

ADAPTATIONS OF THE *PHYSICS BY INQUIRY* CURRICULUM

PART II: ASSESSING SHIFTS IN STUDENT ATTITUDES

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Leon Hsu¹, Karen Cummings², and Jack W. Taylor³

¹University of Minnesota, ²Southern Connecticut State University, ³Baltimore City Community College

Question:

Physics by Inquiry was designed in an environment where the course staff consists of faculty and highly trained graduate students and where the student:staff ratio is relatively small. Can it be successful without such resources and with a larger student:staff ratio?

What is *Physics by Inquiry*?

Physics by Inquiry is a guided-inquiry, lab-based introductory physics curriculum developed by the Physics Education Group at the University of Washington. Students perform experiments and use their observations to develop explanatory models with predictive power. Students also practice skills such as proportional reasoning, use multiple representations, and engage in evidence-based reasoning.

Physics by Inquiry is used to educate pre- and in-service K-12 teachers, students underprepared in science, and liberal arts non-science majors.

What modifications did we make?

Cooperative group techniques:

- Students assigned to heterogeneous groups of three.
- Students work in three different groups during one semester.
- 20% of each exam is a more difficult group question.
- 5% individual exam bonus if group exam average is >80%.

Undergraduate teaching assistants:

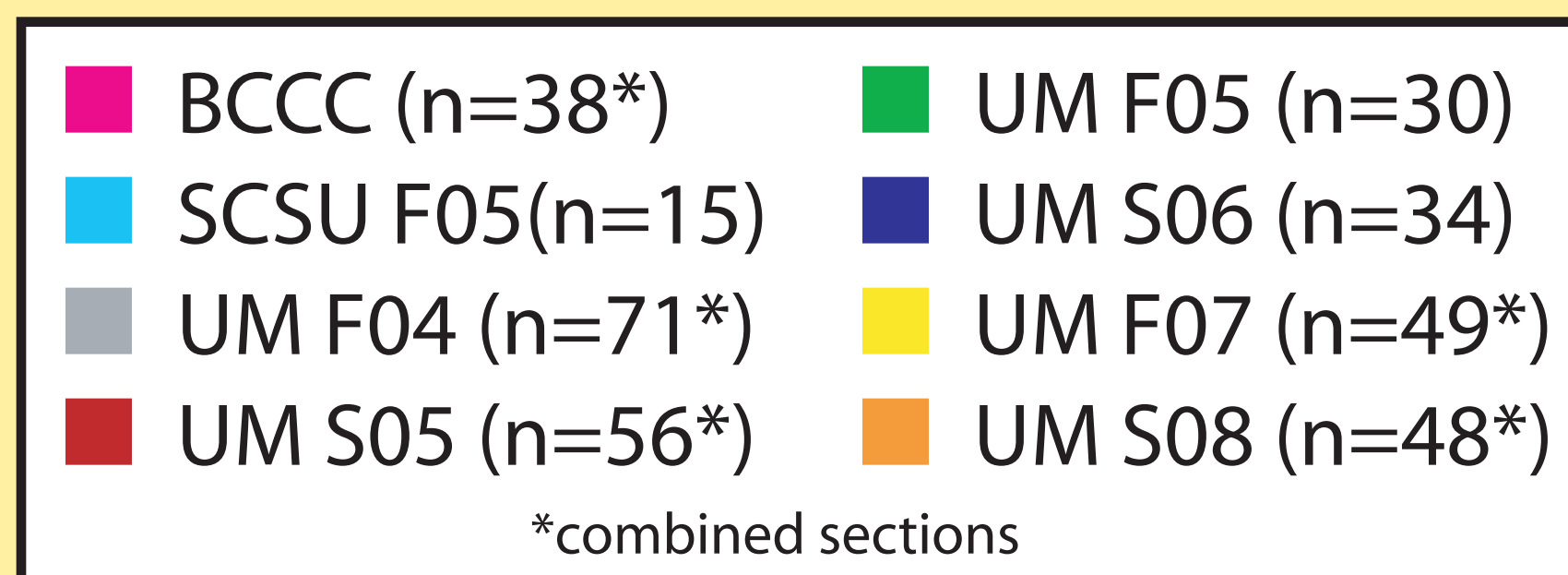
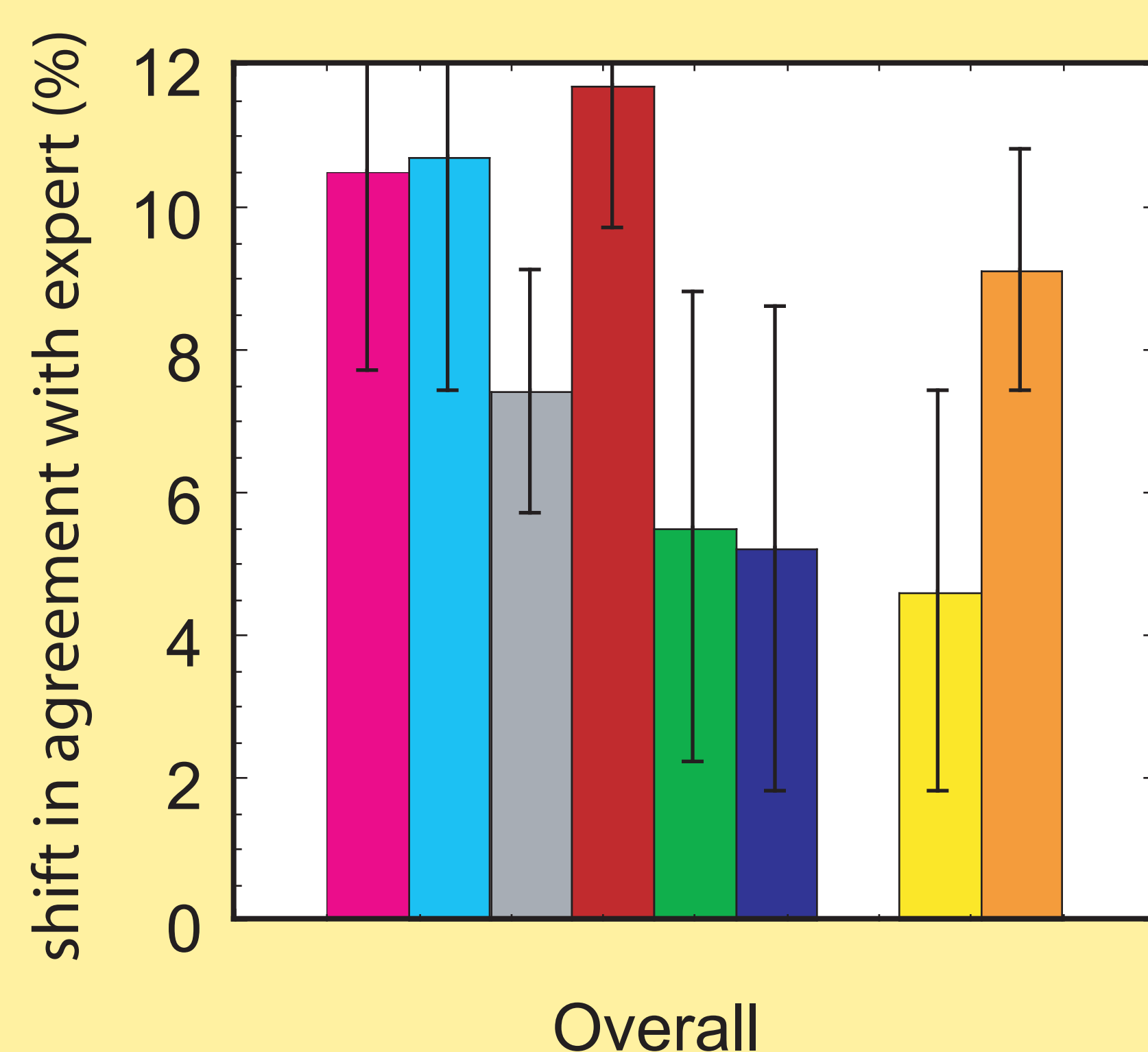
- These are students who have previously taken the class, done well, and showed an aptitude for helping others.
- Two hours of training per week to review experiments and checkpoint questions, role play interactions with students, etc.
- Students compensated with pay or academic credit.

Did it work?

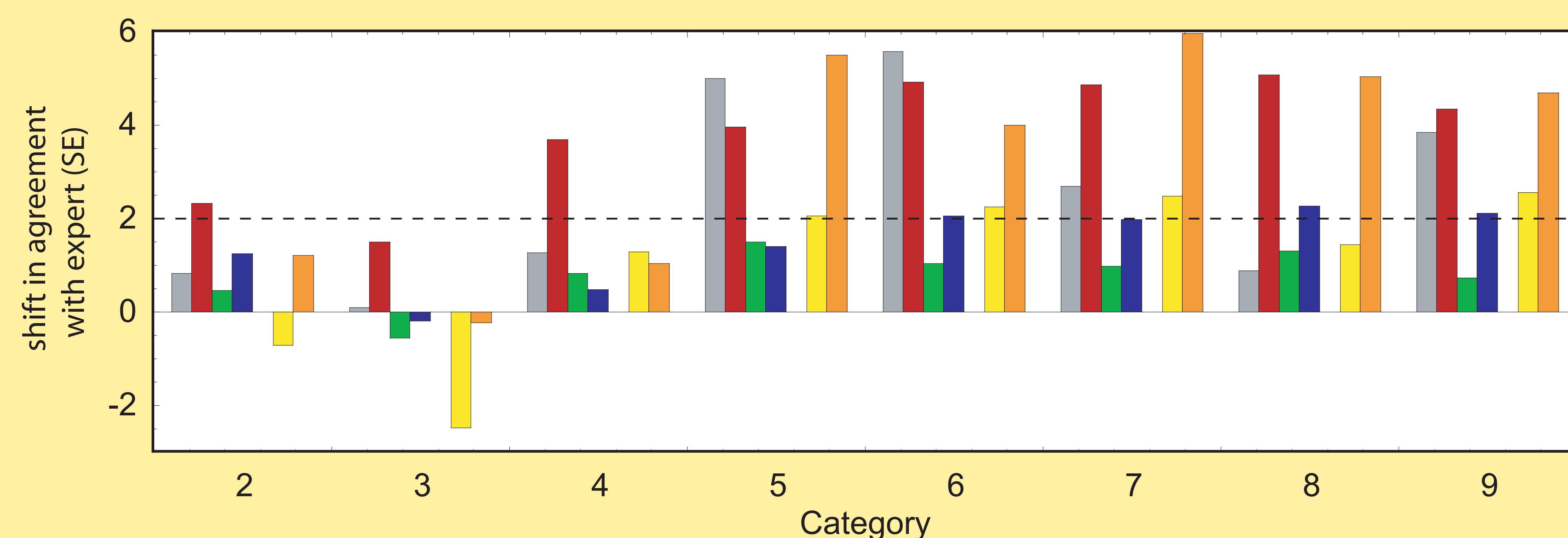
The CLASS is a survey developed at the University of Colorado for measuring students' beliefs about physics and learning physics.

Students' responses on the CLASS become less expert-like or at best, do not change after standard introductory physics courses.

Classes using the PET/PSET curriculum have shown substantial positive shifts (Otero and Gray, 2007).



Shifts in CLASS results



Categories

1 Overall

2 Personal interest

3 Real world connection

4 Sense making/Effort

5 Conceptual connections

6 Applied conceptual understanding

7 Problem solving (General)

8 Problem solving (Confidence)

9 Problem solving (Sophistication)

Summary

Implementing the *Physics by Inquiry* curriculum using cooperative group techniques and undergraduate teaching assistants is practical and enables it to be taught in environments with larger student:staff ratios (roughly 12:1 or more) than the one in which it was originally designed.

Results from the CLASS are similar to those from courses using curricula such as PET or PSET, in which the nature of science and science learning is explicitly addressed.

Other observations

Undergraduate teaching assistants initially require a "script" to successfully conduct checkpoints with students.

Non-science and non-education track teaching assistants seem to burn out after roughly three semesters.

An attendance policy and group contracts may be necessary.