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

Presentation for the Conference
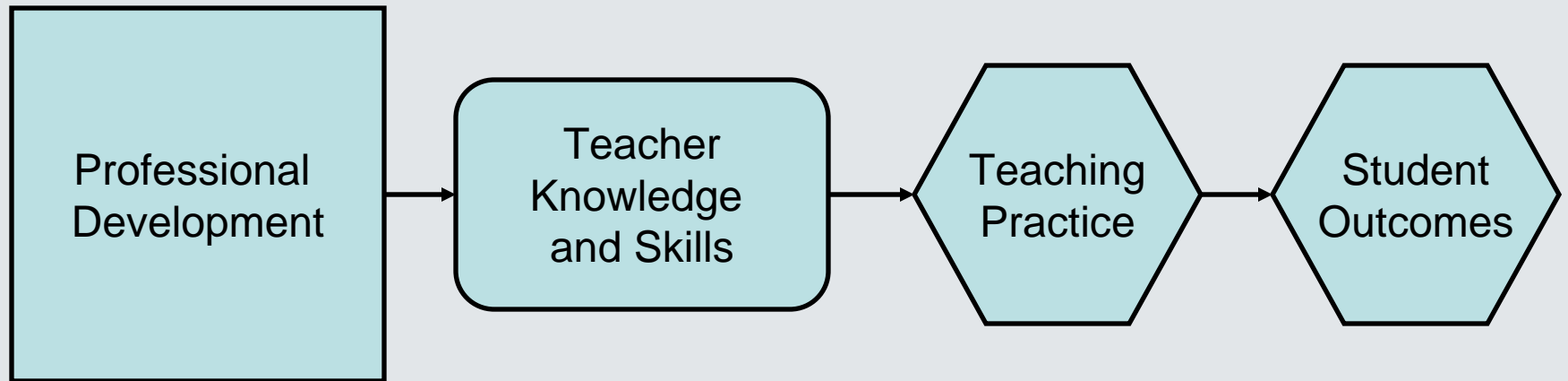Board of the Mathematical Sciences
Iris R. Weiss
December 3, 2010

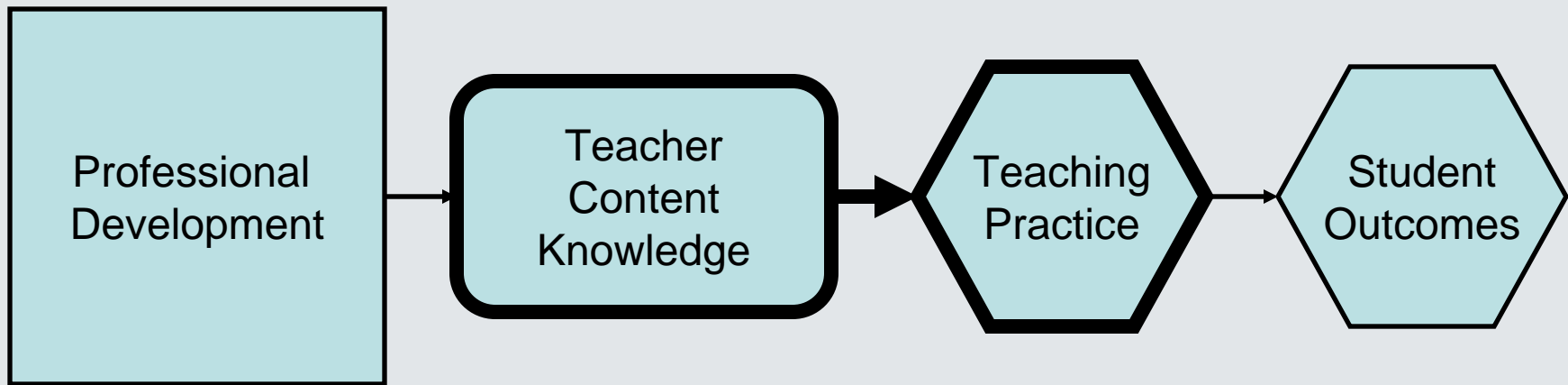Knowledge
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Purposes of this Presentation

- 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

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┌──────────────┐      ╭──────────────╮       ⬡              ⬡
│              │      │   Teacher    │     Teaching       Student
│ Professional │ ───▶ │  Knowledge   │ ──▶  Practice  ──▶ Outcomes
│ Development  │      │  and Skills  │
│              │      ╰──────────────╯
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Teacher content knowledge matters…

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Professional          Teacher          Teaching          Student
Development   →       Content    →      Practice   →      Outcomes
                      Knowledge
```
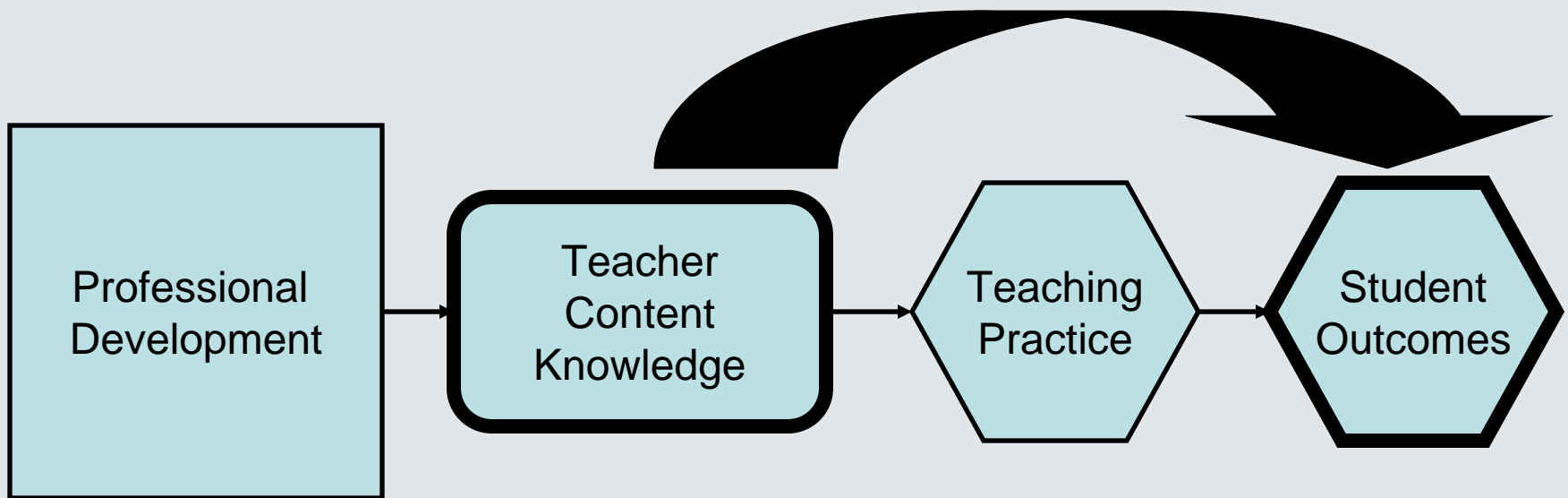
For teaching practice:

- Selecting content to emphasize
- Selecting instructional strategies and sequence
- Selecting assessment tasks
- Implementing curriculum materials

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Teacher content knowledge matters…

```
Professional        Teacher          Teaching         Student
Development         Content          Practice         Outcomes
                    Knowledge
```

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…


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Professional Development → Teacher Content Knowledge → Teaching Practice → Student Outcomes
```
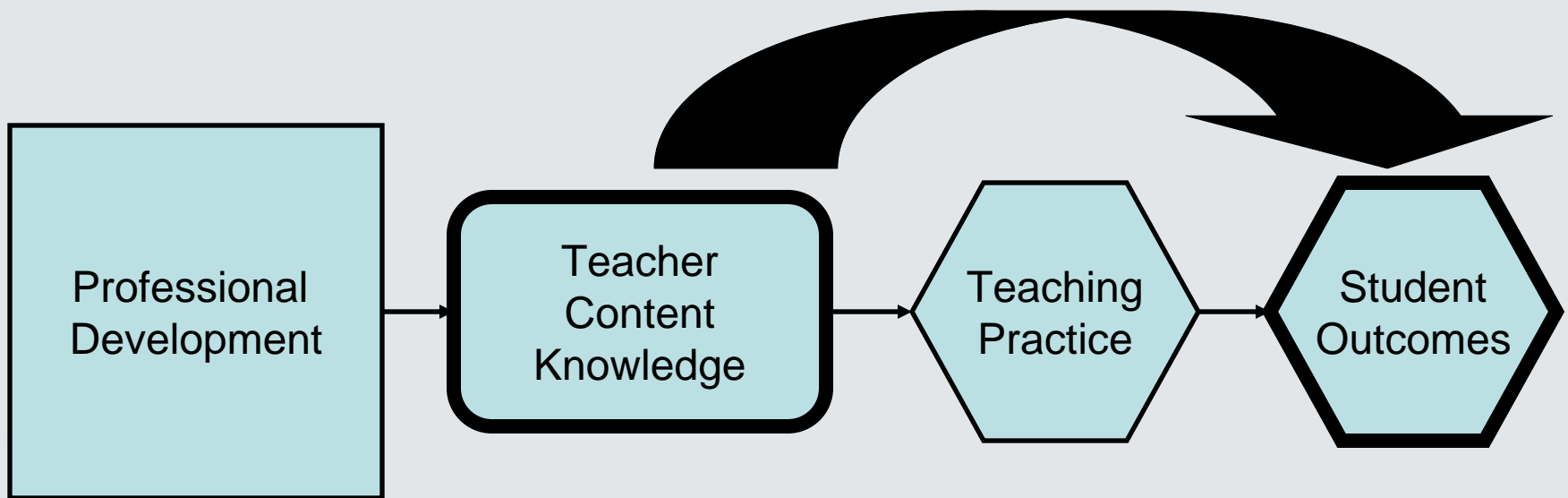
Students of teachers who hold an incorrect idea are more likely than other students to hold the same incorrect idea.

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"?

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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?

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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.

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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

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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.

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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.

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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.

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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.

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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.

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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

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For more information

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