Measurement of Student Perceptions and Attitudes in Mathematics

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The Western Conference on Science Education, July 2011

Overview

1. History of the CLASS (pronounce “C-LASS”) surveys.
2. Method for adaptation to Mathematics.
3. Results from our first version.
4. Lessons from our validation (student, expert)

Goals of this survey

- Sample attitudes, beliefs, perceptions and general dispositions with respect to a discipline.
- Compare student attitudes with typical expert responses.
- Be able to give the same survey at a variety of levels to track attitude shifts.
- Quick: ~35 Likert scale questions, ~8 mins.
- Measure of populations, not individuals.

History of C-LASS

- Original, targeted at Physics:

Colorado **L**earning **A**ttitudes about **S**cience **S**urvey

- Later, adapted to Biology and Chemistry.
- http://www.colorado.edu/sei/class/
- Lots of data, fairly consistent results . . .

Adaptation to Mathematics

Three steps, process is iterative:

1. Identify questions and expert attitudes by surveying experts.
2. Validate questions via student interviews.
3. Categorize questions based on response data.

Categories

- Exploratory and confirmatory factor analysis.
- Some questions load on multiple categories.
- Not every question lives in a category, but we can keep them around for information.

- Relations to real world
  - Reasoning skills used to understand math can be helpful to me in my everyday life. (Q.25)
- Need to understand formulas or procedures
  - It is a waste of time to understand where math formulas come from. (Q.27)
- Dependence on procedures
  - To learn math, I only need to memorize solutions to sample problems. (Q.24)
- Confidence
  - If I get stuck on a math problem, there is no chance that I will figure it out on my own. (Q.36)

- Exploration in problem solving
  - There are times I solve a math problem more than one way to help my understanding. (Q.31)
- Independence in learning
  - I cannot learn math if the teacher does not explain things well in class. (Q.10)
- Uncategorized items
  - Being good at math requires talent. (Q.32)
  - I find that reading the text in detail is a helpful way for me to learn math. (Q.7)

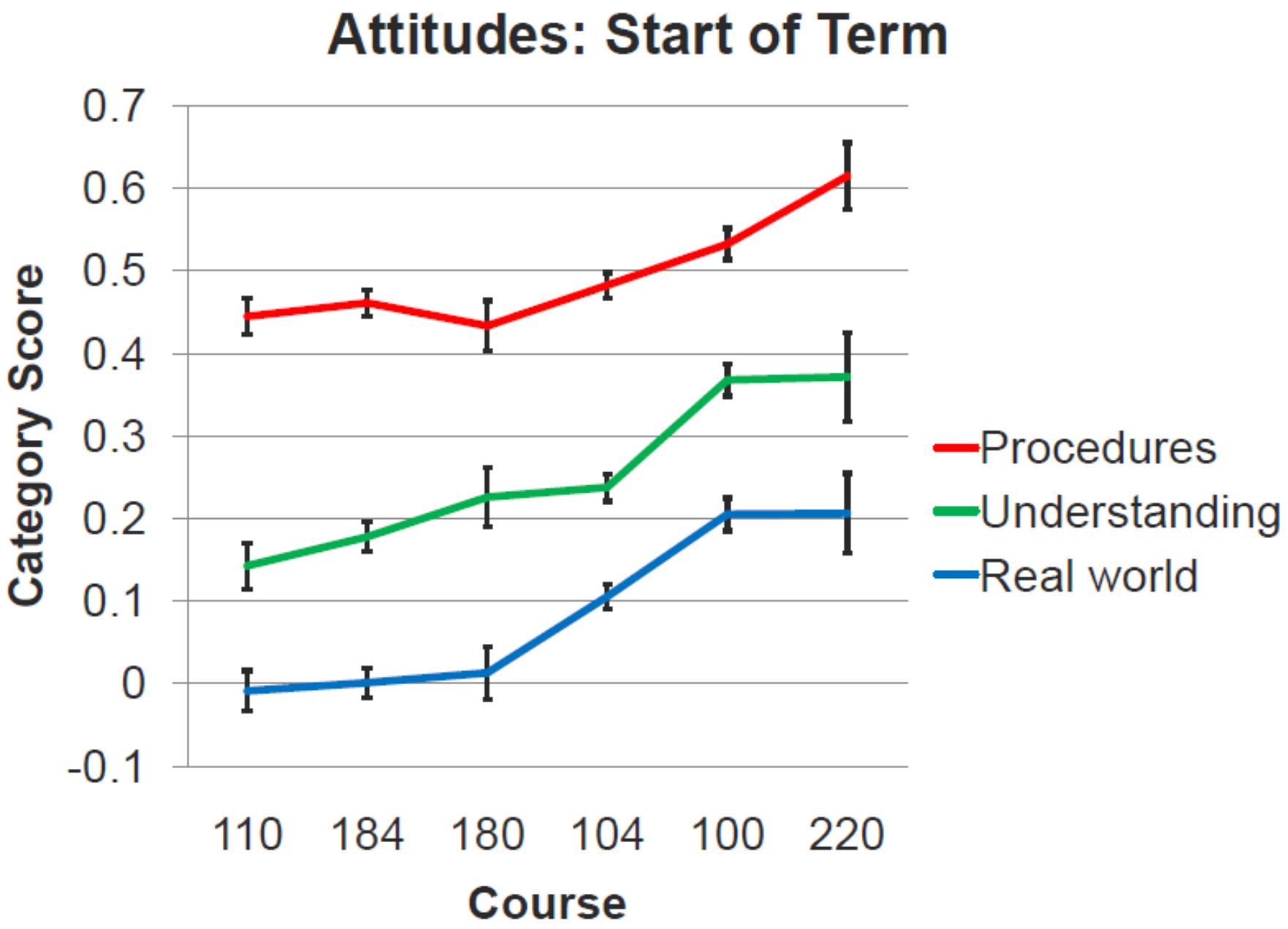
Scoring

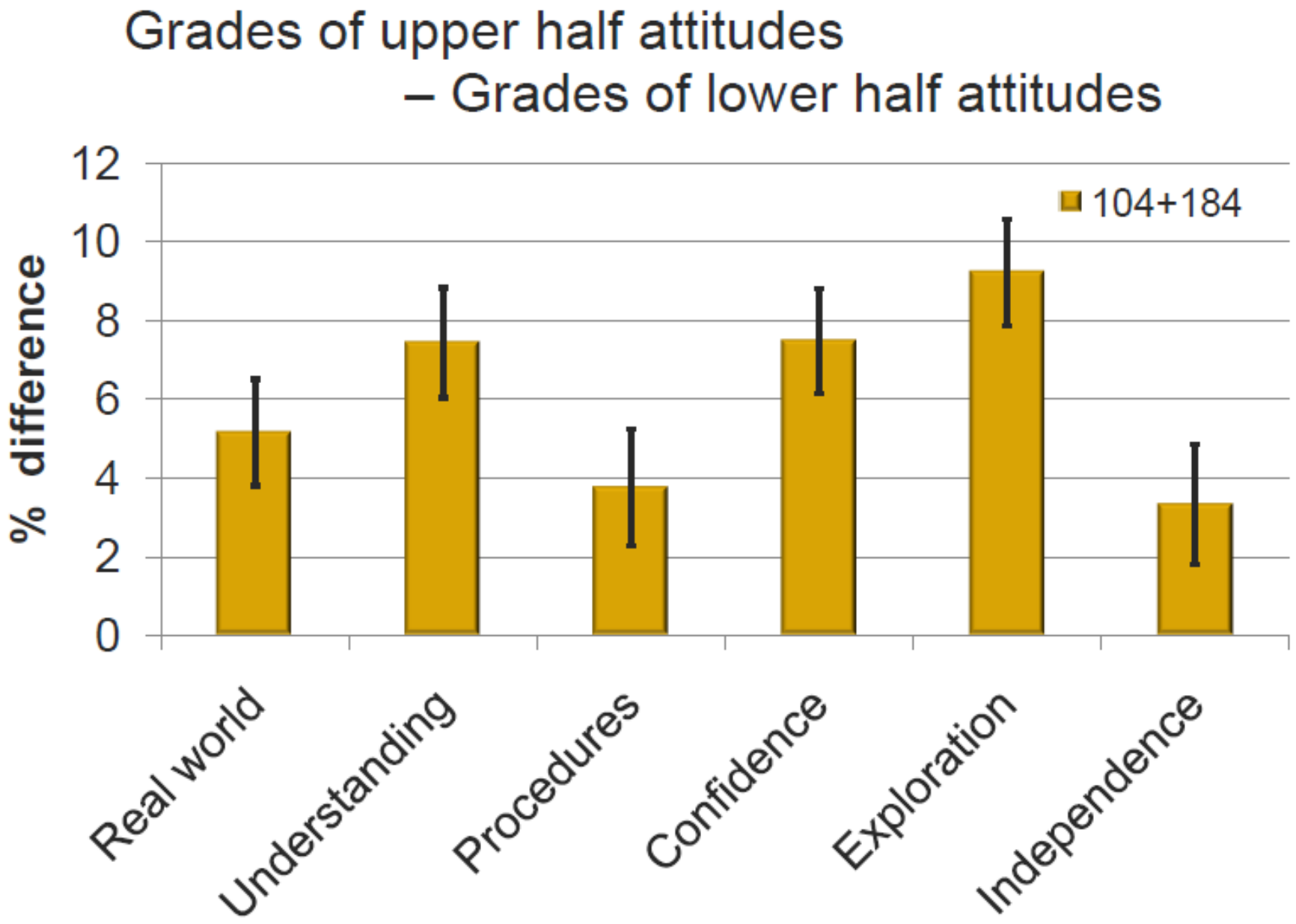
- Survey “experts” to determine preferential directions for questions.

- For each question with an expert direction, students score 1 for alignment with expert, 0 for neutral, -1 for opposite response (group Strongly Agree with Agree)

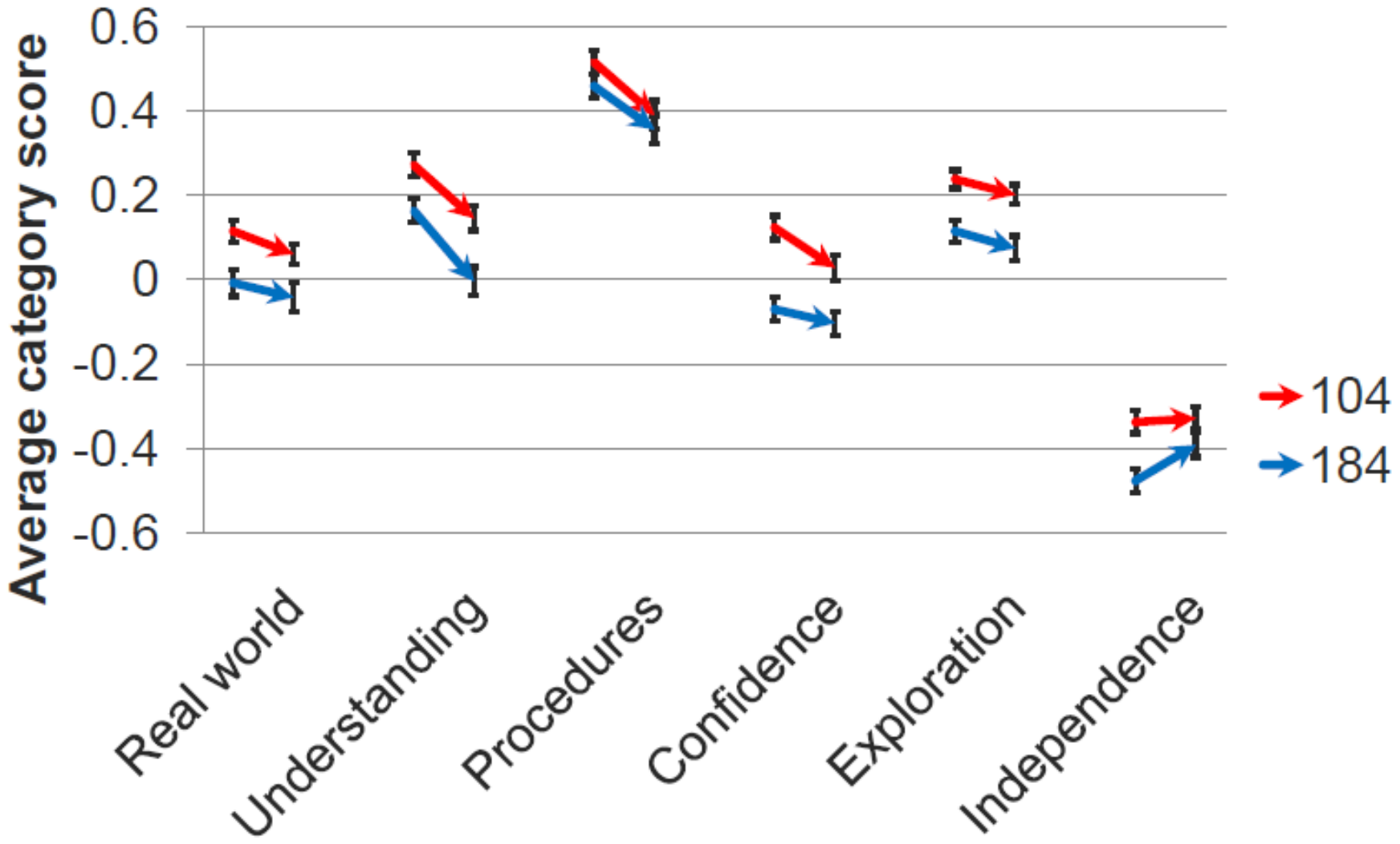
Student responses from Fall 2010

- Differential Calculus
  - without calculus background
    - Math 110 – Two-term course
    - Math 184 – Commerce and Social Sciences
    - Math 180 – Physical Sciences and Engineering
  - with calculus background
    - Math 104 – Commerce and Social Sciences
    - Math 100 – Physical Sciences and Engineering
- Introduction to Mathematical Proofs
  - Math 220


Attitudes: Start of Term
Category Score
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
110
184
180
104
100
220
Course
Procedures
Understanding
Real world


Grades of upper half attitudes
– Grades of lower half attitudes
% difference
12
10
8
6
4
2
0
104+184
Real world
Understanding
Procedures
Confidence
Exploration
Independence

Shifts of Category Scores from Pre to Post



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- Boosted to 45 questions to try some new ones.
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- A lesson to learn over and over:

> You can learn a lot by asking students what they think.

Replace “physics” with “math”?

- Reasoning skills used to understand *physics/biology/chemistry* can be helpful to me in my everyday life.
- To understand *physics/biology/chemistry*, I sometimes relate my personal experiences to the topic being studied.

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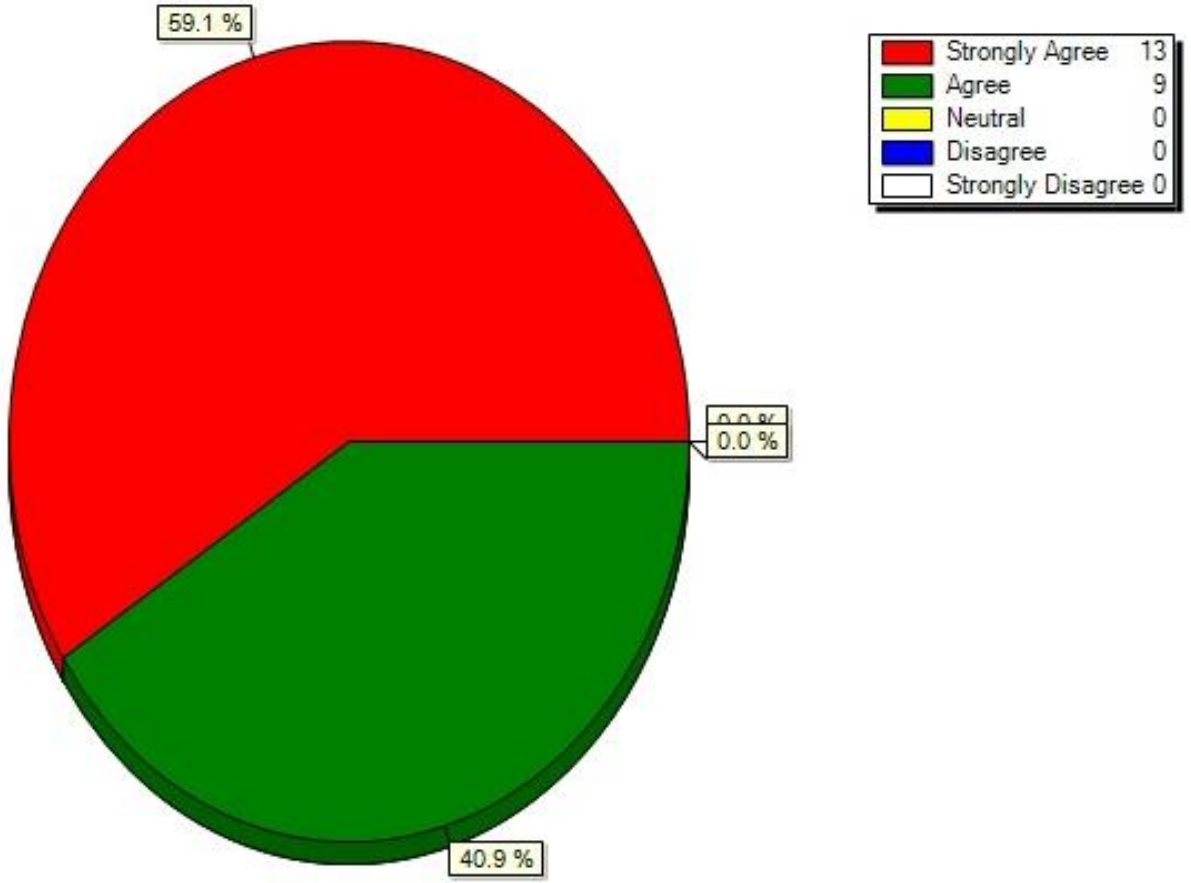
Expert responses (N=22):



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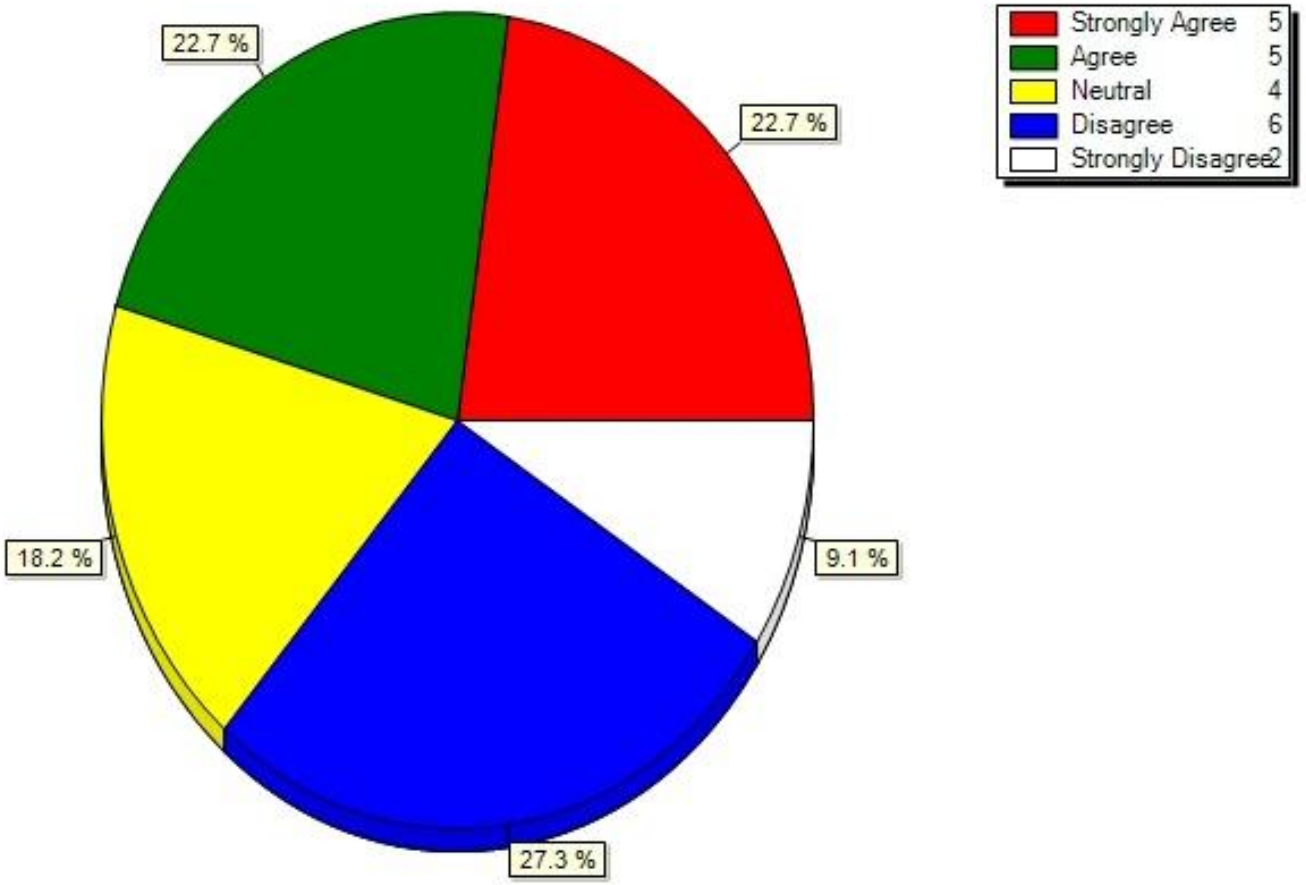

Summary of initial findings

- Math experts don't agree on the same things as other science experts with respect to their own discipline.
- "Expertise level" correlates with performance in Calc 1 in our matched data.
- Students in courses requiring more math background have more expert-like attitudes.
- Attitude shifts are generally negative in the first year, though this is typical of the CLASS.

Expected (typical) results

- Shift away from “expert” attitudes early in university unless attitudes are tackled during courses, *independent of teaching method*.
- Some predictive value in terms of program retention and course performance.
- Gender differences in confidence and levels of interest.

Acknowledgements

- Colleagues at UBC Math-CWSEI: Joseph Lo and Sandi Merchant
- Wendy Adams (CU-SEI, a CLASS-Phys author)
- Mary Nelson (CU)

Thanks!