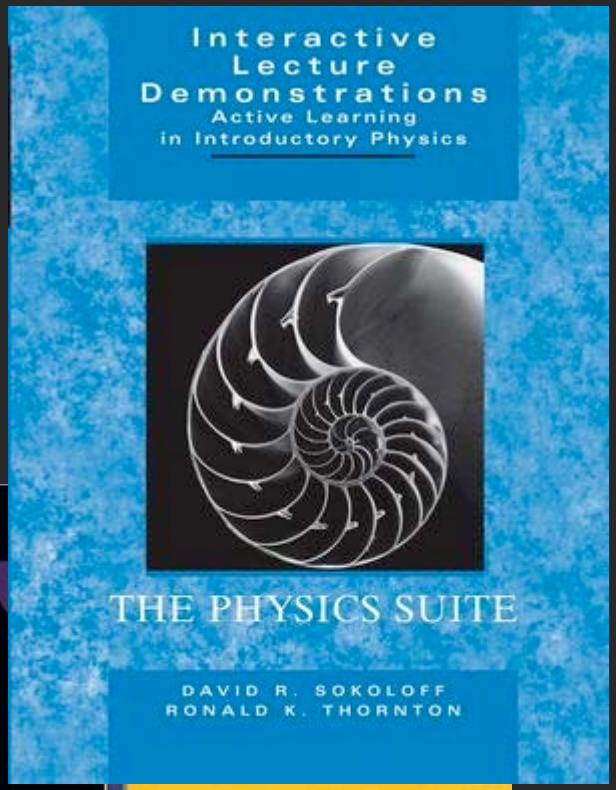
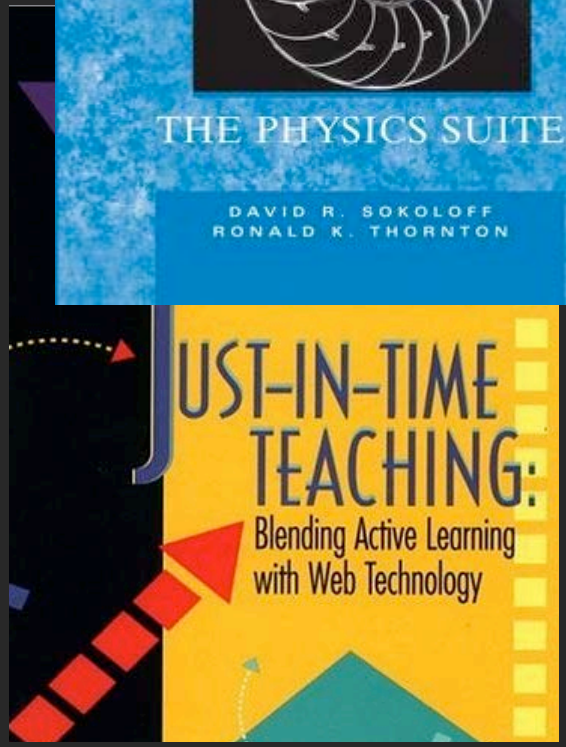
modest reframing of class context

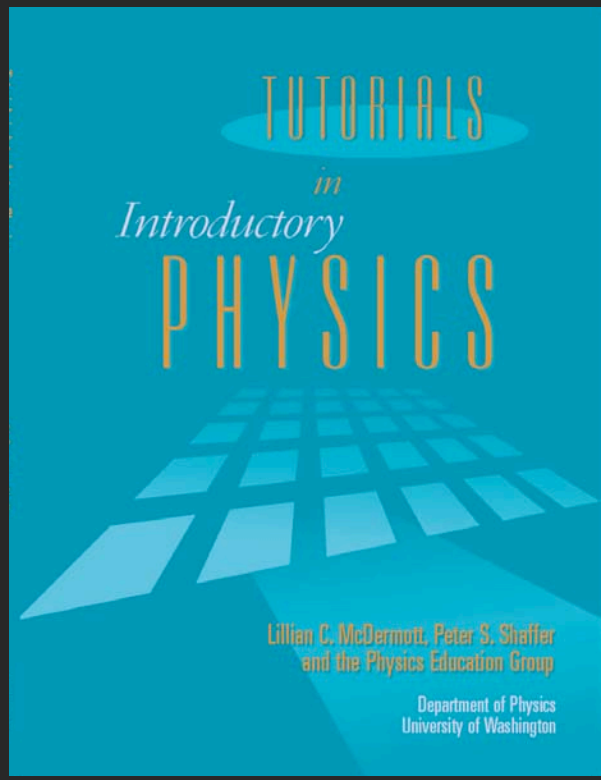

U. Washington Tutorials
50 min/wk, 30 students, 1 grad TA
+ undergrad Learning Assistant
(Weekly prep + LA seminar)
Online HW System
CAPA or MP
Phys lecture
3-600 students
3 lectures/wk
(No lab)
Text
trad or PER based
Interactive Lectures
Peer Instruction,
pers. resp. system

Transformations at CU





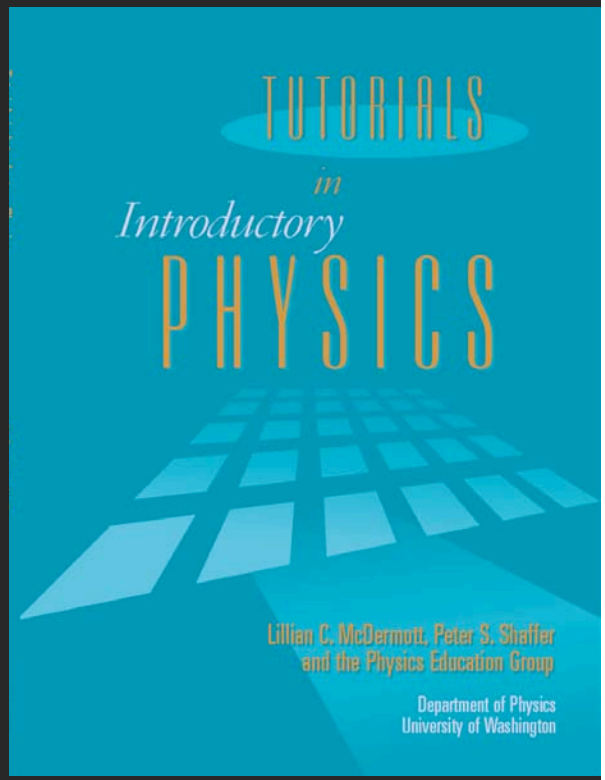




Tutorials in Introductory Physics

Reconceptualize Recitation Sections

- Materials
- Classroom format / interaction
- Instructional Role
- Use of Learning Assistants



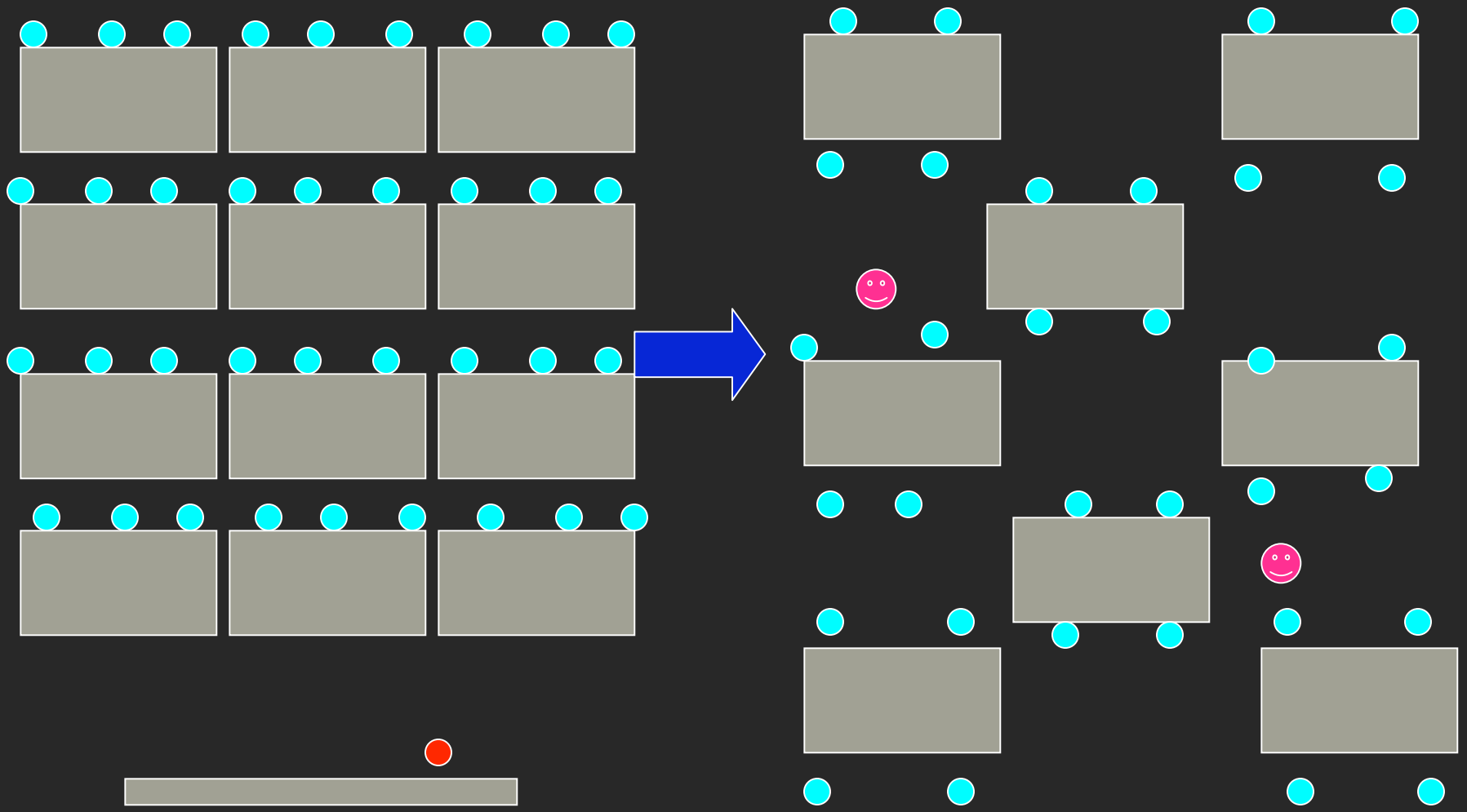
CU Model of Teacher Prep

- Begin *within* physics department
- Learning Assistants:

  Use UG's to implement PER-based materials
  - Model best-practices for all students
  - Improve education of all students
  - Increase likelihood students engage in teaching
- Improve content mastery of future teachers

V. Otero, N.D. Finkelstein, S.J. Pollock and R. McCray (2006). *Science*, **313**, 445

Tutorial vs. Trad'l Recitation



Tutorial

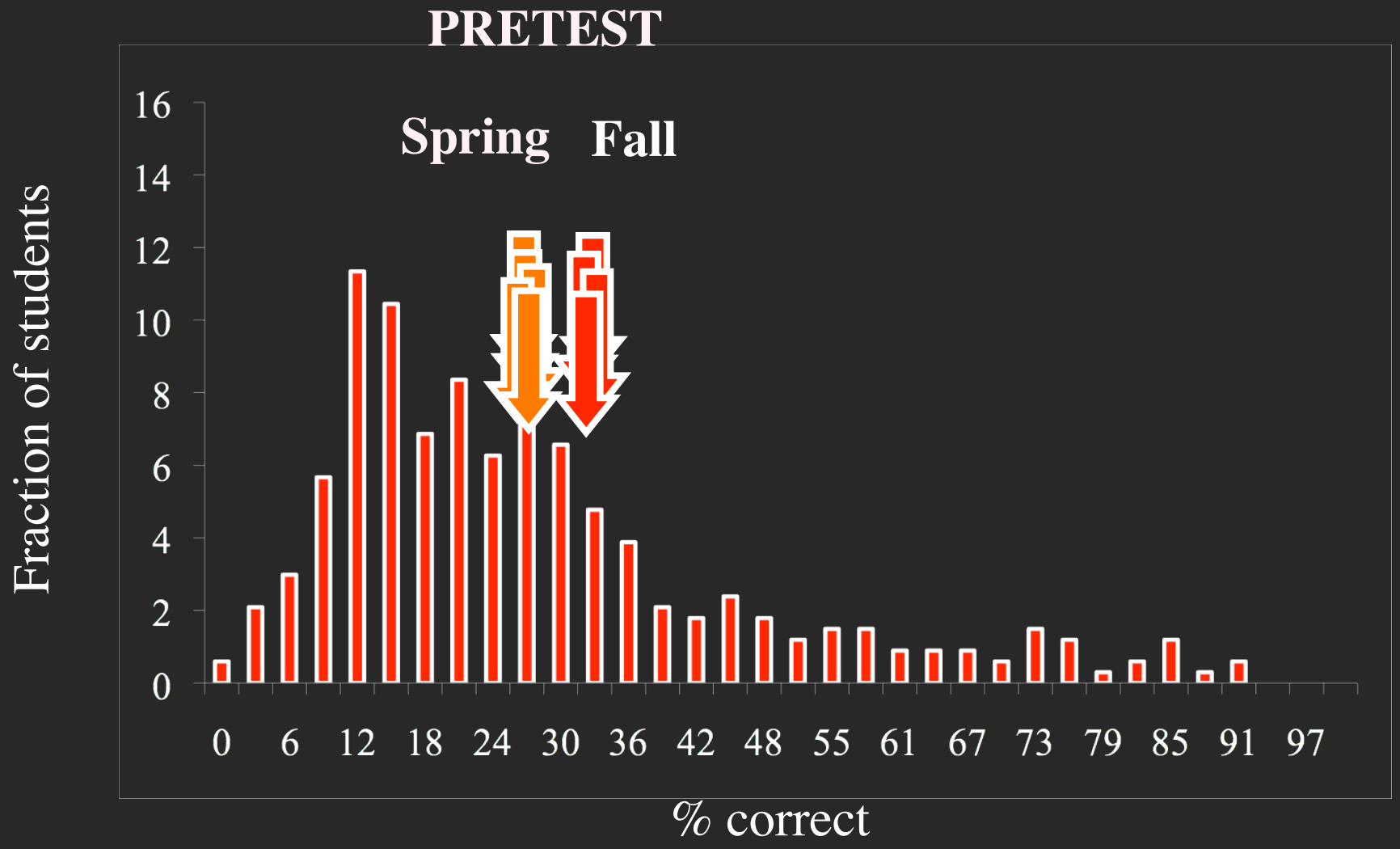
Reproducibility

Topic	U. Wash. *no* tutorial	UW tutorial	CU tutorial
Newton & constraints	45%	**70%**	**75%**
Force diagrams	30%	**90%**	**95%**
Newton's III law	15%	**70%**	**70%**
Combine Newton's laws	35%	**80%**	**80%**

D.E. Trowbridge and L. C. McDermott, (1981). *Am. J. Phys.* **49** (3), 242.

Finkelstein and Pollock, (2005). *Physical Review: ST PER*, 1,1.010101

CU: Pre- Post FMCE scores



Pollock and Finkelstein (2008). *Physical Review: ST PER*, 4, 010110

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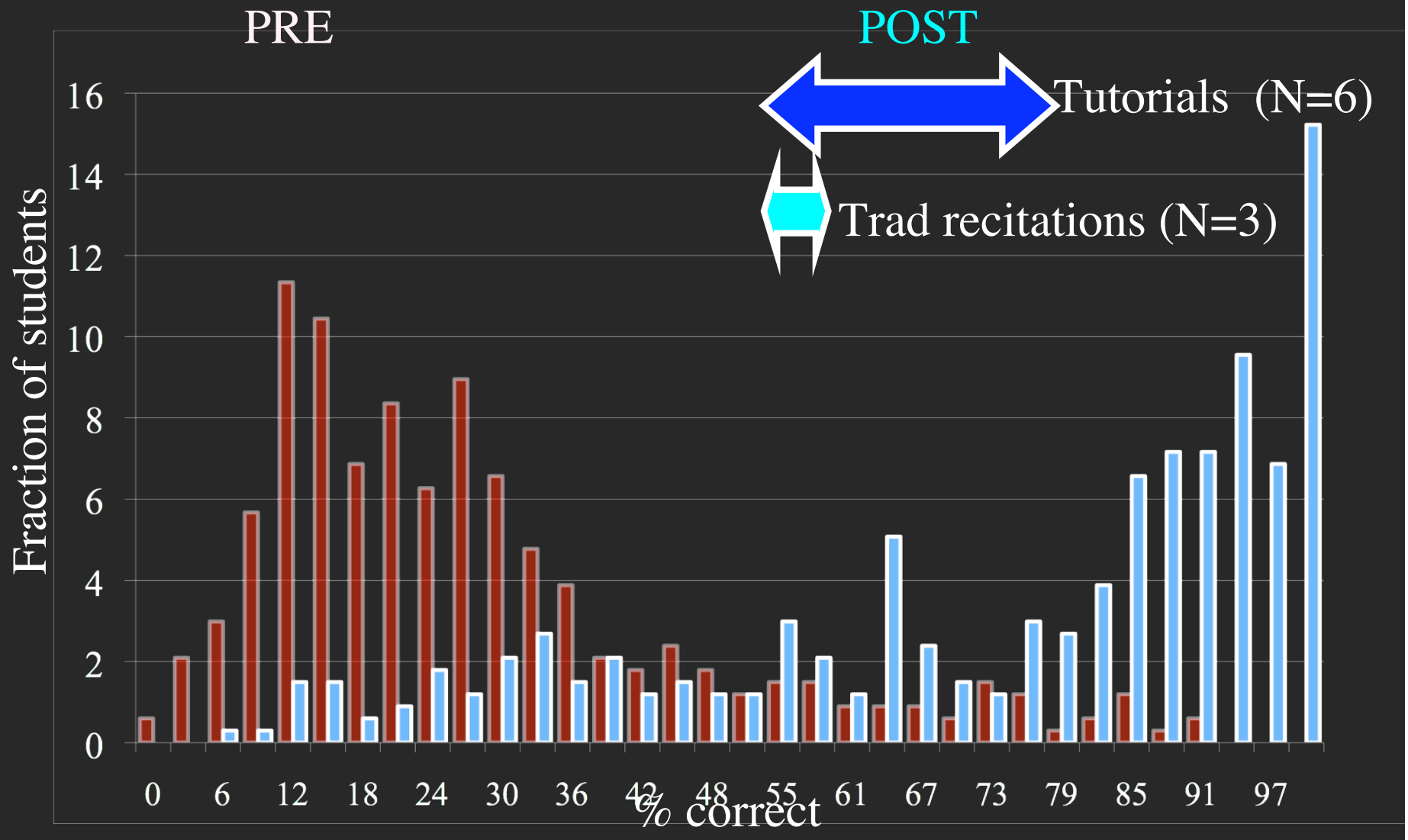
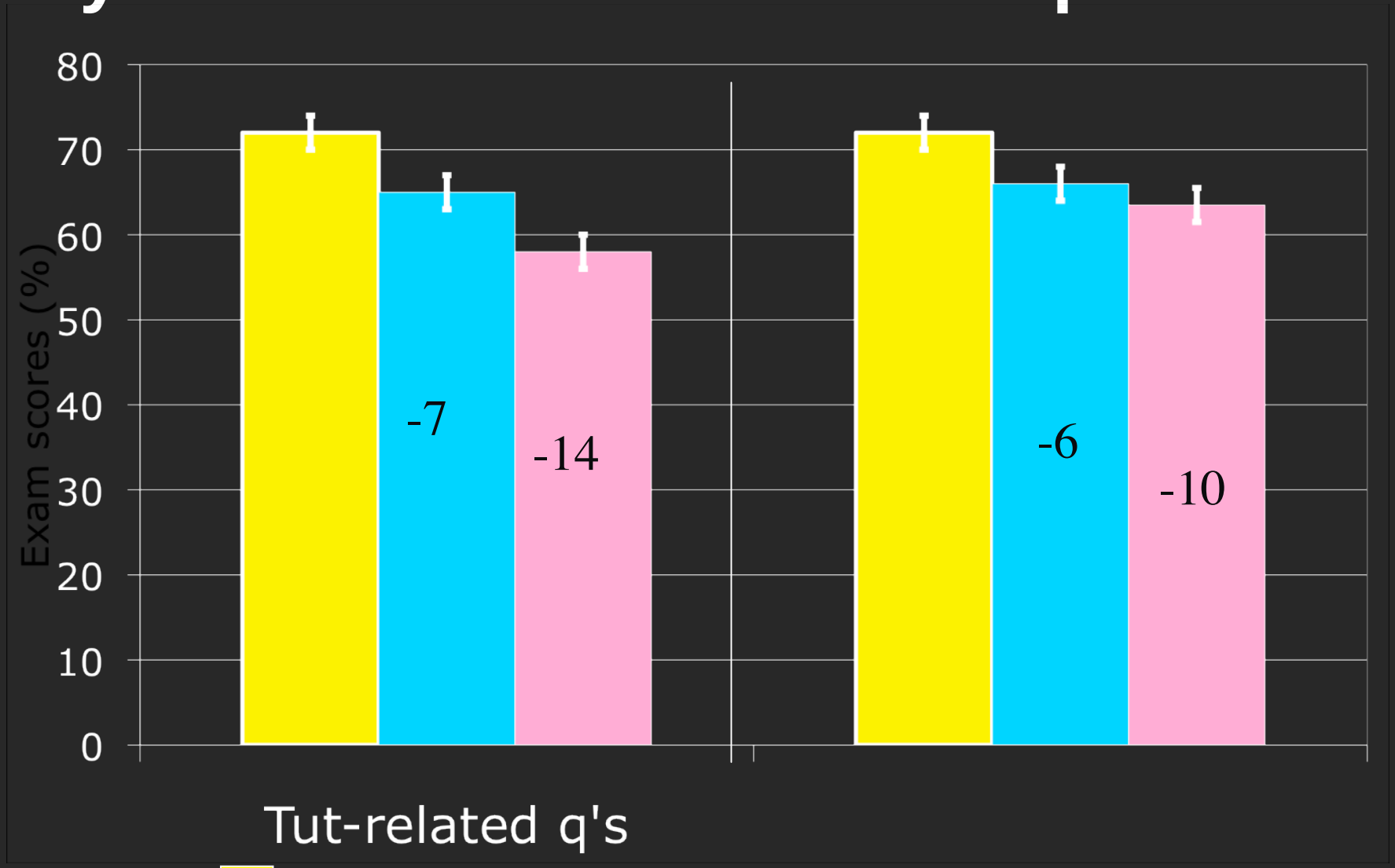


Pollock and Finkelstein (2008). *Physical Review: ST PER*, 4, 010110

Beyond the FMCE: Exam comparisons



N.B. 12 points is roughly 1 letter grade.

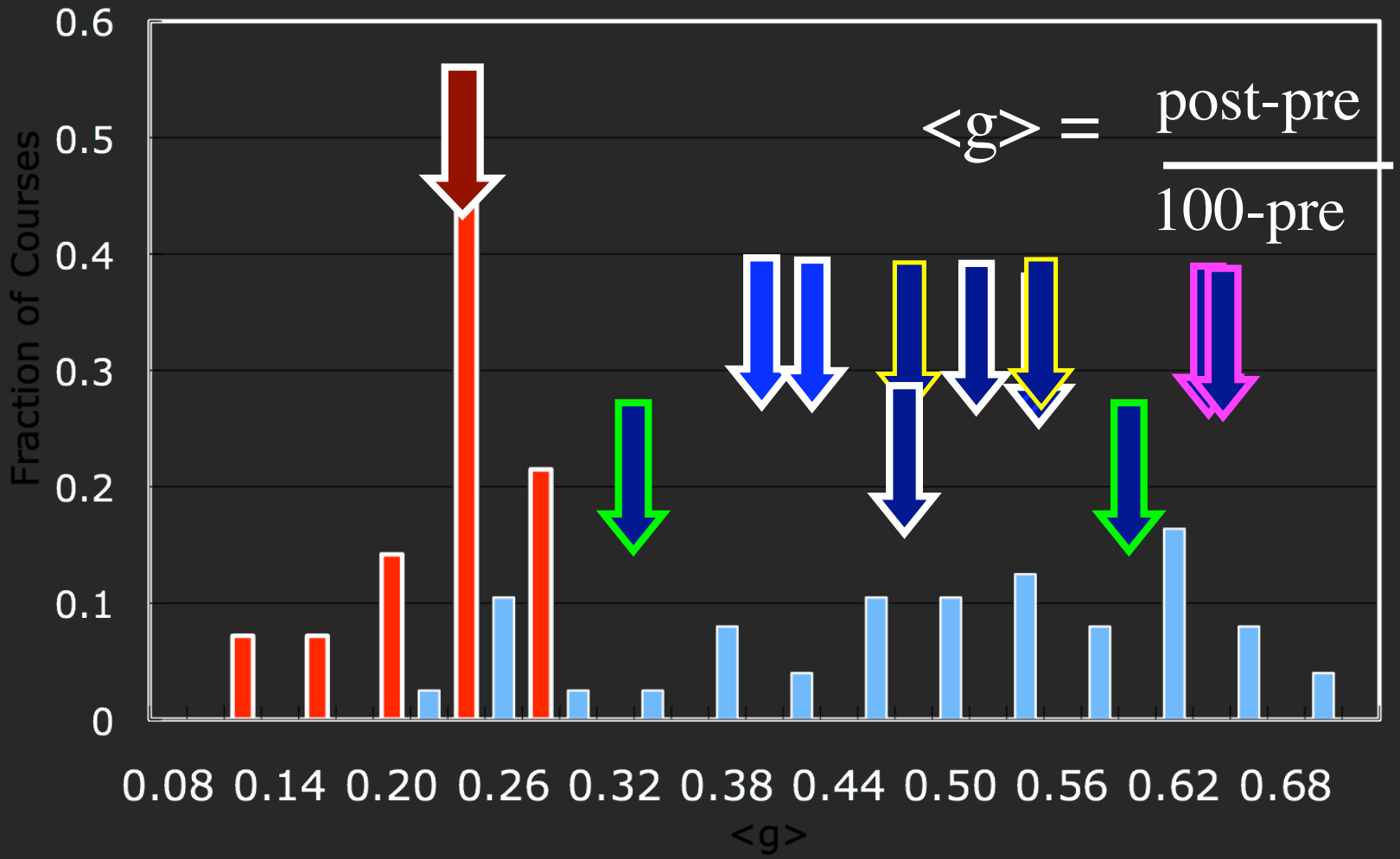
Is the recitation curriculum all that matters?

instructor effects?

Chandra Turpen - Session T13 this afternoon!

Back to the FCI/FMCE

traditional lecture interactive engagement

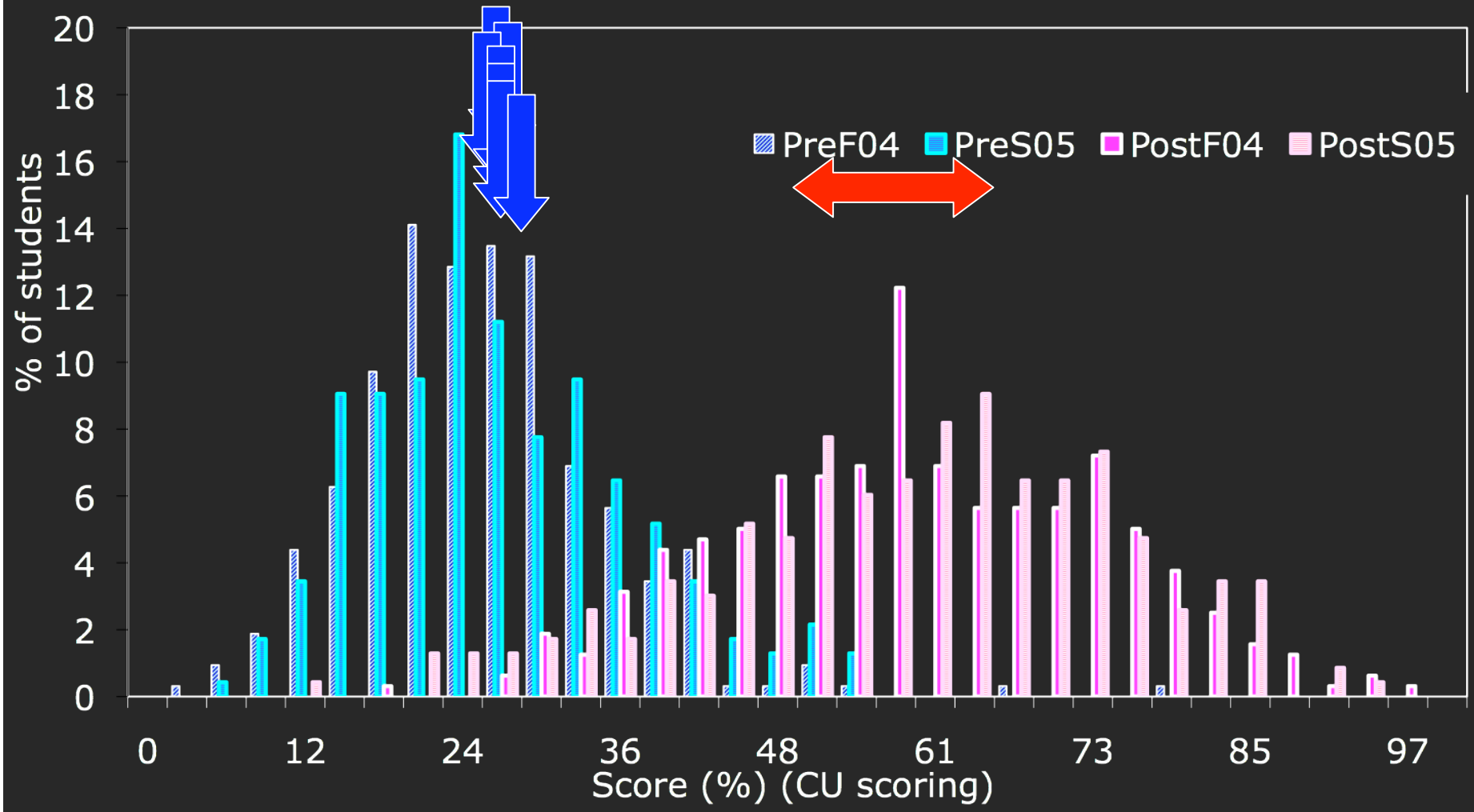


R. Hake, "…A six-thousand-student survey…" AJP **66**, 64-74 ('98).

S. Pollock and N. Finkelstein, *Phys. Rev. ST Phys. Educ. Res.* 4, 010110 (2008)

Replication,
but with strong variations
Why?

1120 BEMA pre/post



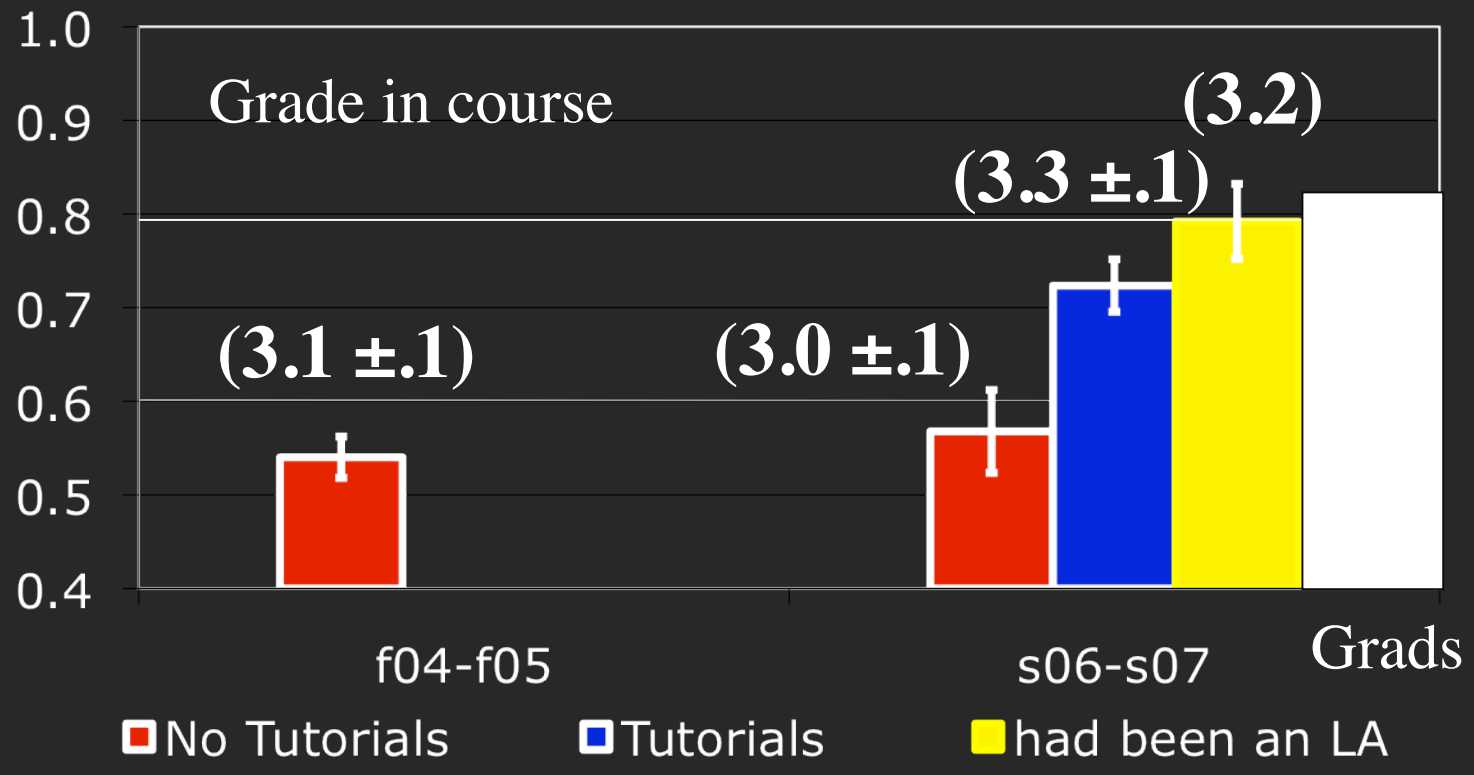
F04 (N=319) Post: 59% S05 (N=232): 59%

S. Pollock and N. Finkelstein, *Phys. Rev. ST Phys. Educ. Res.* 4, 010110 (2008)

does it last?

Longitudinal

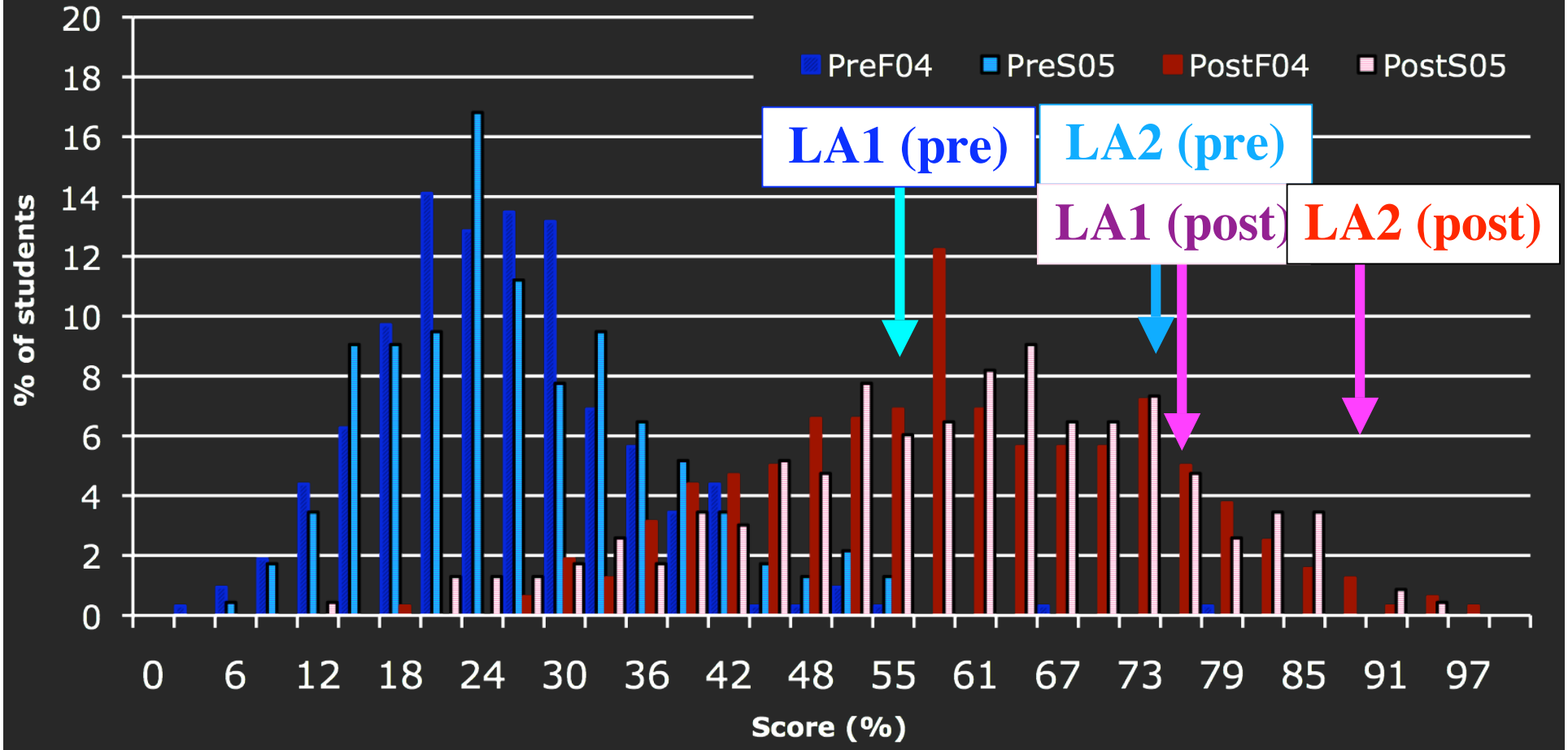
Upper division majors' BEMA scores



Yellow: students who had been E&M LAs

S. Pollock, *2007 PERC Proc. 951,* p.172

1120 BEMA LA's



Otero, Finkelstein, McCray, Pollock, *Science 28 (2006) p. 445*

Conclusions

- Educational practice is a researchable endeavor
  - We can make systematic progress
  - Imperative to include scientists
- Possible to achieve dramatic repeated results
  - Build on/adapting research-based curricula
- CU model strongly couples:
  - Reform and Research
  - K12 Teacher prep

It's not about our teaching, it's about student learning

Questions?

Much more at: *per.colorado.edu*

Or stem.colorado.edu