The Missing Link between Research on Mathematics Curriculum Effectiveness and Policy: Theory as a Mediator

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Overview of the Talk

• Problem of Definition of *Curriculum*
  – Implications of assumptions for teaching
  – Implications of assumptions for policy
  – Implications of assumptions for research

• Research Setting and Questions
• Initial Results
• Comments and Conclusions
What do people mean when they use the term *curriculum*?

- Frameworks or standards that list a set of curricular topics to be taught in particular grades or grade bands (e.g., NCTM Curriculum Standards, State Curricular standards)
- Instructional materials for teachers and students, including assessment materials (e.g., Saxon Math, *Connected Math*)
What might be the implied mechanism for impact of curriculum?

• If curriculum is the set of topics to be covered in a particular year, what about curriculum leads to student learning?
  – For example, assumptions underlying the NCTM Curriculum Focal Points are:
    • covering fewer topics leads to better student learning
    • covering topics in a particular order leads to better student learning
  – What is it about the number of topics covered in a particular order that supports student learning? What is the implied causal mechanism?
Implied mechanism for impact of curriculum as a set of materials

- If curriculum is viewed as a set of materials for teachers and students, there are further ways to define what the materials are/represent, and therefore how they impact student learning
  - Collection of tasks, examples and explanations, carefully sequenced to be taught in a particular order
  - Collection of tasks, examples and explanations, to be chosen from at the teachers’ discretion
  - Descriptions of a plan for instruction and a set of tasks, examples, and explanations that can/must be used to execute that plan for instruction
Examples

• Saxon Math
  – Behaviorist theory of learning
  – Spiral combined with mastery curriculum design
  – Intended to be used in total

• Math in Context
  – Constructivist theory of learning
  – Realistic Mathematics Education curriculum design (Gravemeijer, 1998)
  – Intended to be used in total
Fidelity of Implementation

• Measure of how well the implementation matches the intended intervention (Fullan, 2007)
  – Implication is that teachers work as technicians, implementing the author’s vision in his or her classroom

• Policy makers create policies to enforce fidelity of implementation
  – Curriculum-based professional development
  – Curriculum pacing guides

• Works against other policy reforms attempting to professionalize the teaching profession
Primary Concerns

- When did implementing a particular curriculum become a proxy for effective instruction? (c.f., Tarr, et al., 2008)
- What matters for student learning – effective instruction or implementation expertise?
- Given the existing research that usually finds minimal effect or interaction effects for particular curriculum use, what should policymakers do to improve mathematics learning?
Current Policy Responses

• Mandate curriculum (state/district adoptions, curriculum pacing guides)
  – Assumes the implementation of particular curriculum leads to effective instruction
• Curriculum-based professional development
  – Supports the technical implementation of a particular curriculum
• Seek research on “What Works?”
  – Emphasis on investing in material resources over human resources
Usability

• If curriculum is viewed as providing resources to support instruction, how does one measure the efficacy of the curriculum?
  – How easily can teachers use the materials to implement effective instruction?
  – How easily can teachers adapt the materials to their contexts to implement effective instruction?

• Assumption is that teachers make professional decisions in use, adaptation, and non-use of materials.
Levels of use and adaptation

- Use without modification
- Use with adaptation
  - Adapt to be relevant to students’ lives
  - Adapt to change the numbers in the problems
  - Adapt for special needs students
  - Change the mathematical representations
- Use as one of many resources
- Replace
The Study

- How do teachers use the district mandated curriculum materials?
- What are the impacts of this use on students’ achievement?
Significance of the Study

• Framed not as “fidelity of implementation” as a measure in evaluating the curriculum
• Instead framed as “teachers as decision-makers in their classrooms” and trying to better understand
  – The decisions teachers make
  – The reasons for these decisions
  – The impact on student achievement
• In particular, trying to understand these issues in the context of urban classrooms where teachers perceive unique constraints on teaching
Research Design

- **Connected Mathematics Project (CMP) as the instructional materials**
  - most widely used of the NSF-funded middle grades instructional materials

- **Large urban district in Northeast of about 45,000 students**
  - Uses CMP
  - Has had a Local Systemic Change project that has supported intense, CMP-based professional development
  - Studying a district under “ideal” conditions for the implementation of materials, but otherwise has the other typical issues of urban districts
Research Design

• Mixed methods design
• Population study of teachers’ use based on survey data and student achievement data (March 2009)
• Case studies of two schools (October 2008)
  – Interviews and observations of teachers about their planning and execution of lessons
  – Benchmarking assessments of student achievement in the observed classrooms
Initial Results

- Two distinct profiles of use
  - Implementer – Technical implementation of the written lessons provided by the teacher materials with small adaptations
    - Strong use of the teacher materials and ancillary materials
    - Varying quality of use of standards-based instruction (based on observations)
  - Designer – Uses the materials, in conjunction with others, to design and teach a lesson
    - Use of student materials, but less reliance on teacher materials
    - Varying quality of use of standards-based instruction (based on observations)
Where we are going from here

• Analysis of the student benchmarking examination data from the students in the case study teachers’ classes

• Continuing analysis of profiles of use and relationship to student achievement

• Population survey data collection of the middle grades teachers in the district using the Survey of Enacted Curriculum and a project-designed CMP survey focused on materials use (March 2009)

• Student achievement data collected from state tests and HLM analysis modeling school and teacher effects
Conclusions

• The field needs to be more specific about what is meant by the term *curriculum*

• In particular, as we conduct research, we need to be clearer about what we theorize is the mechanism of impact
  – Particular topic coverage (e.g., curriculum standards)
  – Materials implementation
  – Materials use

• This clarity is needed to provide better advice to policymakers so their policy formulation is better able to be driven by research results (Confrey, et al., 2008)