Responsive teaching in science

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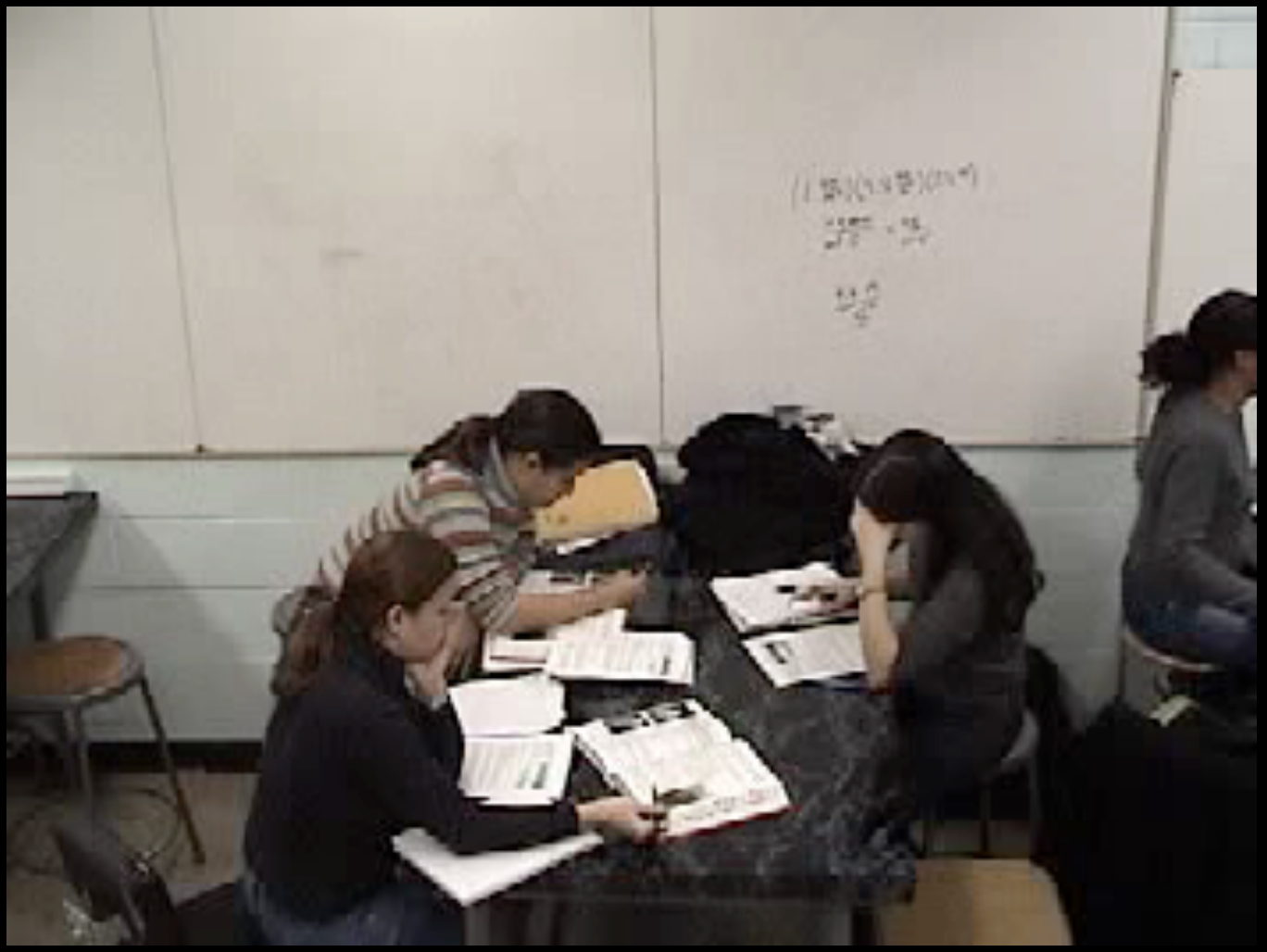
Erin: Um, I think because since you sucked out the air, it's like, it caves in because there's not any air so it has no, nothing's pushing it in from the inside to make it like squa, like -

Students try to estimate the difference in air pressure between the floor and the ceiling.



Tuminaro, 2004

A view of science

- A pursuit: *Of coherent, mechanistic accounts of natural phenomena.*

  Coherent: Holding together, meaningfully connected and consistent

  Mechanistic: Based on reliable, familiar causes-and-effects

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.*

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, Steinberg & 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"

What happened next

Teacher: Okay, so there's less air in the inside that way.

Erin: Yeah.

Teacher: But I don't understand why that makes the sides have to go in.

Erin: [5 s] Maybe its pressure I don't know.

Teacher: What's that? Pressure?

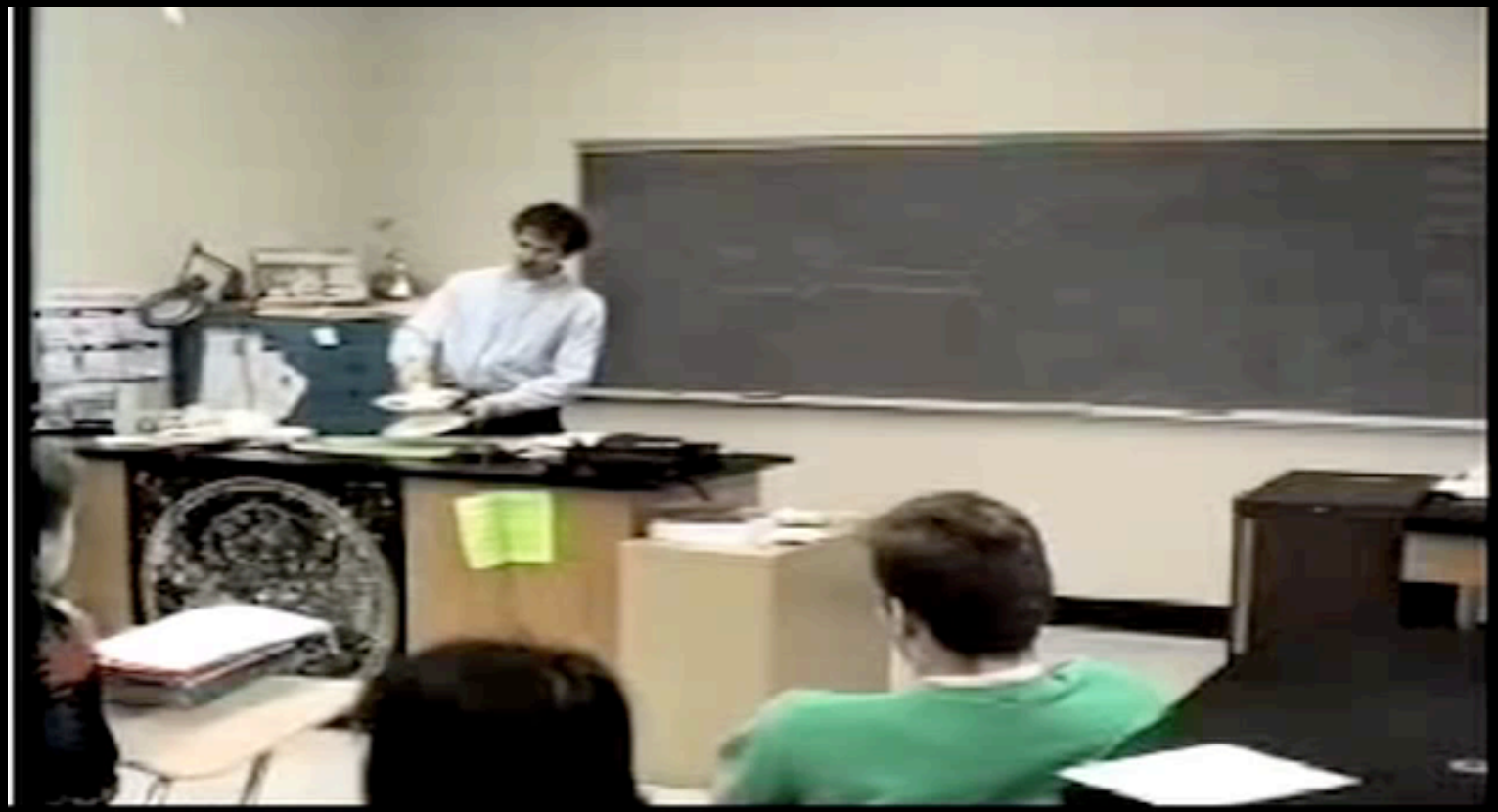
Erin: It's something that's hard to explain. Um. [4 s] It's something that's [6 s] like, it's hard to explain.

Teacher: Okay. Let's try. As a group and individually.

The class's attention shifts to terminology.

Kervin: Like, um, like last time we did three ramps --- Number one, number two, number three. Number two (inaudible) it was lower. So a ramp, if it's lower, it goes faster.

Discussing the "Marino Phenomenon"



Hammer, 1997

studentsdoingscience.tufts.edu

Some discussion points...

Doing science (and engineering, math...) *is* learning!

- learning in a discipline is learning how to learn
- including habits, inclinations, abilities and practices for *assessment*.

The dynamics of students' engagement are complex

- conceptual, affective (Jaber, 2014), epistemological, social, etc
- typical idiosyncrasy
- interest in science vs interests *within* science

Some discussion points...

Assessing students' work and learning requires

close attention to the substance of their thinking

a sense of the discipline

an understanding of learners and learning

It overlaps with the assessment in the discipline.

challenging especially for new, different ideas and ways of thinking... but that's where the action is!

Teaching and teacher education

- Work on hearing and interpreting student thinking
  - as scientific and pedagogical *assessment*
  - less attention to *methods* (less ≠ none!)
- Consider influences on teacher attention
  - of curriculum, formal assessments, culture
  - support stability of teachers' framing