2011 Math and Science Partnership Learning Network Conference

MSP: From Partnerships of Innovation to Student Success

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PAPER SESSION

Examining the Importance of Evidentiary Phenomena in Learning Science

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Cover graphic: Session participants engage in exercise regarding evidentiary phenomena

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About This Summary

This documentation of the 2011 Math and Science Partnership Learning Network Conference offers a brief summary of the presentation that took place during one conference breakout session and focuses on questions, answers and discussions during the session.

Readers interested in pursuing information about the project discussed in this breakout session are encouraged to visit MSPnet to access the abstract and full PowerPoint presentation.

The abstract for this presentation is posted on MSPnet at the following URL:

http://hub.mspnet.org/media/data/43.pdf?media_000000007069.pdf

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Examining the Importance of Evidentiary Phenomena in Learning Science

Exercise: Student Success

Eric Banilower launches this session, noting that the focus is student success and asking participants to engage in the exercise described at right. After studying and discussing the sample items, session participants pick item two as the best way to assess student learning, with the caveat that those students must have the ability to read and understand both the graph and the question.

In terms of knowledge and understanding re-

Eric Banilower

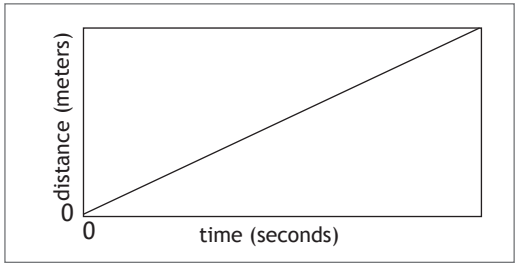
What Constitutes Student Success?

- Examine the two assessment items below.
- Which would you use to assess student learning? Why?

Sample Assessment Items

1. If the motion of an object is constant, which of the following must be true?
   a. A net force is acting on the object
   b. No net force is acting on the object
   c. No friction is acting on the object
   d. Gravity is the only force acting on the object

2. The following graph shows the distance an object travels while moving.



Which of the following describes the net force acting on the object?
   a. There is a net force on the object acting in the direction of its motion
   b. There is a net force on the object acting in the direction opposite its motion
   c. There is no net force acting on the object
   d. Based on the graph, the net force acting on the object cannot be determined

Learning Network Conference Breakout Session Number: 2 - 24

Strand 2: The use of student data to inform and refine MSP work

Authors:
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Presenters:
Eric R. Banilower, Joan D. Pasley

MSP RETA Project, 2009:
Assessing the Impact of the MSPs: K-8 Science (AIM: K-8 Science)

What the field knows about professional development strategies to deepen the content knowledge of teachers is surprisingly limited given the extent of efforts in this area. One challenge for the field is understanding what strategies or features matter most. Another challenge is that the vision for science education described in the *National Science Education Standards* requires teacher to understand science concepts, how scientific knowledge is generated, and how students learn science. AIM is addressing these challenges by developing instruments that can be used in research about professional development and its impacts, conducting a quasi-experimental cross-MSP study to add to the empirical knowledge base, and developing an existence proof of the efficacy of one model of professional development.

Participants studying assessment items

quired to answer the questions themselves, the first item requires memorization of facts and definitions, while the second requires application in a specific context with some data, using that information to choose the right answer.

Student Success for AIM

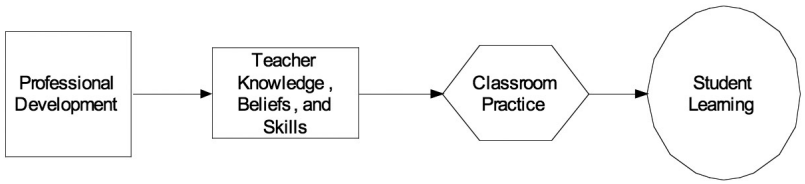
- Learners should have deep conceptual understanding of:
  - Important science ideas
  - The evidence-based nature of science as a way of knowing

Banilower explains that AIM's focus is on learners having deep conceptual understanding of important science ideas, which means having facility with those ideas as well as understanding the evidence-based nature of science as a way of knowing.

Project Background/Rationale

How do you get there? A lot of professional development projects have a theory of action behind them that looks something like this.

PD Theory of Action (Big Picture)



The idea is to do professional development to improve teacher knowledge, skills, and beliefs about what constitutes good teaching, which will lead to changes in classroom practice and ultimately to student success, i.e., more student learning. But what is it that makes PD effective? While a lot of people have ideas about what they think is effective, we don't have a whole lot of knowledge about what makes for effective professional development, Banilower states.

What Makes PD Effective?

- Although there is a great deal of "wisdom of practice" about effective PD...
- There is little empirical research for many of these ideas.
- In addition, there is a lot that we don't know about what makes PD effective.

Why don't we know more? Another Horizon MSP project, Knowledge Management and Dissemination (KMD) did a review of the research and applied standards of evidence to studies that looked at professional development and its impact on teachers' content knowledge. Findings include the following.

Why Don't We Know More from the Empirical Research?

- In applying standards of evidence, the MSP-KMD project often found vague or incomplete documentation of programs or interventions.
- Consequently, we know something worked, but we don't know a lot about what "it" was.
- Studies tended to be more like program evaluations rather than research on particular strategies.

Why Don't We Know More from the Empirical Research?

- We know the overall experience worked, but we don't know how much particular interventions contributed to the gains.
- We often found serious limitations with study research designs, including:
  - Selection bias in samples and contexts;
  - Lack of comparison groups or criteria;
  - Idiosyncratic instrumentation, without evidence of validity/reliability/credibility.
- There are too few studies of any one phenomenon to be able to have confidence in the robustness of the findings in any case.
- High quality research is expensive, which may explain why so many in-depth studies in the literature involved fewer than 5 teachers.

These are all challenges that we as a field face, Banilower notes, and led to the idea for this current project, AIM: K-8 Science.

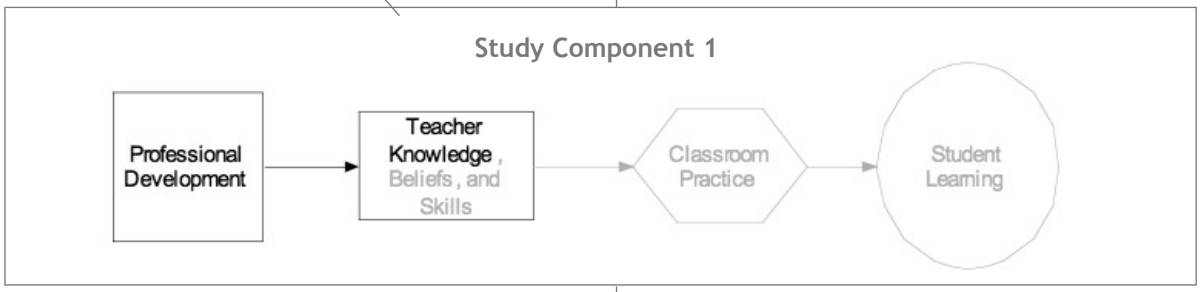
Project Overview

AIM: K-8 Science

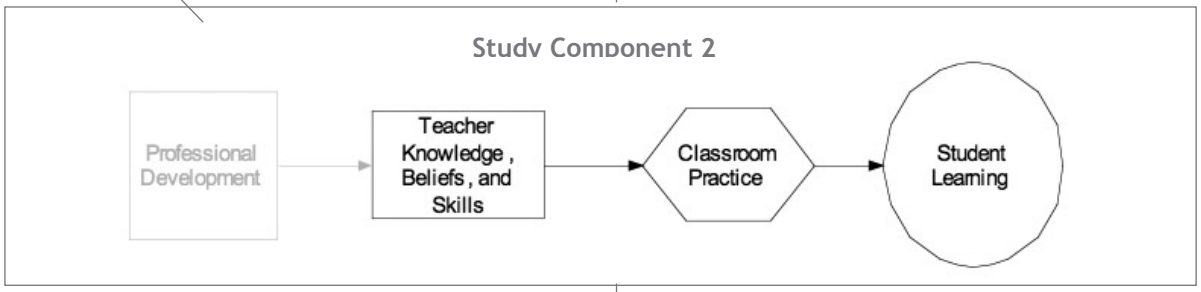
- AIM is a MSP RETA.
- AIM has the opportunity to develop instruments and collect data that single MSP projects typically do not have the resources to do.

AIM has been funded to develop instruments and conduct cross-project research to address some of these holes in the knowledge base.

While the project has evolved in ways that will be described later in this presentation, the project began with two main components. The first is to look at the linkages between professional development strategies and teacher content knowledge to see if it is possible to tease apart which strategies can make the biggest impact for the investment.



The second part of the study then looks at teacher knowledge, as well as some other contextual effects regarding the teacher and his or her teaching situation, and how that plays out in classrooms and ultimately in student learning.



The project works in four topic areas, and used the *NAEP 2009 Science Framework* for guiding selection of topics based on the belief that at

Topics

- Force and Motion
- Populations and Ecosystems (i.e., Interdependence)
- Evolution and Diversity
- Properties of and Changes in Matter

PD-Provider Log

- Captures what teachers experience in PD
- PD providers complete a log at the end of each day of PD on the targeted topic
- 15 minutes or fewer to complete
- Honorarium of $15 per completed log

Log Components

- Log asks about features of the PD
  - Ideas addressed
  - Time spent on different goals
  - How teachers were engaged
  - Alignment of PD with learning theory

that time it was the best precursor to a new set of standards. In each of these content areas the project works at two grade ranges: elementary grades 3-5, and middle school grades 6-8. AIM is avoiding K-2, Banilower explains, because part of the research involves administering these assessments to students, "and like others before us we are not quite sure how to assess students in grades K-2 in a reliable, large-scale way."

Instruments

Banilower proceeds to review some of the instruments being developed as part of the project. The research question being addressed is: What professional development strategies have the biggest impact on teacher content knowledge? Answering that question requires some way of capturing what is going on in the professional development. Ideally, Banilower says, the project would go out and observe every single professional development session, take detailed field notes, code those notes, and then look at the relationship between those codes and teacher content knowledge gains. However, once again, that is not a very practical or scalable solution.

Instead, AIM is experimenting with a PD-provider log, which is a questionnaire that the PD-provider fill out each day they teach a topic included in the AIM study. The log asks about a range of features of the professional development.

Teacher and Student Assessments

- Each assessment will take about 30 minutes to administer (all multiple choice).
- All teacher assessment items are set in the context of work that teachers do, e.g., using content knowledge to analyze student thinking.

The project is also developing teacher and student assessments. This work builds heavily on the work of a previous Horizon RETA, the ATLAST project, which borrowed heavily from Heather Hill's and Deborah Ball's project, Learning Mathematics for Teaching. AIM has opted for multiple choice assessments, Banilower explains, because doing large-scale research is costly and scoring open-ended responses for hundreds and thousands of teachers will quickly use up all of the resources you have.

While multiple choice items have a bad reputation (mostly deservedly, Banilower opines) AIM believes that it is possible to develop good multiple choice items, particularly if you use the research on misconceptions as the distractors on those items.

Banilower points out that the while both the student and teacher assessment items measure disciplinary content knowledge, the teacher items are different in that they are all set in the context of the work that teachers do. Instead of just asking about a concept, it is placed within a scenario. For example, "Students in a class are studying this concept. One student says the following. What do you think

this means? What would you do next in your instruction?"

The down side of this approach, Banilower acknowledges, is that it puts a much higher cognitive load on the teacher in answering the item, but it is more realistic regarding what they have to do every day in their classrooms. "They have to interpret what the students are doing and make a decision on the fly about what they do next."

To look at classroom practice, the ideal would be to go and observe the classrooms of all teachers participating in the study but once again, that approach is simply not feasible, Banilower observes. Instead, AIM has been working on a teacher questionnaire in an attempt to capture what teachers believe is effective instruction, as well as some of the major contextual factors known to affect classroom implementation and student learning, and information about instructional practices.

Classroom Practice

- Teacher questionnaire
  - Beliefs about effective instruction
  - Teacher efficacy
  - Contextual factors that affect science instruction
  - Instructional practices (alignment with learning theory)

Student Success and Evidentiary Phenomena

Joan Pasley steps in to focus on evidentiary phenomena. In the AIM project as well as in other projects at Horizon, the view of what constitutes student success is as follows.

Student Success

- Learners should have deep conceptual understanding of:
  - Important science ideas
  - The evidence-based nature of science as a way of knowing

- Our hypothesis is that both of these outcomes are more likely when learners are intellectually engaged with evidentiary phenomena

The hypothesis above is based on what we know from learning theory, Pasley observes—that students learn when they engage with various activities and become "convinced" of something. They are building cognitive frames when they have experiences that build on their prior knowledge and then make sense of that into a larger concept, she explains.

One of the things AIM has looked at, both in professional development and in classrooms, is the importance of evidentiary phenomena and having both students and teachers experiencing activities or data or examples that provide evidence for the targeted idea. It is not just

Joan Pasley

about the topic itself. Pasley notes that this is how she looks at classrooms now, thinking about how kids engage with phenomena and how that is built on later on in the lessons. If the phenomena (or activity or data or whatever it is) doesn't provide evidence, she elaborates, it is very difficult for the downstream factors that we know from learning theory are important to sense-making with these ideas to happen because the basics aren't there.

What is Meant by Evidentiary Phenomena?

- Evidentiary phenomena provide evidence for the targeted idea
- Doesn't always have to be a hands-on activity but students need to be able to understand the phenomena or data.

The fact that they don't always have to be hands-on is an important factor, Pasley notes. It can be sets of data students engage with or examples, but the important part is that students can access the phenomena, that they understand what those data mean. She offers the example of a kindergarten class where the idea being taught is that everything that is magnetic is metal, but not all metals are magnetic. In order to give them an experience, the teacher decided they needed to actually see things that are metal but not magnetic. For that particular idea, if the teacher had only given students metals that were magnetic they would only be getting part of the idea, Pasley explains. Only part of the evidence would have been built to develop that idea. In looking at activities in which students participate, you look at whether they have the data to be able to develop that concept. If the teacher didn't start the activity by providing adequate examples, it would be difficult to build that idea later on.

Key Features of Evidentiary Phenomena

- Phenomena/examples must be accessible to the learners
- Instruction must focus learners on the relevant aspects of the phenomena/examples

The phenomena must be accessible to learners. For example, Pasley explains, if you're teaching about erosion and using the example of a beach, and the kids have never been to the beach, it would be difficult.

You also need to focus learners on the relevant aspects of the phenomena, Pasley notes. In observing teachers in a classroom bringing students through steps one, two, and three of an activity, the question is, what is it that the students should be attending to during the activity? What should be going on in their heads during that activity as part of developing the idea?

Examples

Physics: Force and Motion

Pasley offers an example in the topic area of force and motion. The central idea in a classroom lesson is that force can change the speed of an object. If you have a greater force, it can change it faster than a lesser force. An activity is offered that involves a cart attached to a string, sitting on a table, with the string dangling over the table edge. The students put varying objects on the end of the string to see what happens to the cart when they let go of the masses dangling from the string. What they should be seeing is that the more mass that is added, the faster it will accelerate, but what kids tend to focus on (because it's a misconception in physics) is velocity—they focus on the speed. Unless there is somebody during that activity to ask them questions about what they or seeing, or they actually generate data to

show that acceleration, they are going to miss the concept entirely. "That is what we mean by evidentiary phenomena," Pasley states.

Sinking and Floating Vignettes

VIGNETTE #1: SINKING AND FLOATING

An Example

- Read the two vignettes
- Which lesson is more likely to result in students understanding the science idea and the evidence for that idea?

Participants studying vignette

A fourth grade class has recently started a unit on sinking and floating. So far, students have brainstormed objects they have observed in their everyday lives that sink and float, and have shared their ideas as to why. Possible reasons they came up with include the mass of the object, how much air is in the object, and the size of the object. The purpose of this lesson is for students to identify why some objects sink and why others float.

The teacher had asked students to bring in small objects from home that they could use for this investigation. Students have brought in a wide variety of objects, including rulers (plastic and wood), coins, wooden blocks, LEGOs, golf tees, pencils, pens, balls (baseball, tennis ball, golf ball), and even plastic dolls. The teacher asks students to first write in their notebooks predictions of whether each object will sink or float in a tub of water. Next, they test their predictions. Students record the mass and size of each object and whether it floats or sinks in data tables they create in their science notebooks. The groups then place their data on chart paper, which they hang on the wall behind their tables. A sample data table is shown below.

After the students have finished collecting data, the teacher leads a whole class discussion about their data and why things sink or float. For example:

Student 1: I noticed that when I placed the plastic cup on top of the water it floated, but if water gets inside the cup, it sinks.

Teacher: So what conclusion can you make from your evidence?

Student 1: I think air has something to do with it.

Teacher: Air has something to do with sinking or floating.

Student 2: I don't think so.

Teacher: Tell us why you disagree.

Student 2: We talked the other day about how big heavy boats float, and big boats are filled up with lots of cargo and stuff so there's less air in them but they still float. So I don't think air has anything to do with it.

Teacher: Okay, so air doesn't matter. Yes or No?

Some students in class nod their heads to indicate "Yes" and others shake their heads "No."

Teacher: So what about the size of the boat?

Student 2: The boat is big and the cup is small, and both float.

Object	Mass (g)	Shape	Sink or Float?
Plastic ruler	42g	Long and skinny	Sink
Pencil eraser	13g	Small	Sink
Troll doll	243g	Medium	Float at first then sinks when water gets in
Penny	16g	Small	Sink
Charm bracelet	478g	Medium long and skinny	Sink
Wooden block	146 g	Small cube	Float
Toothpick	5 g	Small and pointy	Float

VIGNETTE #1 CONTINUED

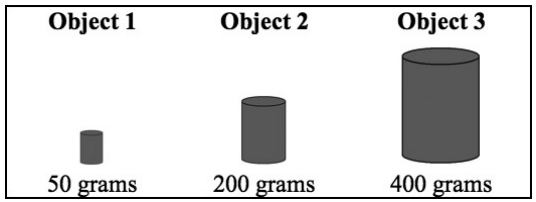
Teacher: So is size an important factor in determining if things float or not?
Students: No.
Teacher: Okay, how about mass?
Student 3: I think that it doesn't have to do with mass.
Student 4: I don't think so...
Student 3: [Interrupting Student 4] Like a penny is not that heavy but it sinks.
Teacher: So you think that...
Student 5: Mass doesn't matter.
Teacher: So you think mass is not a factor as to whether or not it sinks?
Student 3: The penny is light and it still sinks.
Teacher: So you're saying mass has nothing to do with it. We can throw mass right out the window.

The lesson ends with the teacher summarizing the class discussion. The teacher tells students, "Today we investigated what factors determine whether an object sinks or floats. Some of you have already made some conclusions about why things sink and others are still thinking about your data. Tomorrow we'll try putting our objects in a different liquid—salt water—to see how that affects things."

VIGNETTE #2: SINKING AND FLOATING

A fourth grade class has recently started a unit on sinking and floating. In a previous lesson, students were asked to brainstorm about what makes objects float or sink. Ideas volunteered by students included the mass of the object, how much air is in the object, and the size of the object.

The purpose of this lesson is for teachers to learn that mass alone does not determine whether an object sinks or floats. The teacher starts by saying, "At the beginning of this unit, you shared lots of factors that you think determine whether objects sink or float. Many of you thought the mass of the object was important. Let's find out whether the mass of an object determines whether an object sinks or floats. To start, I'll do a demonstration." The teacher shows students the three objects pictured below.



The teacher asks students to predict whether each object will float or sink. Almost all students think Object 1 will float and Object 3 will sink; students are divided as to whether Object 2 will float or sink. The teacher asks students for their reasons. One student shares, "Because heavy things sink and light things don't." Many students agree. The teacher places each object in a large tank of water, and the students observe, much to their surprise, that Object 1 sinks and Objects 2 and 3 float. A discussion follows:

Teacher: You seem surprised by the results of the demonstration. Tell me why.
Student 1: I thought if an object has a lot of mass, it sinks.
Student 2: Me, too. I don't understand why Object 1 sank, but Object 3, which was much heavier, floated.
Student 3: Maybe it was the way you placed the objects in the water that made them float or sink?
Teacher: Okay, I'll repeat the demonstration.

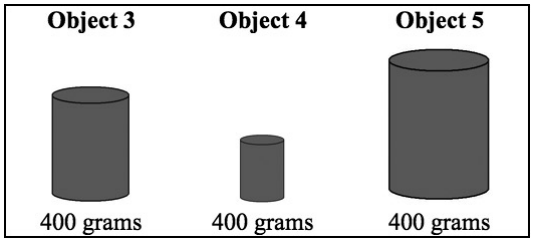
The teacher does the demonstration again, being sure to place each object in the water in the exact same way. The students observe the same results.

Teacher: So can we agree now that Objects 2 and 3 float, and Object 1 sinks?
Students: Yes.
Student 4: But that can't be right. I still think mass makes a difference. It must.
Teacher: Why do you think that?
Student 4: Rocks are really heavy, and you always see them at the bottom of rivers and creeks.
Teacher: Do you think those rocks are heavier or lighter than this 400 gram object?
Student 4: I think they are probably a lot heavier.
Teacher: Okay, so maybe we need to collect some more data. This next demonstration might help. (Addressing the whole class) Do you think all objects with a mass of 400 grams float? Let's test two

VIGNETTE #2 CONTINUED

more objects that have a mass of 400 grams.

The teacher shows the class two additional objects that are pictured below next to object 3:



Teacher: Do you think they will float? Why or why not?

Many students think that the new objects will float because their mass is the same as Object 3's. Some think that the new objects will sink because 400 grams is a lot of mass. The teacher places the objects in the water, and the class observes that object 4 sinks and object 5 floats.

Teacher: So what does this experiment tell us about mass and sinking and floating?
Student 5: Mass doesn't seem to matter.
Teacher: Does everyone agree? [Many students nod their heads in agreement.]
Teacher: Who can tell me why?
Student 6: The really heavy object in the first demonstration floated, but when you tested the other two objects that also were 400 grams, one floated and one sank.
Teacher: So what does that tell us?
Student 7: If mass was the reason why things float or sink, all of the 400 gram objects would have either sank or floated, but two floated and one sank.
Teacher: It sounds like we agree that mass alone does not determine whether an object floats or sinks. Can we think of some examples from real life that support this conclusion?
Student 8: At the swimming pool, we throw in coins and dive after them. They sink to the bottom of the pool, but they aren't very heavy.
Student 9: Boats. They are really heavy, much heavier than coins, and they float.
Teacher: If it isn't mass alone, do these demonstrations raise any new ideas about what factors might affect sinking and floating?
Student 10: The size of the object
Teacher: Why do you think the size, which we call volume, might matter?
Student 10: In the first demonstration, the volumes of the objects were not all the same and we got different results—one object sank and two floated. So maybe the volume has something to do with it.

To close the lesson, the teacher says, "As a class, we are now in agreement that mass alone does not determine whether an object floats or sinks, but we need to consider in our upcoming lessons if volume is a factor that affects floating and sinking."

Participants discussing vignettes

Discussion Question:

Which lesson is more likely to result in students understanding the science idea and the evidence for that idea?

- Are we talking about short-term understanding or enduring understanding? • Participant
- Both. • Pasley & Banilower

Participants studying vignettes

Vignette Discussion

Vignette #1

- Vignette 1 is far too unstructured for students to get the connection between mass and volume, especially since some of the objects are irregularly shaped, like the doll. • Participant
- And the fact that they decided that mass was irrelevant and size was irrelevant, so they weren't coming to the right conclusions. • Participant
- I liked it better, in that the students were producing the data, whereas vignette 2 is a demo situation, with kids watching. • Participant
- That's an interesting observation. A question that we ask when training around protocols that have this frame is: Do you think students will be able to understand the data that will be generated if they don't put their hands on the stuff, but only act as observers? Do they understand if the teacher is doing it, and is that any different from them doing it? There are some concepts in physics, I'm told, that require the students to be doing it themselves. One of the questions I ask myself, whether the students are doing it or not, is whether they understand the data being generated through the method chosen. It would be very difficult for them to make sense of the data being generated in vignette 1 to come to the larger idea, as opposed to the more structured one. • Joan Pasley

Choosing the Lesson Plan: The Point

- There are trade-offs, so you have to decide what your purpose is. I heard some of you saying, "Let's do the exploratory thing first and then do the more constrained one." Part of it is what your intention is. • Joan Pasley
- Our point here was not to show you an ideal lesson and a flawed lesson, but to point out the need for having students engage with the evidence for the idea. There are strong elements in both vignettes, but if you don't have the evidence for the idea, they're not going to have the understanding, long term or short term. • Eric Banilower

Observing Lessons in the Classroom

- This is part of our thinking when we go in and watch lessons, even before students touch the materials or do the activity. Looking at that particular plan and activity in vignette 1, it would have been very difficult for any implementation to take it to understanding of that concept because of the irregularly shaped items involved. That second vignette did generate evidence.

  When we observe the lesson, we ask: Is the evidence being generated accessible to these students, to this grade level? Do they understand the data being generated and what those represent? And during the activity, when they're doing the sinking and floating, what should they be attending to? What is the importance component of that? We are listening

for that, whether it happens through the materials or the implementation. It is looking at the whole experience to see how that would work to develop conceptual understanding for students. • Joan Pasley

- When you observe lessons in the classroom do you have a protocol that you use? Is it available to share? • Participant

- We do. We have been developing one around this theory. It is not quite ready to share yet. • Joan Pasley

- One of the things about the framework we have been using for looking at professional development or the classroom is the assumption that the observer has very strong content knowledge and also pedagogical content knowledge, that they understand teaching and learning of the subject. So we are not quite ready to just throw a protocol out there for use without necessarily the training or knowledge to observe what is going on. • Eric Banilower

- We have a dream of something like a Palm into which you could enter the idea, the misconceptions, and different phenomena that would develop it, but that's still a dream right now. Observing is a struggle because knowledge of the content is critical for observing using this kind of learning theory frame. • Joan Pasley

Life Sciences: Form and Function Example

Pasley proceeds to an example dealing with the idea of form and function. In step three of this lesson plan, students generate evidence for the idea using the rodent bones, and then there is a follow-up with the bones of a different animal, which they use to develop the same type of evidence.

A Bone's Size and Shape Provide a Clue to its Function

- Students are given rodent bones and asked to "reconstruct" the skeleton using a key.
- Teacher focuses students' attention on the fact that some bones are very similar and some are very different.
- Students divide into small groups to (1) individually document the physical characteristics of the different types of bones, and (2) examining where the bone is on the skeleton, students discuss what function each bone might have.
- Students are given "mystery" mammal bones and each student is asked to predict what function each serves based on its shape.

Earth Sciences Example

Banilower offers an example from earth sciences, noting that in physics a lot of what is taught in K-12 science is directly observable phenomena, whereas in other sciences like life sciences as well as earth sciences, they are not always directly observable. However, those engaged in the AIM project still believe that you can have students engage in evidentiary phenomena. For example, there is the idea that the earth is comprised of plates. You can't see the plates, but there is evidence that the plates exist and that shows us the size and location of the plates. You could look at patterns of earthquake and volcanic activity and you will see that there are these irregularly shaped parts of the earth and there might be something going on here. So you can develop the idea of plates that way, Banilower explains.

Questions About Challenge One

- Where were you collecting this data? • Participant

- Different projects across the country. I don't want to say it's nationally representative, but it is spread out across the country. • Eric Banilower

- When you say "less variation in PD," is that in terms of quantity, quality, what? • Participant

- In the approaches, the different ways that teachers were experiencing professional development. There was definitely less variation in exposure in "seat hours" on any topic than we expected, but also the experiences we saw tended to be fairly homogeneous. They weren't using different strategies. • Eric Banilower

Challenges

Eric Banilower reiterates the point that key to AIM's research is the attempt to understand the different experiences that teachers have in professional development and that students have in the classroom. To what extent does instruction at either level align with learning theory and provide opportunities to engage with evidentiary phenomena?

Challenge One

- AIM's research design relies on substantial variation in teachers' professional development experiences. In our first year of data collection (2009–10), we found much less variation than we had anticipated.

When starting this project, one assumption AIM held was that partner MSPs were going to be doing vastly different things with professional development, and that within their projects teachers would have different options regarding things they would be doing. The expectation was that there would be this natural variation that AIM would be able to take advantage of in this study. As it turns out, Banilower reports, that is not the case, which is probably a good thing in the broader picture. Since the days of the Local Systemic Change Initiatives, projects have gone to much more structured experiences for teachers, so there is much less variation within a project regarding what teachers are experiencing.

Challenge Two

- Another challenge AIM has faced is capturing the extent to which instruction (professional development or classroom) allows learners to engage with and draw meaning from evidentiary phenomena without having to observe it all.

Banilower points to a second challenge, noting that a question asked in the project log and questionnaire is, "Were learners provided with opportunities to use evidence to draw conclusions?"

In the vignette examples offered earlier the teachers could have said, "Yes, there were opportunities to draw conclusions from the evidence." However, they wouldn't have drawn the right conclusion in vignette 1, Banilower notes. "It is hard to get these type of data with a questionnaire," he adds, "and we are not sure that it is possible at all."

About Challenge Two & Advantaging Hands-on Activities

- One thing I find in science, and the same might be true of mathematics, is that because we focus so much on inquiry and problem-solving, we tend to have scales in which you get high points if you're doing hands-on activities. Just because kids are doing hands-on activities doesn't mean they're learning anything. You can actually have a good lecture or demo that teaches a concept better, but then that scale that leans towards manipulatives would bring that teacher down on their score. • Participant

- Right. That was something we feared might have been happening back with the LSC data collection, that people were advantaging hands-on over the intellectual engagement with evidence for an idea. • Eric Banilower

Study Component 3

To address these challenges, AIM has developed a third component to this study involving a week-long PD program for teachers in North Carolina that will focus extensively on one content area.

Study Component 3

- We are planning a week-long professional development program for elementary teachers that will focus on deepening teachers' understanding of science content and learning theory-based science instruction, as well as how to apply this knowledge in their own classrooms.
- Teachers attending the PD will also participate in Components 1 and 2 of AIM.

One thing the project has observed, particularly with projects working with elementary teachers, is that they have finite resources and must make a choice between covering all of the topics teachers teach or going in depth on one topic. Most of the PD projects involved with AIM in data collection have made the decision to go broad, Banilower reports, which means spending three to six hours on topics like force and motion or populations and ecosystems. "You can only do so much in that time and can only engage in so much evidence in that time," he observes.

AIM is going to spend thirty to forty hours on one topic. It will include both developing a theory of learning-theory based instruction and helping teachers make the connections to their classrooms. Participating teachers will also participate in AIM data collection, helping to increase the variability in the data set. This effort can also provide an existence proof that if you do these certain things you can expect these types of learning outcomes, Banilower notes. The PD will be videotaped and those tapes used for training evaluators and others interested in this type of PD down the road.

Participating in AIM

AIM is looking for additional partners, Banilower states, and briefly reviews what is required to participate in component one and component two. Each project gets their own data back for use in their own evaluation, which is a win-win, he points out. AIM does not evaluate your project, they provide instruments and data you and your project evaluators can use in your own evaluation. It allows you to reallocate your evaluation budget because you don't need to develop your own instruments. The second year of data collection begins this summer, and the plan is to continue for another couple of years.

The content areas AIM is looking for are those mentioned earlier: force and motion, populations and ecosystems, evolution and diversity, and properties of and changes in matter. They are independent parts of the study, so if a project is doing one of those four content areas, that is enough to qualify for participation.

Burning Question

Can Additional Projects Participate?

Yes!

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)
- 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