Assessing the Impact of the MSPs: K–8 Science

Examining the Role of Professional Development in Effective Science Teaching

Eric R. Banilower
R. Keith Esch
Horizon Research, Inc.

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Quick Task

- Imagine an “ideal” science lesson.
  - What would a teacher need to know and be able to do to implement it effectively?

- Discuss with group

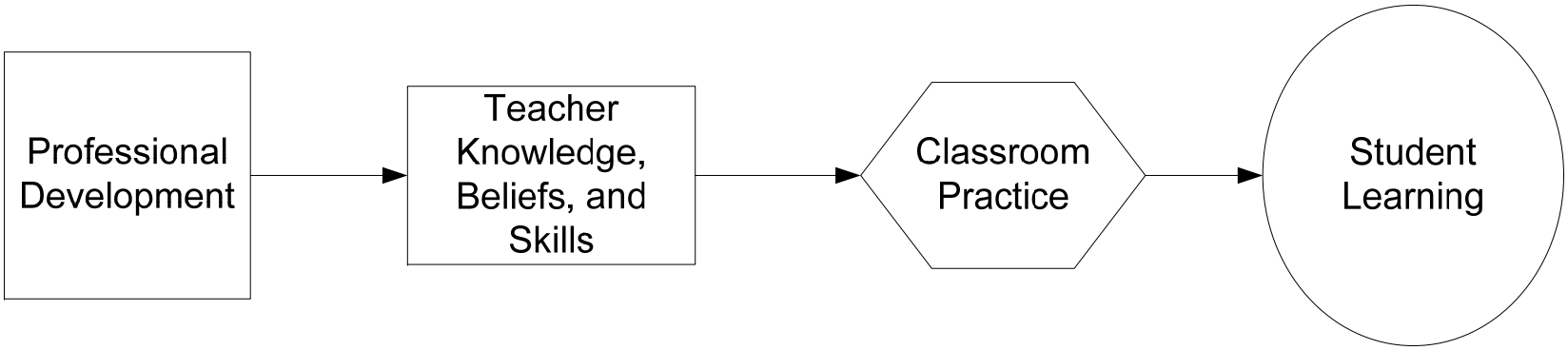
Effective Teaching for AIM

- Promotes student development of a deep conceptual understanding of:
  - o important science ideas; and
  - o the evidence-based nature of science as a way of knowing.

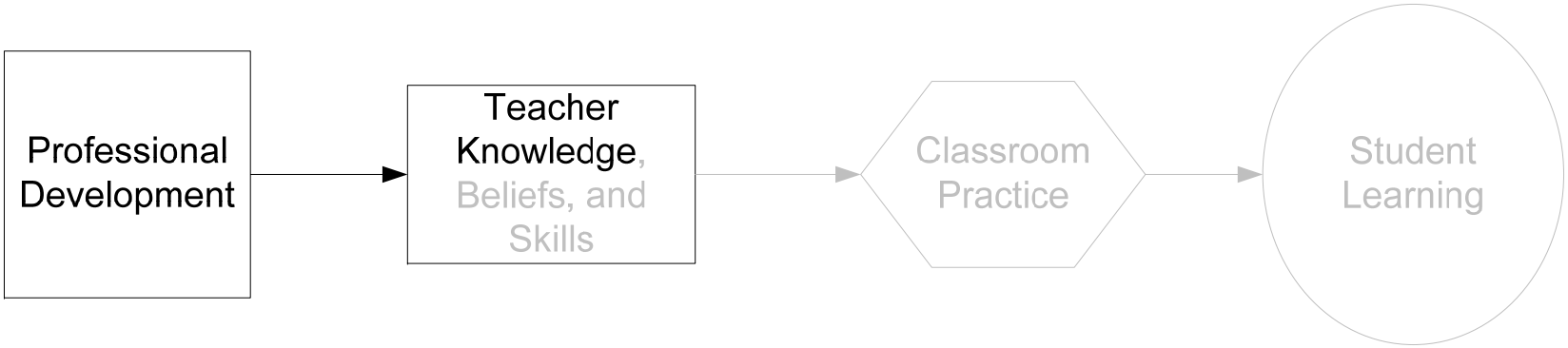
AIM: K–8 Science

- AIM is an MSP RETA
- AIM developed and is using instruments to collect data that individual MSP projects typically do not have the resources for:
  - o PD-provider logs;
  - o Teacher Questionnaire, with a focus on classroom practice;
  - o PD observations; and
  - o Teacher and student content assessments.

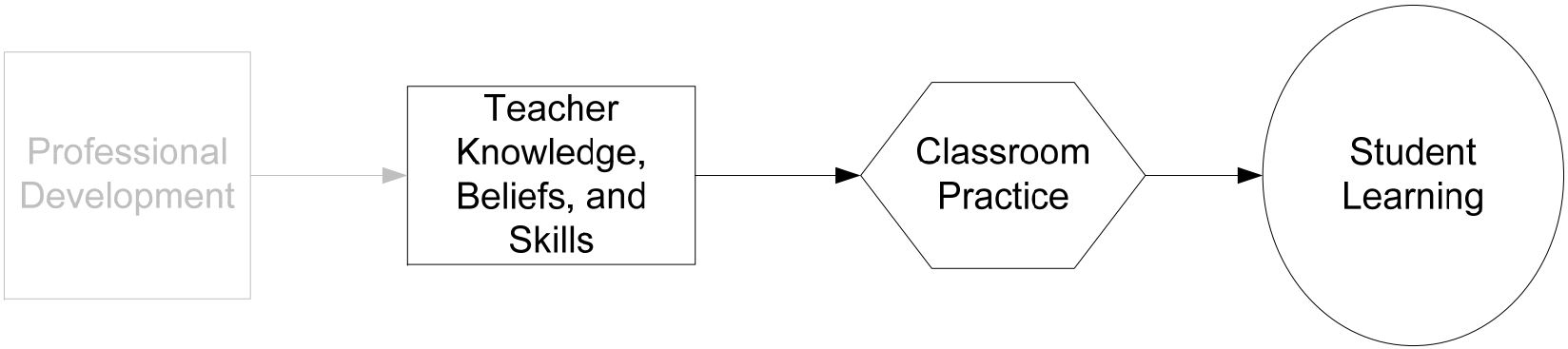
PD Theory of Action (Big Picture)



Study Component 1



Study Component 2



Initial Findings

- AIM's research design relies on substantial variation in teachers' professional development experiences.
- The data we collected showed much less variation than we had anticipated.

Also…

- Previous studies have found that increased teacher content knowledge is necessary, but usually not sufficient for improved classroom practice.
- Factors inhibiting change include:
  - Teachers not knowing how to translate what they've learned to what they are supposed to teach their students
  - Teachers lacking instructional materials that facilitate this translation

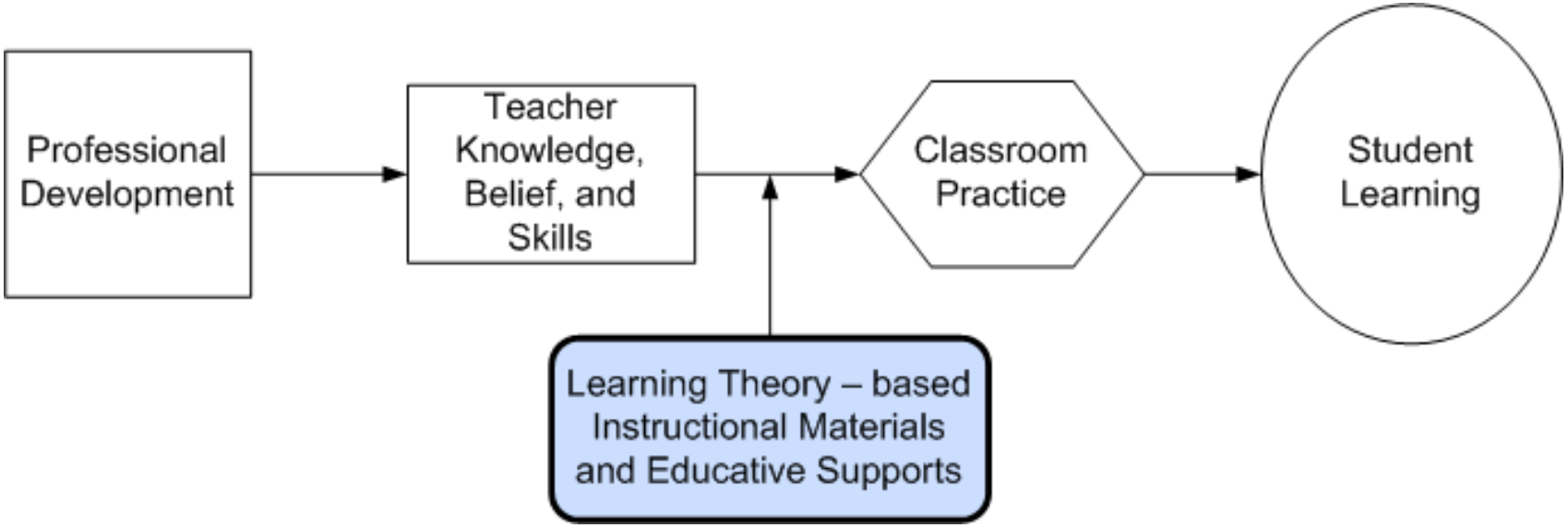
Study Component 3

- We decided to conduct a test-of-concept study of a particular model for PD.
- Chose to work in Force and Motion:
  - A difficult topic for many teachers; and
  - There is a relatively large body of knowledge about the teaching and learning of this topic.

Key Question

- What would the effects be of a PD program that:
  - Works to develop a common vision of effective science instruction;
  - Focuses on deepening teacher disciplinary *and* pedagogical content knowledge;
  - Uses pedagogies aligned with learning theory;
  - Provides learning-theory based instructional materials that engage learners with evidentiary phenomena; and
  - Helps teachers understand how to implement those materials as well as the reasons why the materials are structured as they are?

Modified Theory of Action



AIM PD Principles

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
   - Opportunities for sense making

AIM PD Principles

2. In addition to deepening teachers' disciplinary content knowledge, focuses on relevant pedagogical content knowledge
   - Knowledge of how to sequence ideas for students
   - Areas of student difficulty (including preconceptions/naïve ideas)
   - Knowledge of content-specific strategies that can build students' conceptual understanding
   - Knowledge of methods for assessing science learning

AIM PD Principles

3. Teachers learn to use instructional materials incorporating principles 1 and 2
   - Reliably provide evidence for the target ideas
   - Use cheap, easy-to-find supplies
   - Include educative teacher supports (e.g., summary of the targeted ideas, common misconceptions, how the activity provides evidence for the target idea)

PD Development

- Defined Force and Motion content focus based on 2009 NAEP framework (5th grade)
- Unpacked content
  - What students need to know
  - What teachers need to know in order to facilitate student learning
- Organized ideas into psychological sequence

Component 3: PD Development

- Worked with Steve Robinson (Tenn. Tech.) to create Force and Motion replacement unit and the PD.

Structure of a Typical Student Activity

- "What do we think" – surfaces prior knowledge.
- Activities engage learners with phenomena that provide evidence for the target idea.
- "How do you know" questions encourage the use of evidence from the activity to support a claim.
- "Making sense" questions helps learners relate the target idea to their initial thinking, what they did in the activity, and apply the idea to other contexts/examples.

Support for an Activity Provided in Implementation Guide

- Important Background Information at the beginning of the activity:
  - Ideas targeted by the activity;
  - Common misconceptions related to the targeted ideas; and
  - A description of how the activity is intended to help students get to the targeted ideas (i.e., what the relevant aspects of the activity are).

- Additional guidance embedded throughout the activity:
  - Logistical suggestions for the activity;
  - Implementation suggestions to help ensure students do the activity as intended (and ways they may go wrong); and
  - Expected student responses to questions and what those answers indicate about student thinking.

Summer Institute Agenda

	Monday	Tuesday	Wednesday	Thursday	Friday
9 AM	Icebreaker: experiences teaching F&M	Content Activities	Fishbowl: key pedagogical moves	Content Activities	Addressing Imp. Concerns
	Content Activities		Content Activities		Content Activities
		Reflection on the Learning Process & Intro to Elements of Effective Sci. Instruction		Implementation Concerns	Video Analysis: attending to evidence
4 PM	Content Reflection		Pedagogy Reflection	Practice with the Elements	Post-Assessment

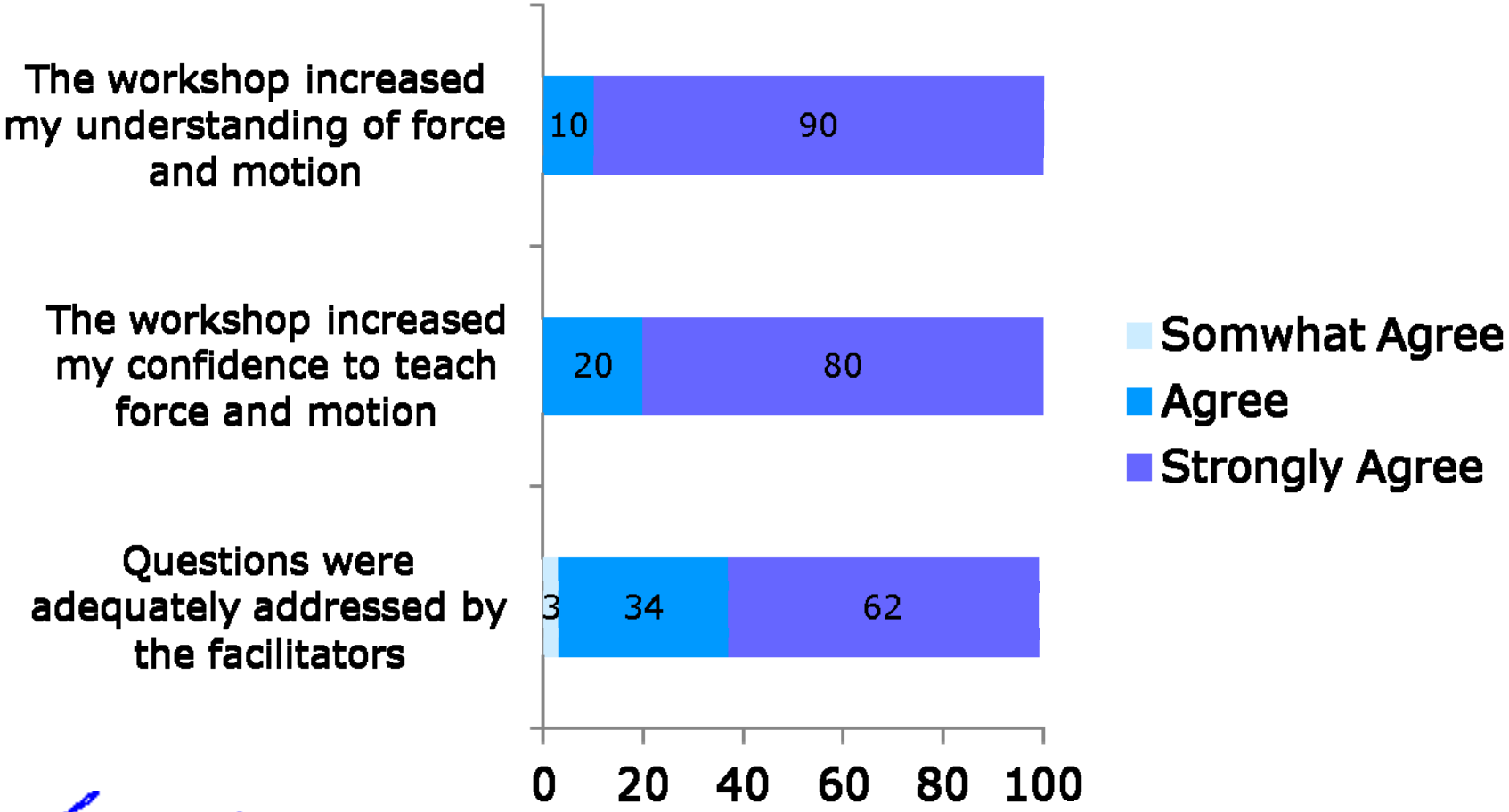
Making the Study Happen

- Partnered with two local schools districts.
- Recruited 30 teachers to participate who were slated to teach force and motion during the 2011-12 school year.
- Acceptance into the PD was conditioned on agreement to participate in the research study.

Data Collection

- Teacher content assessments
- Student content assessments
- Teacher questionnaires – instructional practices, beliefs about science instruction, contextual factors
- Classroom observations – focusing on student opportunity to learn and fidelity to the materials
- Teacher interviews – instructional decision making process

Teacher Opinions



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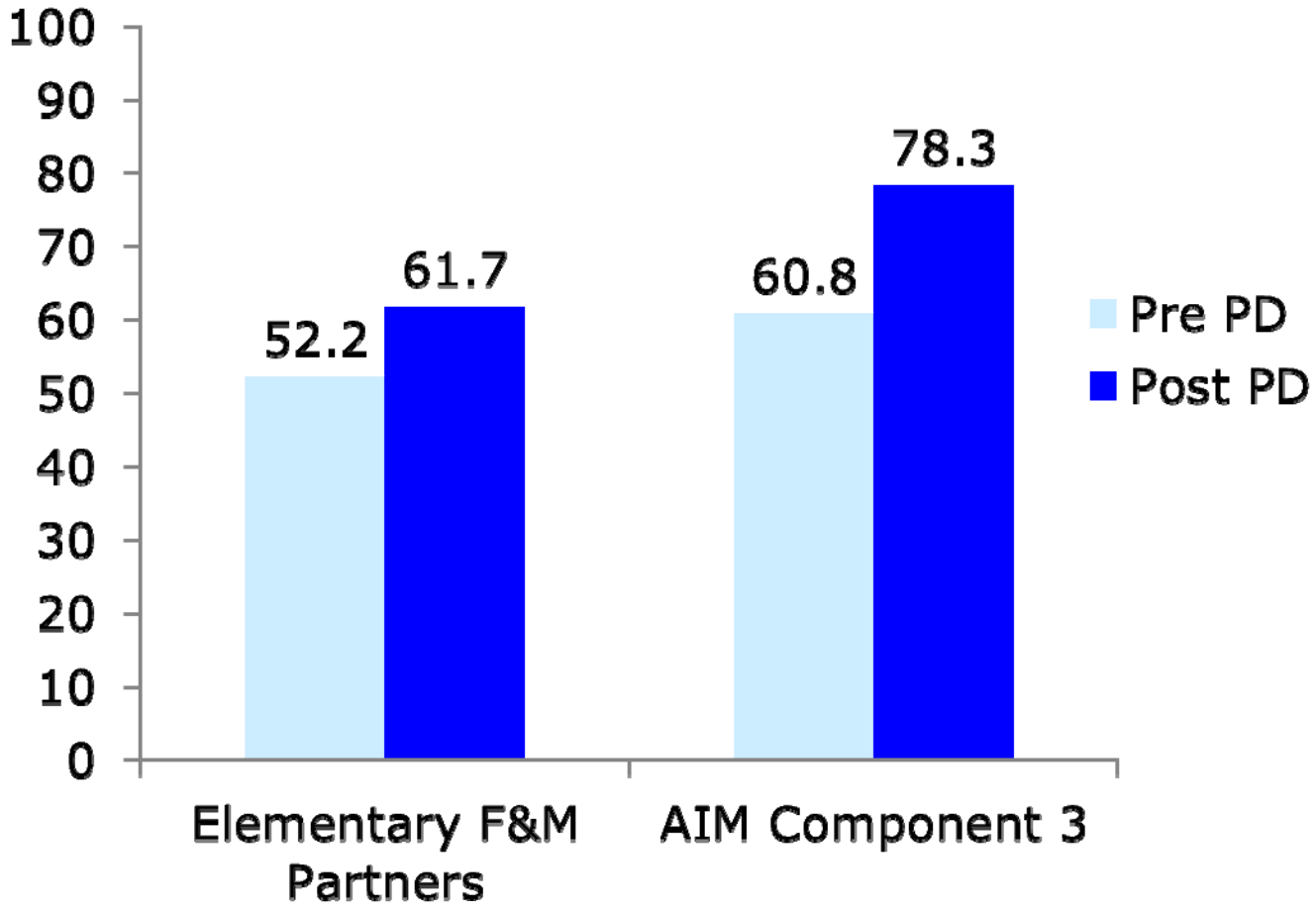
On the other hand…

"I have opened up to the idea of letting the students explore, find their own evidence, prove each other wrong/right, discover the correct answer by looking at the majority of the evidence. With this method of teaching, the students are engaged and motivated to find the evidence to prove their ideas right and if wrong, understanding why they're wrong."

Teacher Assessment Data



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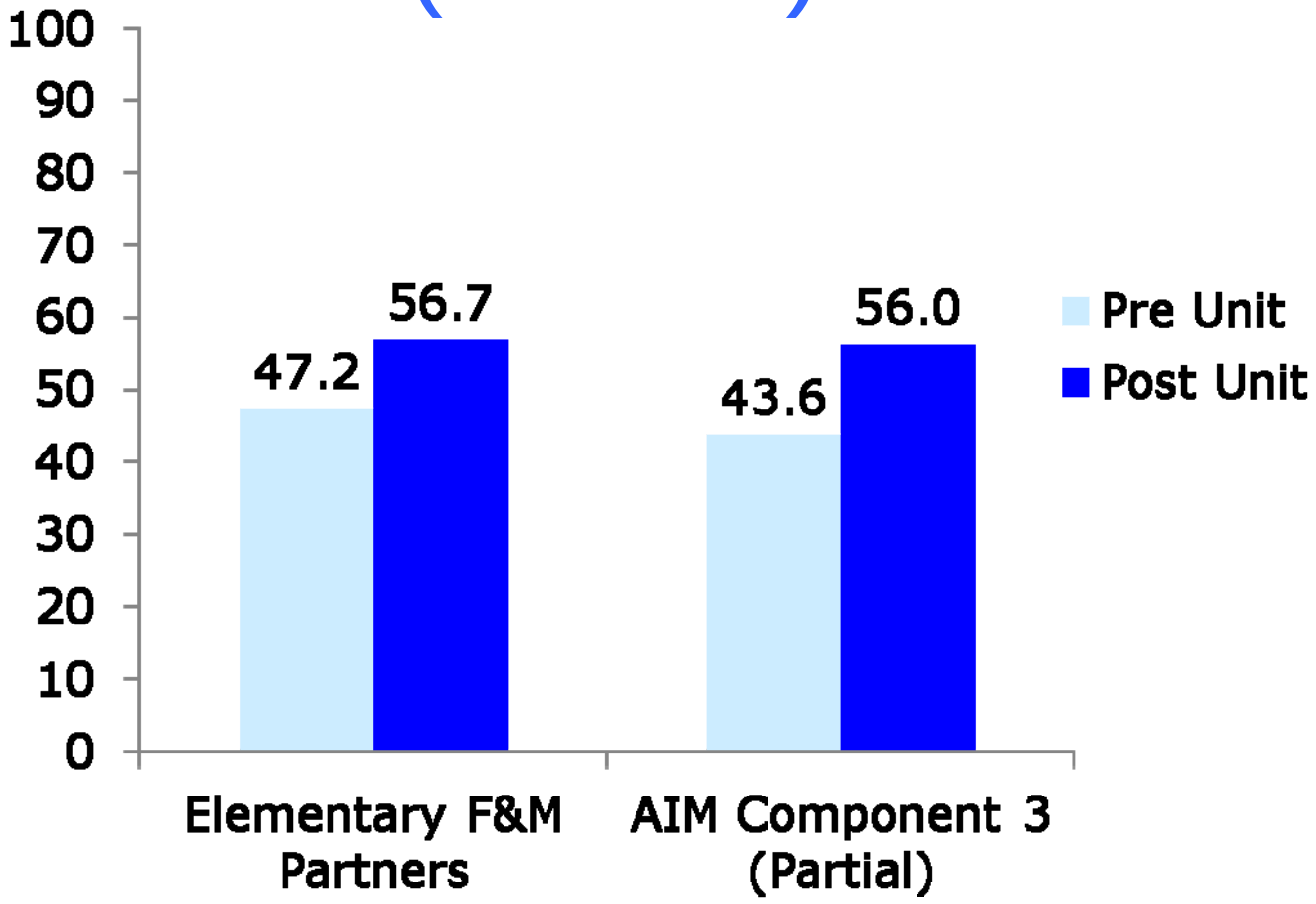
Classroom Observations

- There has been a wide range of implementation fidelity:
  - Extent to which the activities are used; and
  - Varied degrees of success at adopting the pedagogical approach.

- Implementation guide facilitated instruction more closely aligned with PD principles.

Student Assessment Data (Partial)



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LESSONS LEARNED

- There is never enough time - AIM had to make trade-offs in the design and implementation of the PD.
- Wealth of knowledge about the teaching and learning of force and motion is atypical.

Future Plans

- We are still collecting data for all three components of the study.
- We are interested in collaborations with additional partner projects.

Topics

- AIM is working in four topic areas:
  1. Force and Motion;
  2. Populations and Ecosystems (i.e., Interdependence);
  3. Evolution and Diversity; and
  4. Properties of and Changes in Matter.

What's Required to Participate

- Component 1:
  - Complete PD-provider logs
  - Submit teacher attendance data
  - Administer content assessment to teachers pre- and post-PD
  - Allow PD to be observed (if selected for observation)

What's Required to Participate

- Component 2:
  - Administer content assessment to teachers prior to their teaching of the unit on targeted topic
  - Administer student content assessment at the beginning and end of unit on targeted topic
  - Administer teacher questionnaires

Next Steps for Component 3

- Complete data collection and analysis.
- Revise and expand Implementation Guide.
- If the results are positive:
  - Create surround materials so other providers could implement the PD; and
  - Study the impact when the program is implemented by non-developers.

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Horizon Research, Inc.
www.horizon-research.com/aim/
aim@horizon-research.com

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