The importance and challenges of attending and responding to students’ thinking

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Discussing the “Marino Phenomenon” Hammer, 1997

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A view of science

• A body of knowledge: The accounts that result from that pursuit. “Inquiry”
• A body of knowledge: The accounts that result from that pursuit. “Content”
  - including the canon of accepted understandings, and
  - gaps and questions these understandings raise.

A view of science

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Well-established findings

1. Children have extensive intellectual resources for learning science. (Duschl et al., 2007; many many studies)

2. College students typically treat science as information to memorize. (Hammer, 1994; Redish, Sezginer & Saul, 1998; many others)

Why the second, given the first?

A likely conjecture

We assess ideas, and teach students to assess ideas for alignment with the canon — the results of scientists’ inquiries — rather than by the ideas’ merits within the students’ inquiries.

Students take up a different pursuit: Figuring out how to score points in the course = “get it right”

Sharon Fargason’s third grade class

- 14 days of lesson (~ 1 hour / day)
- “Toy car module”—elicit beginnings of energy
- Launching question: What ways could they think of to get a toy car to move?
- Spawns many other questions

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Physics 11, calculus based intro
- Lectures as conversations
  - some planned clicker questions
  - emergent topics around students’ thinking
- Open-ended labs
  - E.g. You can’t take the cart off the track or move the track. Figure out a way to mass the cart.
  - Predict the landing spot for a ball that rolls down a ramp and off the table (before rotational motion)
- Fewer but harder problems for homework
  - Evaluated largely for “sensible effort” (the pursuit)

A view of science
- A pursuit: Of coherent, mechanistic accounts of natural phenomena. “Inquiry”
- A body of knowledge: The accounts that result from that pursuit. “Content”
  - including the canon of accepted understandings, and
  - gaps and questions those understandings raise.

We care about the pursuit
- As essential for objectives of content
- As an objective in itself

In Isaac’s notebook

- Lectures as conversations
- Open-ended labs
- Fewer but harder problems for homework

Sharon: Isaac.
We care about the pursuit

Practices highlighted as Dimension 1 of NGSS

- As essential for objectives of content
- As an objective in itself

But we keep focusing on “content”

For many reasons

- The intellectual challenges of recognizing and interpreting students’ productive thinking
- Fears of letting students be wrong
- Seeing science as the canon of knowledge

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- The intellectual challenges of recognizing and interpreting students’ productive thinking
- Fears of letting students be wrong
- Seeing science as the canon of knowledge
- and students as lacking in knowledge and abilities or as having bad knowledge

For many reasons

- Language
  “inquiry-based science” / “inquiry science”
  As if there’s another kind!

- Standards
  Objectives of “disciplinary practices” are in tension objectives of core ideas and crosscutting concepts
  In moments such as with Erin, Kervin, my students…
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• Assessment
  Aims of objectivity, efficiency, standardization favor
  assessing for alignment with the canon
  But even that is problematic…

Content

From the San Diego Unified Science Benchmark.

26. Brian is twirling a ball on a string over his head. The string represents a pull on
the ball. What is another name for the pull on the ball?
A. gravity
B. orbit
C. revolution
D. rotation

We need…

• Genuine, systemic reform
  including with respect to assessment
  but it’s a very stable system!

• Intellectual rigor in teacher education
  including with respect to attending and responding
to student thinking

Thanks for listening

If you’re interested in more…
cipstrends.sdsu.edu/responsiveteaching/
dhammer.phy.tufts.edu