MAPS – Math Attitudes and Perceptions Survey

Warren Code
Joseph Lo
Sandi Merchant

Abstract

Student perceptions of mathematics play a role in their motivation and approaches to learning in their math courses. We adapted an existing survey for Physics and surveyed students at the beginning and end of a range of Math courses (including several first-year calculus courses). This has allowed us to assess student attitudes and perceptions relative to those with experts, and to track how they shift over time. We present our development of the survey and some of these initial results.

What is it? Why bother?

- Our Math Attitude and Perception Survey (MAPS) modelled on the C-LASS* for Physics developed at Colorado U (adapted to Biology and Chemistry so far).
- Surveys alignment of student attitudes with professional academics in the field.
- More a measure of population, not really of individual students.
- Good at finding low scores and shifts over time.

*C-LASS: Colorado Learning Attitudes about Science Survey

Development

- Determine Expert Approach
  - What items do experts care about and agree on?
- Field Test
  - Run the survey with actual students.
- Categories
  - What questions make sense as group?
- Validate
  - Are students interpreting the questions consistently?
- Iterate (about 1 to 2 years)

Categorization

- Start with questions that appear related.
- Use some form of Factor Analysis
  - Which groups of questions are usually answered in the same direction but independently from the other questions/blocks? (Move beyond pair-wise correlation)

- 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)

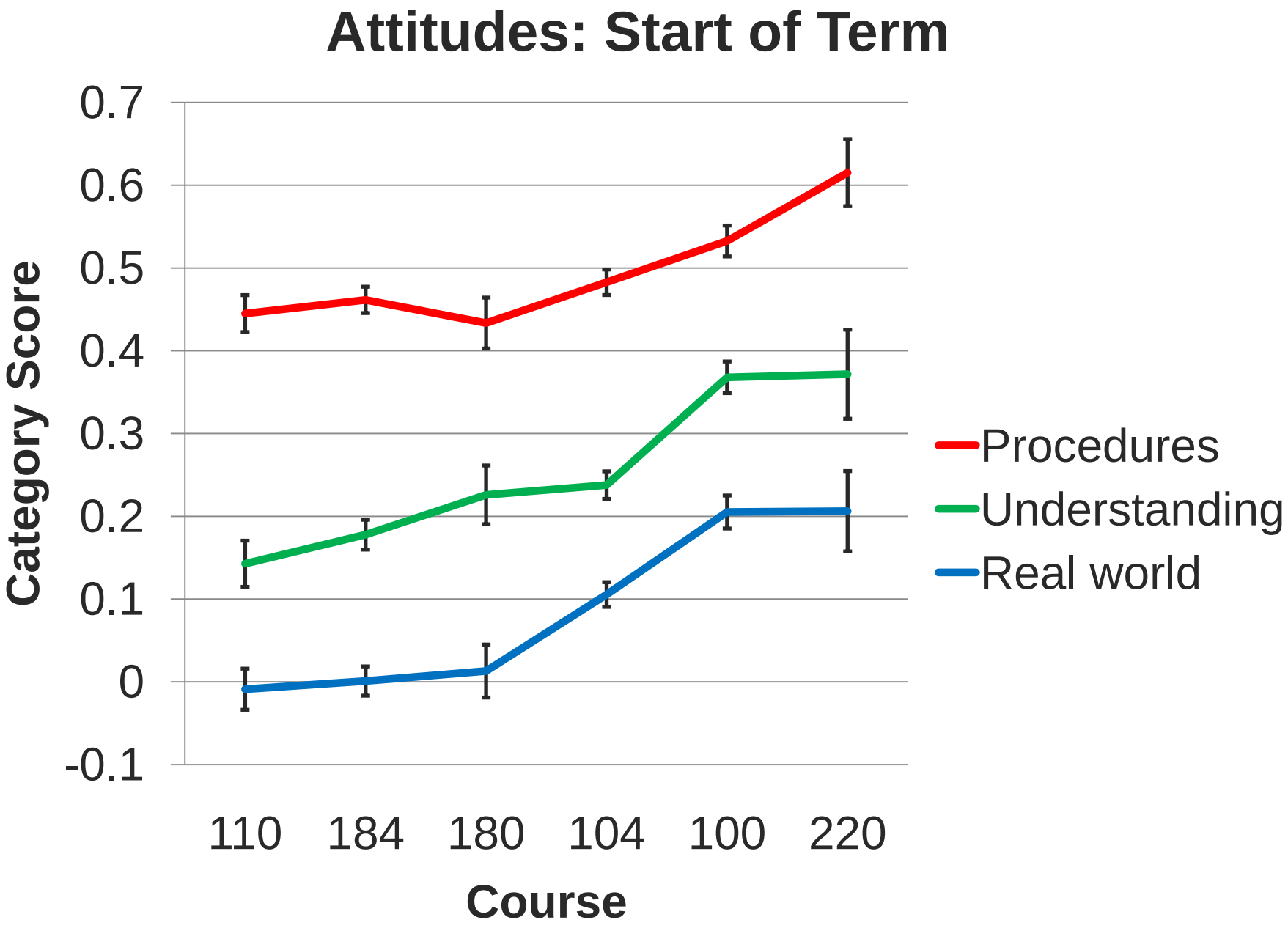
- Exploration in problem solving
  - There are times I solve a math problem more than one way to help my understanding. (Q.31)
- Independence in learning
  - I cannot learn math if the teacher does not explain things well in class. (Q.10)
- Uncategorized items
  - Being good at math requires talent.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

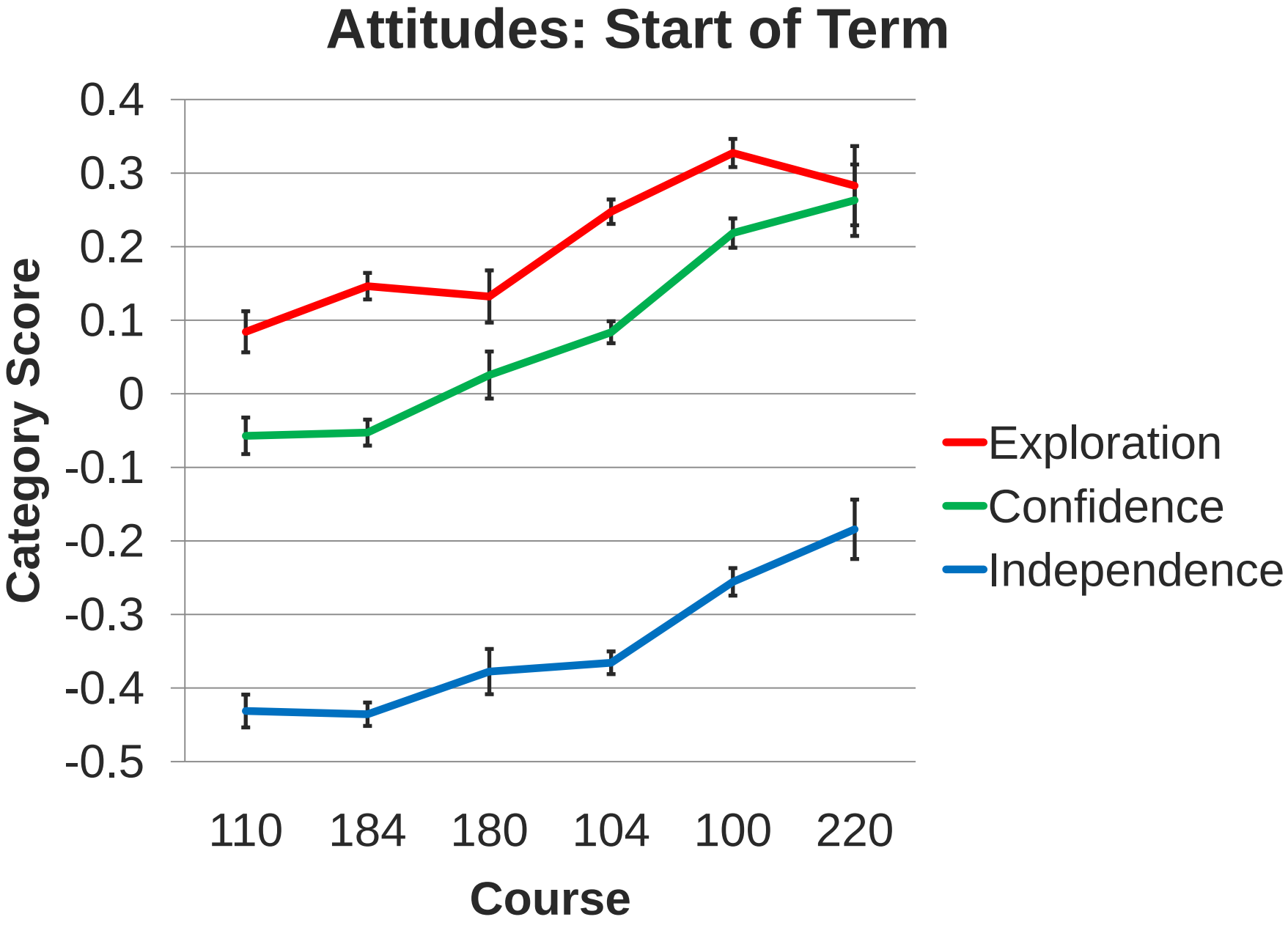
Category Scores – An expertise index?

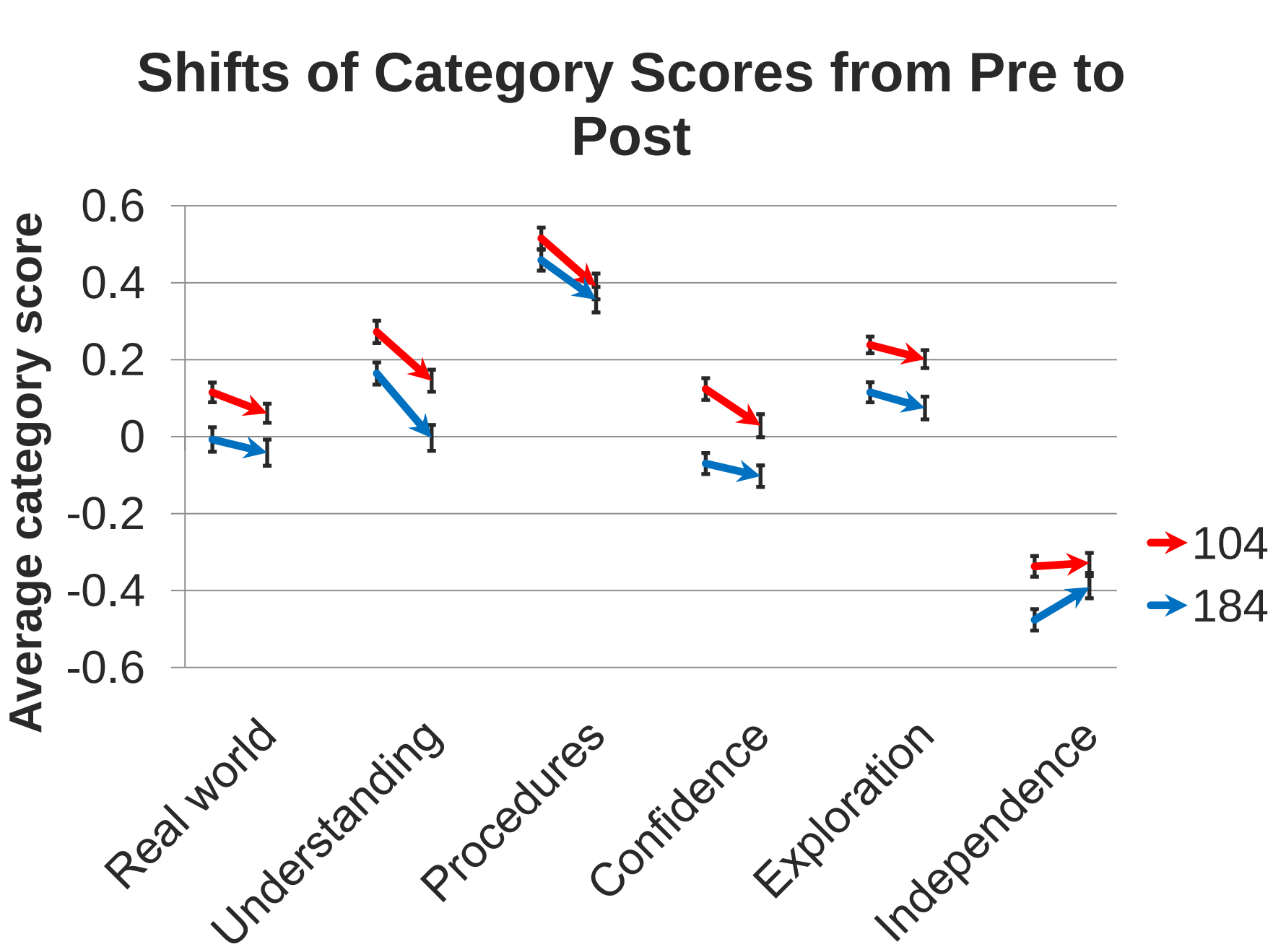
- For each statement, a score of -2, -1, 0, 1 or 2 is assigned.
- The scores are summed up for each category.
- The category scores are normalized to a scale from -1 to 1.
- Positive being expert, negative being novice.

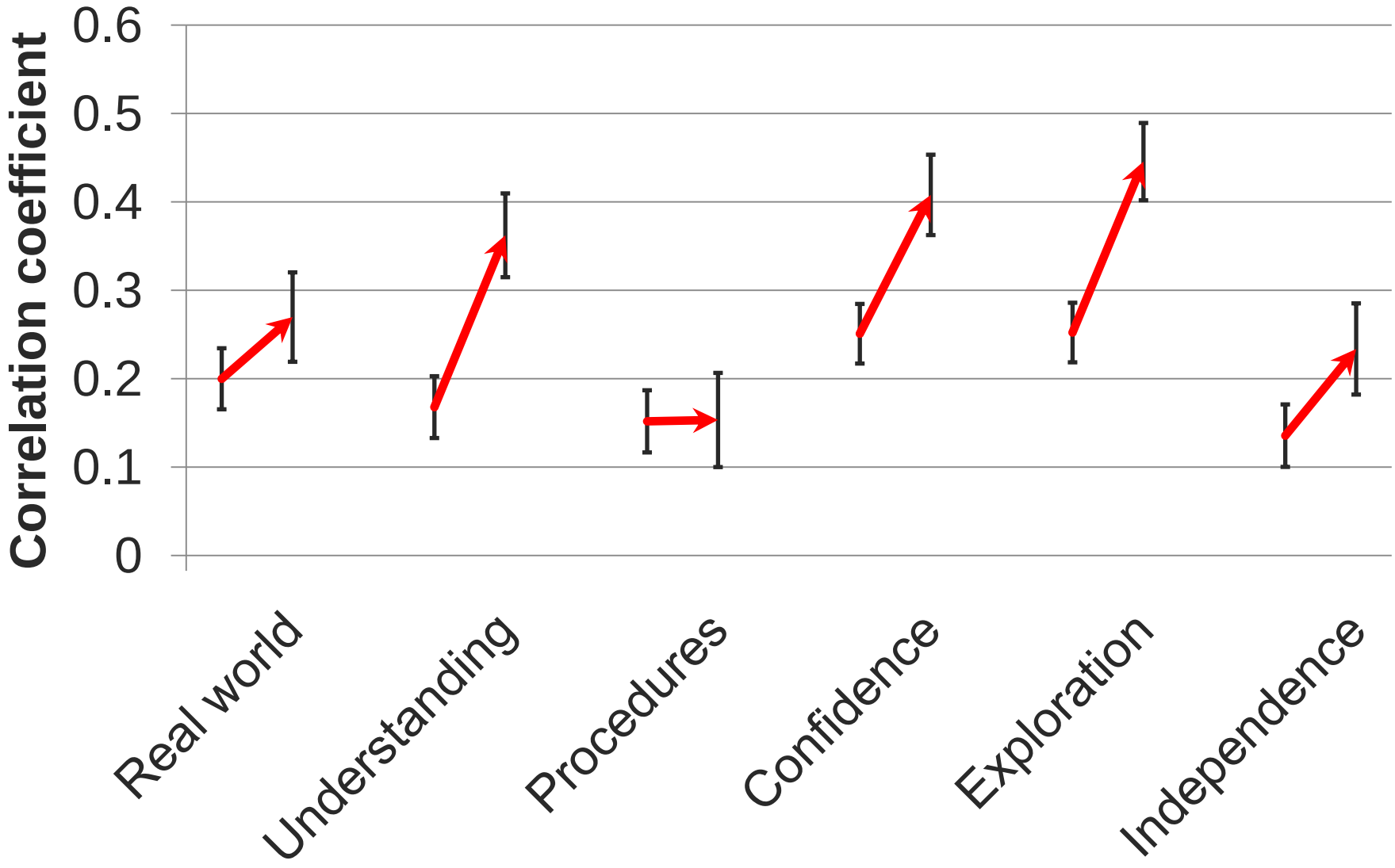
Who did the survey?

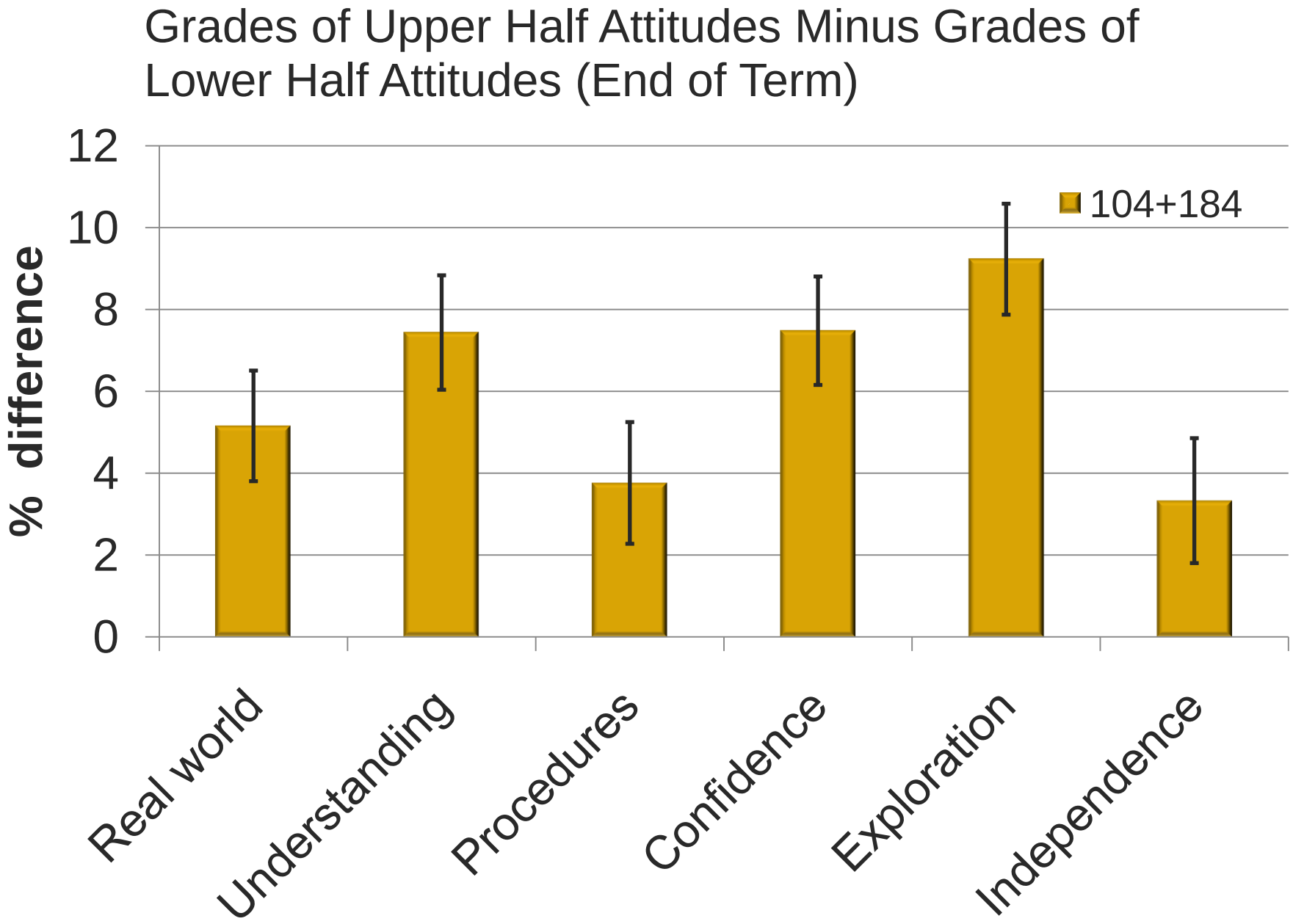
- Differential Calculus
  - without calculus background
    - Math 110 – Two-term course
    - Math 184 – Commerce and Social Sciences
    - Math 180 – Physical Sciences and Engineering
  - with calculus background
    - Math 104 – Commerce and Social Sciences
    - Math 100 – Physical Sciences and Engineering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


Attitudes: Start of Term
Category Score
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
110
184
180
104
100
220
Course
Exploration
Confidence
Independence


Shifts of Category Scores from Pre to Post
Average category score
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
Real world
Understanding
Procedures
Confidence
Exploration
Independence
104
184


Correlation with Course Grades in Math 104/184 (pooled) from Pre to Post
Correlation coefficient
0.6
0.5
0.4
0.3
0.2
0.1
0
Real world
Understanding
Procedures
Confidence
Exploration
Independence


Grades of Upper Half Attitudes Minus Grades of Lower Half Attitudes (End of Term)
% difference
12
10
8
6
4
2
0
104+184
Real world
Understanding
Procedures
Confidence
Exploration
Independence

Conclusion

We have found three main results in our math courses. First, the "expertise level" of attitudes correlates positively with performance in first-year differential calculus. Second, on average, students in courses that require more math background have more expert-like attitudes. Finally, in a differential calculus course we generally observed shifts towards more novice-like attitudes from the start to end of term. Future work on MAPS will include interviews with students to validate the survey and the refinement of the current questions and categories.

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Introduction

Categorization

Results