Assessing Adaptations of *Physics by Inquiry*: Student beliefs

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What is *Physics by Inquiry*?

- A guided-inquiry lab-based physics curriculum developed at the University of Washington by the Physics Education Group (McDermott et al.)
- Students engage in the process of science, practicing scientific reasoning and model development, as well as skills such as proportional reasoning, using multiple representations, etc.
- Used primarily to educate pre- and in-service K-12 teachers (esp. elementary), but also with students underprepared in science and non-science majors.

Goals of our collaboration

- Adapt the PbI curriculum to our environments
  - No highly trained graduate students
  - Larger student:staff ratio
- Explore ways to integrate PbI with other content addressing various state standards for teachers.
- Develop ready-to-use materials to increase efficiency of adoption.
- Work in three different environments
  - Large state research university, UM
  - Small comprehensive state university, SCSU
  - Community college, BCCC

Assessing student beliefs

- Do students hold scientist-like beliefs about science?
  - Personal interest
  - Coherence of science knowledge
  - Confidence and sophistication in problem solving
- Unfortunately, prior work indicates that students emerge from standard introductory physics courses with beliefs that are less scientist-like.
  - MPEX, CLASS, VASS, EBAPS, etc.
  - This is true even when a “reform” curriculum resulting in substantial conceptual gains is used.

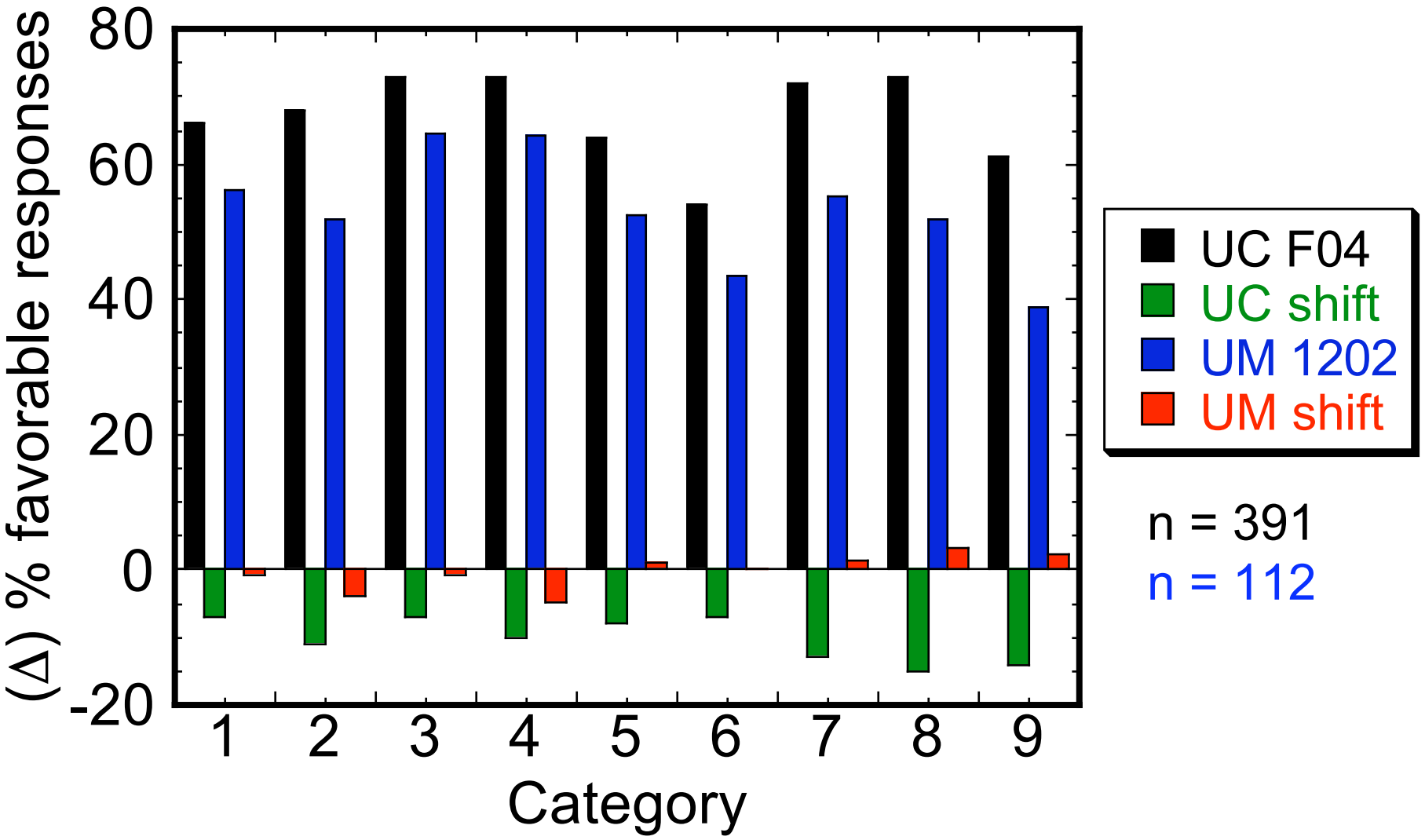
Colorado Learning Attitudes about Science Survey

- 42-question Likert-scale survey developed by the PER group at the University of Colorado
- Questions clustered into 8 categories

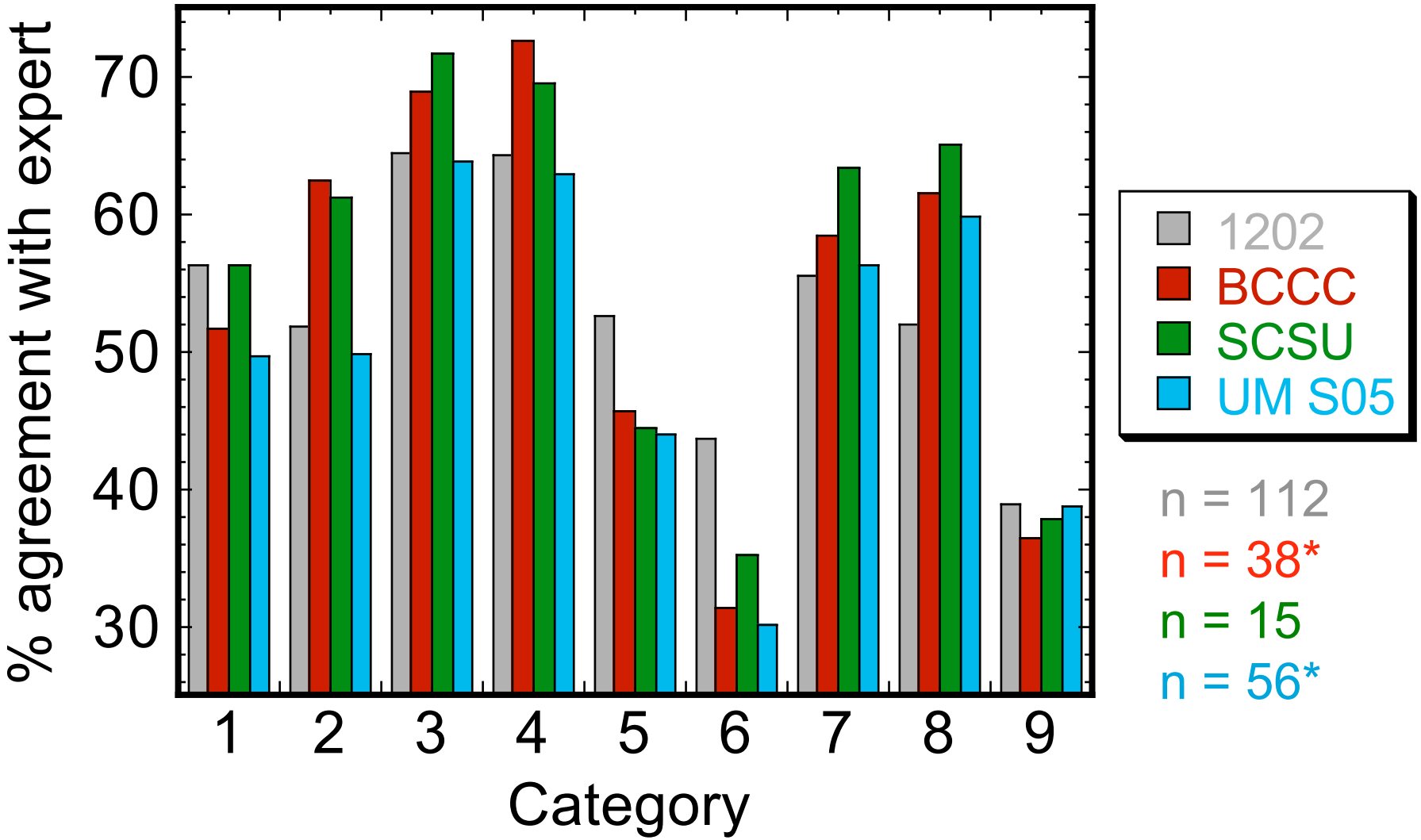
CLASS categories

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)

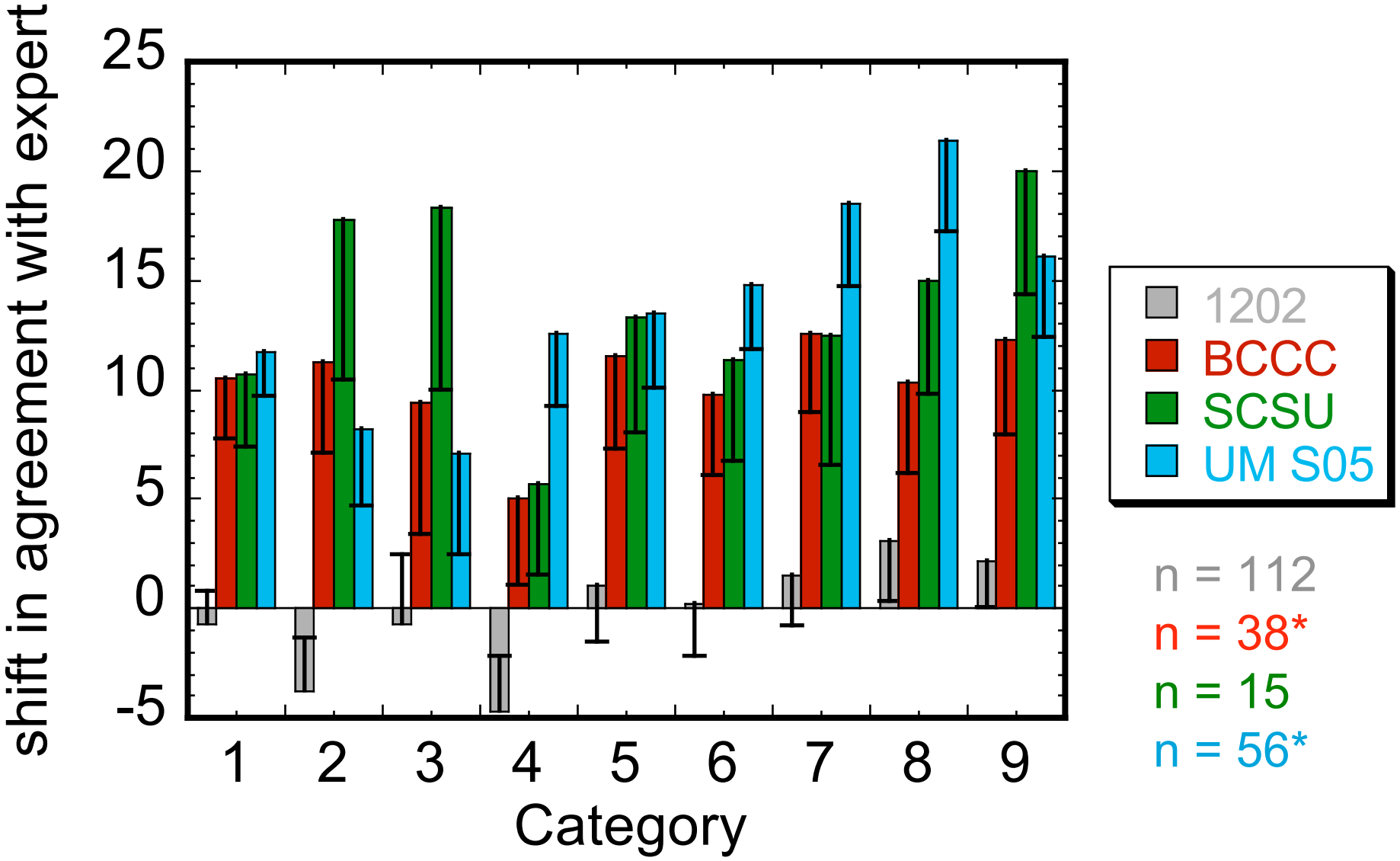
Typical CLASS results



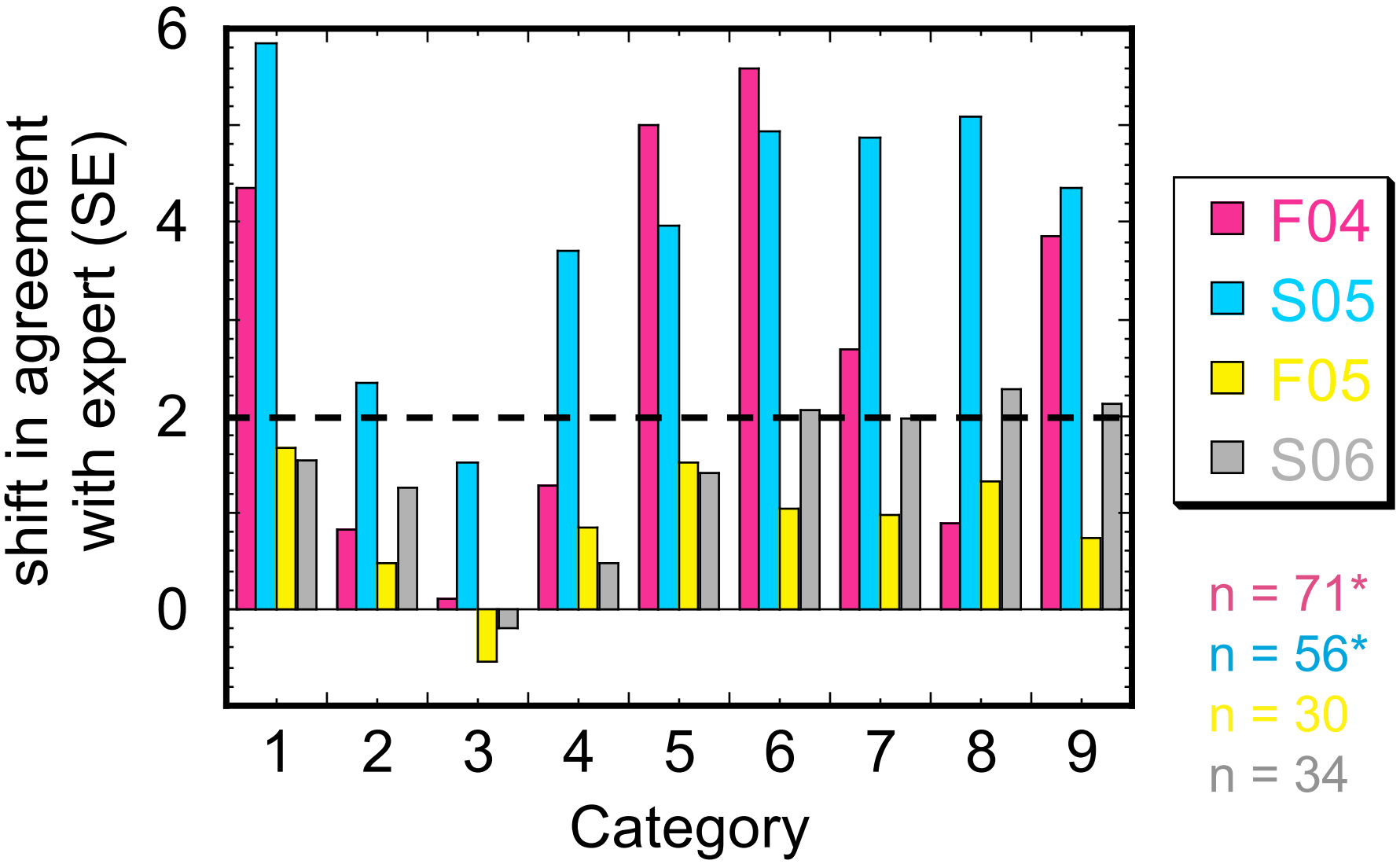
Our CLASS results



Our CLASS results



But wait…


shift in agreement with expert (SE)
6
4
2
0
1
2
3
4
5
6
7
8
9
Category
F04
S05
F05
S06
n = 71*
n = 56*
n = 30
n = 34

Summary and further questions

- The *Physics by Inquiry* curriculum can produce substantial positive shifts in students' beliefs about physics and learning physics.
- But not always…
- What are the factors that promote substantial positive shifts?
- See PST 2-15 tomorrow for more details!

CLASS categories

1. Overall
2. Personal Interest

   I study physics to learn knowledge that will be useful in my life outside of school.

CLASS categories

1. Overall
2. Personal Interest
3. Real world connection

   To understand physics, I sometimes think about my personal experiences and relate them to the topic being analyzed.

CLASS categories

1. Overall
2. Personal Interest
3. Real world connection
4. Sense making/effort

   In physics, it is important for me to make sense out of formulas before I can use them correctly.

CLASS categories

1. Overall
2. Personal Interest
3. Real world connection
4. Sense making/effort
5. Conceptual connections

   Knowledge in physics consists of many disconnected topics.

CLASS categories

1. Overall
2. Personal Interest
3. Real world connection
4. Sense making/effort
5. Conceptual connections
6. Applied conceptual understanding

   If I want to apply a method used for solving one physics problem to another physics problem, the problems must involve very similar situations.

CLASS 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)

   In physics, mathematical formulas express meaningful relationships among measurable quantities.

CLASS 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)

   If I get stuck on a physics problem, there is no chance I'll figure it out on my own.

CLASS categories

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)

If I don't remember a particular equation needed to solve a problem on an exam, there's nothing much I can do (legally!) to come up with it.