Without a Map, You're Lost: Using an Assessment Framework to Improve Research

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Introduction

The design of high quality science assessments is essential to building high quality science instructional programs. If we can't research and measure progress effectively, how will we know when it occurs? This presentation discusses two familiar frameworks: the assessment triangle created by National Research Council (NRC 2001) and the BEAR Assessment System (Wilson 2004) and demonstrates how the use of a flexible assessment design framework improves the task of refining research questions, creating learning progressions, and designing assessments.

The NRC Assessment Triangle

In 2001, the National Research Council published Knowing What Students Know: The Science and Design of Educational Assessment (2001).

Any assessment is based on three interconnected elements or foundations: the aspects of achievement that are to be assessed (cognition), the tasks used to collect evidence about students' achievement (observation), and the methods used to analyze the evidence resulting from the tasks (interpretation). To understand and improve educational assessment, the principles and beliefs underlying each of these elements, as well as their interrelationships, must be made explicit. (NRC 2001)

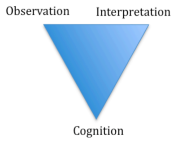

Figure 1. The National Research Council's assessment triangle. (NRC 2001)

Current Study

Content for this presentation comes from a current multi-year collaboration between the San Francisco Unified School District middle school science teachers, the Berkeley Evaluation and Assessment Research Center (BEAR Center), Stanford University, and the Strategic Education Research Partnership (SERP)

http://portal.sfusd.edu/template/default.cfm
http://bearcenter.berkeley.edu/
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The BEAR Assessment System: Four Building Blocks

In *Constructing Measures* (Wilson 2004), a much more detailed assessment design approach is presented that is organized around four building blocks (Figure 2) within a highly iterative instrument design process. One of the most promising and relevant features of Wilson's approach is its reliance on a single explicit developmental construct as the first building step in the process.

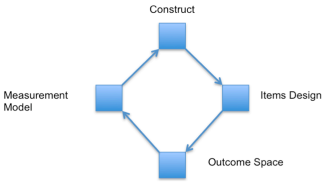
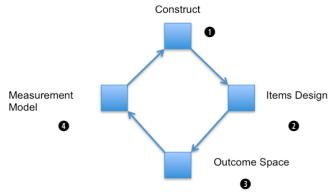


Figure 2. The four building blocks of the BEAR Assessment System (Wilson 2004)

Mapping Research Questions

The San Francisco Unified School District identified, among several priorities, the science achievement of English Language Learners and how literacy and language challenges can serve as barriers to accessing math and science content in middle school .

"How can we overcome literacy and language challenges? "



Four questions derived from the four building blocks

1. Do ELL students think differently about some concepts?
2. Will they understand our written or verbal assessments?
3. How will we make sense of their responses?
4. Will our data analysis plan tell us what we need to know?

Mapping Learning Progressions

One draft of a learning progression co-developed with middle school science teachers in the San Francisco Unified School District is shown below.

SERP-SF Science Development Team

DRAFT Heat Transfer Progress Map (11/6/08)

6th Grade Earth Science

Relational	Describe how these three mechanisms work in various contexts (e.g. mantle, atmosphere, ocean) and through different media (solid, liquid, and space).
Identification/ differentiation	Identify and differentiate the 3 different types of heat transfer using correct scientific terminology.
	Identify and describe the 3 different types of heat transfer and that they occur in particular conditions and scenarios with particular kinds of materials.
	Identify and describe at least 2 types of heat transfer, generate scenarios consistent with each, and can point out differences and similarities between types.
Recognition	Identify and describe only 1 type of heat transfer. (Does that mean they think there is only 1 kind?)
	Students have an intuitive and experiential understanding of heat and heating; basic understanding of 'cause and effect' of how heat is transferred, identifying sources of heat, and equalization of temperature. Able to recognize and generate basic heat transfer scenarios.

1. Do we have the progression right? Is HT one thing or many things?
2. What is the best way to assess student understanding of HT?
3. How will we make sense of student responses to our assessments?
4. Will our data analysis plan tell us if we have the progression right?
   Will it locate students along the progression?
   Will it help teachers decide what to teach next?

Mapping Heat Transfer Items

The design of items (items design) and a plan for scoring student responses (outcome space) are the second and third building blocks. It requires the items to be "aimed" at or mapped onto the learning progression (construct) to answer the following research design questions:

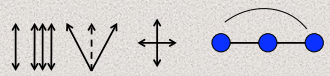
"What questions, tasks, or performances will best reveal student knowledge and ability, and what is our plan for interpreting and scoring student responses?"

Testing New Item Types

Item: Draw and label an example for each type of heat transfer:

1. Is being able to generate scenarios part of "understanding" HT?
2. Does a drawing require less "language" and more "science"?
3. How will we make sense of and score student drawings?
4. Will our data analysis plan tell us how our items are performing?

Interactive Sandbox!



Contact information

I am always pleased to hear from other researchers working on issues in assessment, science education, and instrument design.

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