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

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Effective Teaching

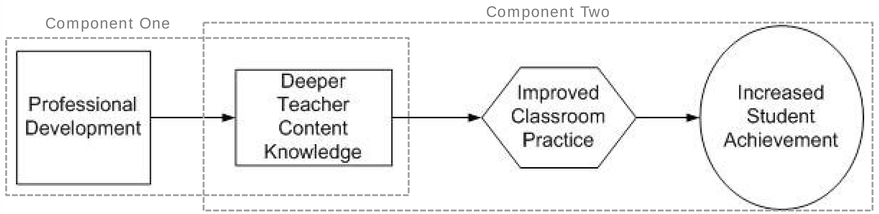
AIM defines effective teaching as that which promotes student development of a deep, conceptual understanding of (1) important science ideas, and (2) the evidence-based nature of science as a way of knowing.

Theory of Action

Overview

AIM: K–8 Science is an MSP RETA designed to add to what the field knows about 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 has been added to test a model of PD purposefully designed to incorporate learning theory and lessons learned from past professional development efforts. AIM will cumulate 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., instructional materials, 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 from the 2009 *NAEP Science Framework* for our work:

1. Force and Motion;
2. Evolution and Diversity;
3. Interdependence; and
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; and
- Student science content knowledge assessments for each content area (elementary and middle school versions).
- A classroom observation protocol based on the elements of effective instruction for measuring student opportunity to learn.

Studying a Model PD Program

Component Three was developed to investigate the impacts of a PD program that is aligned with learning theory and builds on what the field has learned about effective professional development:

1. Based on learning theory:
   - Elicitation of initial ideas;
   - Engagement with phenomena that provide evidence for target ideas;
   - Use of evidence to support/critique claims; and
   - Opportunities for sense making.

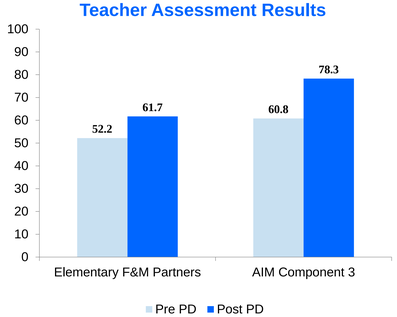
2. In addition to deepening teachers' disciplinary content knowledge, focused on relevant pedagogical content knowledge:
   - How to sequence ideas for students;
   - Areas of student difficulty (including preconceptions/naïve ideas);
   - Content-specific strategies that can build students' conceptual understanding; and
   - Methods for assessing science learning.

3. Centered on instructional materials that incorporate learning theory, appropriate content, and PCK supports for that content:
   - Reliably provide evidence for the target ideas;
   - Use common, easy-to-find supplies; and
   - Include educative teacher supports.

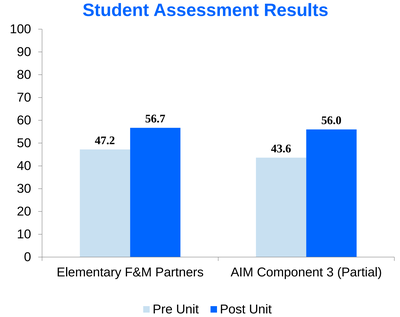
AIM developed and implemented a PD program on elementary grades force and motion that embodied these principles. The PD included a week-long summer institute with an additional day during the academic year. It also provided participants with a replacement unit to use in their classrooms, and addressed disciplinary and pedagogical content knowledge through these materials. In addition, AIM developed educative supports for the unit. Thirty elementary teachers participated and all of the AIM instruments are being used to collect data. We are observing instruction during the unit and interviewing teachers about their experiences.

Preliminary Findings

Teacher Assessment Results



Student Assessment Results



Challenges

- There is never enough time to do it all. Like other projects, AIM had to make trade-offs in the design and implementation of the PD for this study.
- Real life happens. Some teachers were reassigned to different grade levels; some schools limited the amount of time teachers could devote to science; etc.
- There has been a wide range of implementation fidelity.
- This study took advantage of the wealth of knowledge about the teaching and learning of force and motion. Many content areas do not have such a rich knowledge base to draw upon.

Next Steps

- Complete data collection and analysis for Component Three.
- If the results are positive, study the impact of this approach when implemented by non-developers.

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For Further Information

Projects interested in participating in AIM can sign up at:
http://www.horizon-research.com/aim/
All other inquiries should be directed to Eric Banilower by phone (919-489-1725) or email: aim@horizon-research.com.

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