Measuring Mathematical Knowledge for Teaching Community College Algebra

Dexter Lim, Irene Duranycz, Bismark Akoto, AI@CC 2.0 VMQI Research Group

Abstract

This poster presents preliminary findings about the dimensionality of our 34-item instrument designed to measure MKT-CCA and the performance of items within our instrument. Our analysis showed that a three-dimensional model structured by function types better fitted the data than a unidimensional model. Our analysis also showed that two- and six-dimensional models, structured by the tasks of teaching or the combination of function types and tasks of teaching, did not converge.

Project Description

The Algebra Instruction at Community Colleges (AI@CC 2.0: VMQI) project (Mesa et al., 2020-2023) seeks to develop and validate an instrument to assess instructors’ Mathematical Knowledge for Teaching Community College Algebra (MKT-CCA) and to revise a video coding protocol. The MKT-CCA instrument sets out to measure the mathematical knowledge for teaching college algebra at community colleges (CCCs) using multiple-choice or testlet items focusing on the following college algebra topics: Linear equations and functions, Exponential equations and functions, Rational equations and functions. We hypothesize that MKT-CCA will also be organized along the following two Task of Teaching:

- Choosing problems
- Understanding student work

Research Question

Are there six distinct dimensions of mathematical knowledge for teaching college algebra at community colleges?

Method

- A 34-item MKT-CCA instrument (27 multiple choice and 7 testlets) + Identified 7347 instructors (900+ responded) + Collected 556 responses from 315 institutions + 2 Parameter Logistic MIRT model using maximum likelihood estimation

Institutional Characteristics (315 Colleges)

- 44 States + Guam
  - 37% western
  - 36% southern
  - 50% represented a majority of non-white students
- Setting
  - 47% urban
  - 26% suburban
  - 14% small towns
  - 12% rural
- Institution size
  - 50% medium/large
  - 26% small/medium
  - 22% large
  - 3% small

Sources

- 34-item MKT-CCA instrument (27 multiple choice and 7 testlets)
- Identified 7347 instructors (900+ responded)
- Collected 556 responses from 315 institutions
- 2 Parameter Logistic MIRT model using maximum likelihood estimation

Next Steps

- Corroboration independence of the three constructs
- Conduct validation interviews
- Analyze data from a sample of people who have the knowledge but no teaching experience mathematical majors with NO tutoring experience
- Identify associations between instructors’ performance on MKT and their characteristics and beliefs.

Preliminary Findings

- Sample size was not enough for modeling six dimensions.
  - +800 complete files would have been necessary to find all dimensions.
  - Difficult to separate the two tasks of teaching at the level of choosing problems or understanding student work used here
  - Ko and Herbst (2020) had a more fine-grained distinction.
  - MKT-CCA instrument provides good coverage of a wide range of latent ability levels.
  - Discrimination: ranged from 0.183 to 2.555
  - Level of difficulty: ranged from –4.914 (very easy) to 2.140 (difficult)
  - The three-dimensional model fit the data significantly better than the one-dimensional model, $\chi^2(3) = 12.37, p < .01$.

References


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