Deepening Teacher Mathematics Content Knowledge: What do we know about effective professional development?

Presentation for the Conference Board of the Mathematical Sciences
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December 3, 2010
Purposes of this Presentation

• Give you a sense of what we know and don’t know about effective PD to deepen teacher mathematics content knowledge.

• Provide information you can share with others in your professional society interested in PD for K-12 mathematics teachers.
Simplified Logic Model for Professional Development

Professional Development → Teacher Knowledge and Skills → Teaching Practice → Student Outcomes
Teacher content knowledge matters…

For teaching practice:

• Selecting content to emphasize
• Selecting instructional strategies and sequence
• Selecting assessment tasks
• Implementing curriculum materials
Teacher content knowledge matters…

Students of teachers with stronger content knowledge have higher achievement scores than other students, in particular on measures of conceptual understanding.
Teacher content knowledge matters…

Students of teachers who hold an incorrect idea are more likely than other students to hold the same incorrect idea.
Deepening Teacher Content Knowledge

- Research has shown that content-focused professional development is related to changes in teaching practice and positive results in student achievement.

- What does it mean to have professional development that is “content-focused”? 
Facets of Teacher Content Knowledge

- Disciplinary content knowledge (DCK)
- Pedagogical content knowledge (PCK)
- Ways of knowing content (WoK)
What facets of content to choose in content-focused PD

- Most people seem to agree that all of these facets are important for teaching
- With unlimited time and resources, we would likely address them all
- But we don’t have unlimited time and resources, so we have to make choices
What facets of content to choose in content-focused PD

• For a given group of teachers, people might have different perspectives on:
  – How much emphasis to place on various facets of teacher knowledge
  – Optimal sequencing and connecting of those facets
What Is Effective PD?

- Several reviews of research have identified lists of common elements of PD programs that have some evidence of effectiveness.

- Expert practitioners identify similar elements, suggesting an “emerging consensus.”
An Emerging Consensus
Effective PD:

• Focuses on content knowledge and how students learn content
• Involves a substantial number of hours
• Sustains focus over time
• Models effective practice, including active learning experiences
• Engages teachers in communities of learning
• Involves active participation of school leaders
Designing PD: Selecting Goals

• The Common Core State Standards for mathematics aim for fewer (as well as clearer and higher) standards.

• However, given the breadth of content included in the CCSSM, and the limited time available for PD, choices still need to be made.
Designing PD: Selecting Goals

• It may be useful to do an assessment of teacher content-related needs.
  – Can be expensive and time consuming
  – Asking teachers may ensure ownership but teachers may not know what they don’t know.
Designing PD: Selecting Goals

• District mathematics supervisors can provide insights about teacher content-related needs.

• Or decisions can be based on student achievement data, the “bottom line” for parents and policy-makers.
In choosing content foci, consider:

• Will deepening teacher content knowledge make a difference in the quality of teaching and learning?

• If lack of content knowledge is not the primary problem, then deepening teacher content knowledge is not likely to be the answer…what else besides teacher content knowledge needs to be addressed?
Sequencing PD Goals

One line of reasoning:

• Teachers can’t teach what they don’t know. Therefore, it is important to start with mathematics content, and only after teachers themselves have a sufficiently deep understanding of the content, move to considering classroom application.
Sequencing PD Goals

Another line of reasoning:

• Teachers are by their very nature practitioners. Starting with classroom applications, e.g., trying to analyze student work, provides a context for engaging the teachers in learning mathematics content.
Sequencing PD Goals

- It is important to note that the available research doesn’t help in making this kind of decision.
Sequencing PD Goals

• In making these decisions, PD designers need to consider:
  – The needs of the particular group of teachers in relation to the selected content areas
  – Your views on what knowledge is most important
  – What you have time to do
  – What you know how to do well.
There are options for PD strategies

- Engage teachers in content-focused investigations;
- Have teachers consider content provided via lectures, readings, demonstrations;
- Have teachers analyze student instructional materials, or “cases” of instruction, or samples of student work.
In designing learning experiences for teachers

• Consider the potential strengths and weaknesses of each PD strategy in relation to a particular purpose or set of purposes.

• Design PD – and select PD providers – to take advantage of the strengths and avoid the likely pitfalls.
Don’t let form trump substance

- Choose PD strategies that will help achieve your purposes, rather than choosing the latest strategies and seeking purposes for them.
Be realistic

- Choose PD strategies that fit the resources and capacity you have (or can develop) to provide high quality professional development
Avoid reinventing the wheel

• Use existing high quality professional development materials if available.

• TE-MAT: www.te-mat.org
Design PD to facilitate transfer to the classroom

- Point out connections between what teachers are learning and what they are expected to teach.

- Help teachers apply what they are learning to their classrooms, with opportunities for practice and feedback.
How Can STEM Faculty Contribute?

- STEM faculty can provide content expertise to the design and implementation of professional development programs and courses for K-12 teachers.
Helpful STEM faculty roles in the **design** of PD:

- Identifying learning goals for teachers;

- Developing the scope and sequence of professional development programs/courses;

- Selecting/adapting/designing learning experiences for teachers;
- Developing instruments to assess teacher content knowledge;
- Preparing professional development/course providers;
- Providing input on redesign of professional development programs/courses.
Helpful STEM faculty roles
in implementing PD

- Providing lectures/explanations focused on mathematics content;
- Facilitating teacher investigations/discussions focused on mathematics content;
- Facilitating investigations/discussions focused on mathematics pedagogical content knowledge (e.g., considering student thinking);
- Monitoring teacher understanding of the content;
- Serving as a content resource to address teachers' questions; and
- Serving as an on-demand content resource for teachers.
Flexibility is Key

- Deciding which STEM faculty to involve will depend in part on the roles STEM disciplinary faculty will play;

- But it is important to select individuals who are open-minded, flexible, and reflective about their own teaching.
It takes time

• Work to establish a collaborative culture among STEM disciplinary faculty and teachers/teacher leaders right from the start, but recognize that efforts must be ongoing.

• Engage STEM disciplinary faculty first as participants, then apprentices, then as leaders of project components.
What’s in it for them?

• STEM faculty often want to help improve K-12 education.

• Highlighting the scholarship aspects if the work has a research component is a way to pique STEM disciplinary faculty's interest and continued involvement in the work.
Trust but verify

• Program designers need to monitor to see if the PD is being implemented as designed, especially during scale up.

• Collect (and use) formative evaluation data to refine STEM disciplinary faculty efforts.
Resources provided by MSP KMD

- Knowledge reviews, including summaries of research and practice-based insights, focused on deepening teacher content knowledge, teacher leadership, and STEM faculty involvement in PD

- Searchable database of instruments for measuring teacher content knowledge
For more information

• Contact us at:

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