Assessing the Impact of the MSPs: K–8 Science (AIM)

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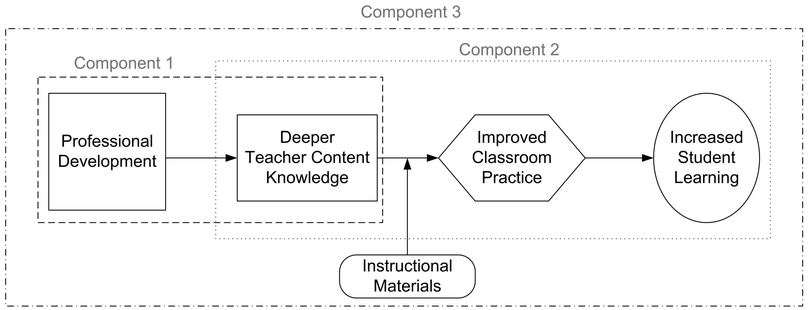
Goal: To study the relationships among learning theory-based professional development and instructional materials, teacher content knowledge, classroom practice, and student learning.

Overview

AIM: K–8 Science is an MSP RETA designed to add to what the field knows about learning theory-based professional development (PD) strategies for deepening the content knowledge of science teachers, and the impact of teacher content knowledge on classroom practice and student achievement. The study documents the PD offered to teachers (i.e., the interventions), and measures teacher content knowledge and student learning using rigorously-developed instruments. Component One of AIM is examining the impact of MSP professional development on teacher content knowledge and investigating the relative impacts of different approaches to the PD of science teachers. Component Two is exploring the relationships among teacher content knowledge, classroom practices, and student achievement. Component Three tests a model based on lessons learned from past professional development efforts; 5th grade teachers were provided with a learning theory-aligned force and motion replacement unit and 30 hours of learning theory-based professional development. AIM is cumulating data from across partner MSP projects and Component Three to examine the relative impact of a number of factors on teacher and student knowledge gains.

Simplified Theory of Action for Professional Development



Many contextual factors mediate the effect of professional development on classroom practice and student learning (e.g., availability of instructional resources, state-mandated tests). AIM is gathering data about a number of these factors to better understand the particular contributions of the different professional development strategies.

Content Areas

Based on partner MSP feedback, we selected four topics for our work:

1. Force and Motion
2. Evolution and Diversity
3. Interdependence of Living Systems
4. Properties of and Changes in Matter

Instrument Development

In order to conduct this research, AIM has developed several instruments:

- A PD-provider log which gathers information on the goals, design, and approaches used in the PD, and the extent to which it aligns with learning theory;
- Teacher content knowledge assessments for each content area (elementary and middle school versions);
- Teacher questionnaires to measure beliefs about effective science instruction, instructional practices (including alignment with learning theory), and contextual factors that affect instruction;
- Student science content knowledge assessments for each content area (elementary and middle school versions); and
- A classroom observation protocol based on the elements of effective instruction for measuring student opportunity to learn.

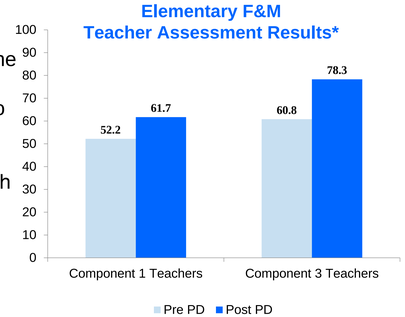
Challenges

Aligning science classroom instruction with learning theory, particularly at the elementary level, can be challenging for a number of reasons including:

- Teachers' beliefs about effective science instruction;
- Teachers' limited preparedness to use learning theory-aligned instructional practices;
- The strength of teachers' disciplinary and pedagogical content knowledge;
- A lack of learning theory-aligned instructional materials;
- Assessments that advantage factual recall over conceptual understanding;
- Limited research about effective instruction across science topics;
- Limited amount of time available for planning and delivering science instruction; and
- Limited support for implementation of learning theory-aligned instructional practices (school and district leaders, parental expectations, etc.).

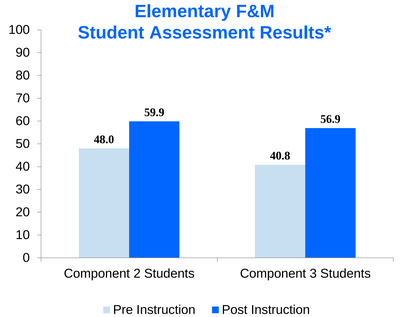
Findings

- Although Component 3 teachers started with somewhat higher scores on the content assessment, their overall growth from the pre- to post-assessment was significantly greater than Component 1 teachers' growth (an effect of 0.49 standard deviations).



* $p < 0.05$, HLM

- Students of Component 3 teachers had, on average, significantly lower scores on the content assessment prior to instruction than comparison students from Component 2.
- However, students of Component 3 teachers had significantly greater gains from the pre- to post-assessment than comparison students (an effect size of 0.21 standard deviations).
- Students of Component 3 teachers implementing the unit with high fidelity had significantly greater gains than students of medium fidelity teachers (about 7 points more, an effect size of 0.34 standard deviations).



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For Further Information

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