Coordinated Progress in Conceptual Understanding and Representational Competence

Leah Walker, University of California, Berkeley, Graduate School of Education
Mark Wilson, University of California, Berkeley Graduate School of Education
Robert Schwartz, University of California, Berkeley Graduate School of Education
David Torres Irribarri, University of California, Berkeley Graduate School of Education

Introduction
Researchers from the Berkeley Evaluation and Assessment Research center, the Assessing Data Modelling team at Vanderbilt University, and teachers from Phoenix, AZ and Northwest Arkansas collaborated in the effort of creating assessment system that captures the progression of student learning in the area of data modelling.

Data modelling refers to the skills and practices of making decisions about what and how to measure, the ways that data should be structured and displayed, and the conduct of inference. It is essential for students to learn these skills in order to understand the world and the problems it presents (Lehrer & Schauble, 2004).

To assess student understanding, we created 7 constructs spanning data modelling.

The constructs were developed from theory and research conducted in classrooms then refined through the process of creating items, developing scoring guides, assessing student work, and analyzing results.

This presentation reports on results from a multidimensional analysis of two constructs: Data Display (DaD) and Conceptions of Statistics (CoS).

Participants
- 29 middle school teachers participated in teaching the introductory statistics curriculum. Teachers were supported by training materials and workshops.
- 658 students.
- Students in the same classrooms were all given the same pre-test form.

Data Collection

Example Items
- Homemade Bowling Part 1: (DaD) Item.
  Danny created a homemade bowling game. In the game, he counted how many bottles, out of ten, he was able to knock down each time he rolled a ball. Here are the numbers of bottles Danny knocked down 3 times.

  5, 6, 6, 7, 7, 7, 8, 8, 8, 8
  1. Draw the sample, make a display that helps you think about how you expect Danny to perform in general.
  2. Given the sample, make a display that helps you think about how you expect Danny to perform in general.

  Exercise Ball Part 1: (CoS) Item.
  A group of 7 students measured the circumference of an exercise ball. The measurements, in inches, are listed below.

  6.5, 6.6, 6.7, 6.8, 6.9, 7.0, 7.1
  1. Find the mode, mean, and median of the balls’ measurements and write your answers below. Show your work in each box.

Research Questions
- How does learning progress in Conceptions of Statistics and Data Display separately?
- How are Conceptions of Statistics and Data Display related?
- How is learning coordinated across the two constructs?

Theoretical Framework
- The one-dimensional constructs follow the learning progression in each area.
- Evidence of connections:
  - overall theory
  - item design

Discussion of Findings
- Data Display and Conceptions of Statistics are reasonably correlated with each other, suggesting that they are related but separate constructs.
- At low ability levels, the domains converge. Relevant but flawed responses (N(d)) in both Data Modelling and Conceptions of Statistics were observed in the same region.
- Calculating statistics of central tendency (CoS 2(A)) is central to a major level of understanding associated with most levels of DaD.

Limitations and Future Research
- Because of the fact that many of the items in the analysis set were targeted at CoS 2(A), the conclusion about the connection between central tendency and CoS should be interpreted carefully.
- The post-test data will provide additional information on changes within a certain student after taking the complete course. Analysis of the post-test data will include a latent growth item response model.

Contact: Leah Walker, leahwalker@berkeley.edu