Data Connections

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Measures of Effective STEM Teaching
• Large-scale achievement test scores (student growth > expected)
• Attitudes (student & teacher)
• Mathematical Knowledge for Teaching (MKT)
• Mathematical Quality of Instruction (MQI)
• Teacher professional network (Professional Learning Community collaboration)
• Habits of mind (no good measures yet)

Value-Added Modeling (VAM) Techniques
• Estimate contribution of educational factors to growth in achievement, while controlling for effect of non-educational factors
• Potential to identify characteristics of highly effective teachers
• Require a single developmental scale and quality longitudinal data

Layered Value-Added Models
• Utilize incomplete student records for efficient use of available data
• Model relationship between multiple test scores on same student
• Robust to omitted covariates (e.g., SES) in some instances
• Estimate “teacher effects”

Parallel Processing Illustration

Longitudinal student achievement data tend to follow a cross-classified instead of a nested structure across time, where students at level one are nested within level two teachers’ classrooms at each time. However, not all students who have the same teacher at one time have the same teacher at another time, resulting in a cross-classified structure.

The level one curve-of-factors model has two indicators, or observed measurements, e.g., CA1 and MA1, of a latent trait at each of the four time points. The latent factors A1-A4 represent the latent trait of interest, e.g., achievement, at each of the times. The covariance between two latent factors is represented by a two-sided arrow connecting the two factors, with the variance of a factor represented by a self-connecting arrow. When linked to teachers, this model structure allows for the estimation of a teacher’s effect on changes in a latent trait over time.

Value-added refers to growth in achievement above what is expected across time for a given student.

Layered Model
• Links past teachers to student outcomes
• Student Score = overall mean + cumulative effects of previous and current teachers + random residual variation

Non-layered Model
• Links current teachers to student outcomes, so ignores effects of instruction in earlier years
• Student Score = overall mean + effects of current teachers + random residual variation

Challenges Related to Value Added Modeling
• Plethora of instruments to measure student achievement in math.
• Districts change tests and/or use different tests for different grade levels
• Z-scores and binning allow standardization across instruments; more needs to be known about their performance relative to one another and possible alternatives
• Achieving alignment between desired student learning outcomes & what student achievement instruments can measure
• Conceptual MSP work often does not align well with procedural state tests
• Lack of alignment leads to meaningless results
• No easy choices regarding inclusion of covariates
• Researchers must choose between potentially confounding teacher effects with student-level variables and potentially underestimating teacher effects.
• Student mobility
• How to estimate teacher effects on students when students have multiple teachers in a year
• Requires potentially unrealistic assumptions (each teacher’s effect is proportional to the time the student spent in his/her classroom)
• Teacher effect estimates should be linked to other valid measures of teacher effectiveness
• The challenge for value-added-modeling is to augment models with aspects in addition to achievement that predict (or allow us to characterize) effective teaching and learning so that the refined models enhance rather than dilute our ability to identify and reward good teaching
• Need to better model the persistency of teacher effects
• Most models either omit previous years’ teachers’ effects or assume they persist undiminished over time

References