Re-thinking “who is smart” in the classroom: The roles of sensemaking talk and scientific modeling

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Identities get shaped by the classroom culture: The “smart kid” can...

...respond to requests for “right answers”
...pick up science vocabulary and repeat it, to give appearance of understanding
...comply with procedural activities that don’t connect with their interests, or with authentic science
....reproduce textbook ideas on quizzes and tests

Let’s do reform but not getting distracted by its shiny bits:

• Open opportunities for participation by all
• Connect the science with their lives and interests
• Allow them to show more of what they know

• Can I participate?
• Will I participate?
• Can I see my interests in the science?
• Will people care about my ideas?
Anchoring events: Designing motivating units, tapping interests & everyday experiences

- Sophomore biology: Why did my aunt get breast cancer and will it spread?
- Kindergarten: How can someone little push someone big off the end of a slide?
- 5th grade: Why are solar eclipses predictable and so rare?
- 8th grade: Why are killer whale populations in Puget Sound declining?

Outcomes of this work? Unique explanations & models
- Social behavior of wolves
- Eco disturbance
- Elk no longer trampling river banks
- Competition with coyotes
- Climate change

Essential question: How could the re-introduction of a small number of wolves cause dramatic changes in the Yellowstone ecosystem?

What the arc of a unit looks like...

Ecosystems: Yellowstone

Studying the “energy story” behind sound
Inside Amy's 6th grade classroom

- Diverse urban K-8 school
- 80% Low income, 47% English Learners
- 20% Homeless

Show singer

How are auditoriums built to make voices & music clear?
Can ultrasound help us see hidden things?
How bats and dolphins use sound to find prey?
How do neighborhoods cut down on noise pollution?
What makes noise vs. music?
Can technology help us overcome hearing loss?
How can “booming” speakers make me shake?
Can a person who is blind echo-locate?

Cool stuff

Principle 1 for expanding participation

1. Create links between science topics and students’ everyday experiences, use their ideas as resources

Day 1

“Straw inside the glass was freaking out.”

“Flicked the glass, that maybe made a crack…”

“Sound of his voice vibrated the cup and straw.”

Connections to your experience

Before, during, after
- Before anything happened, I noticed this...
- While ___ was happening, I noticed this...
- After it happened, I noticed...

Saw, heard, felt
- I saw something happen...
- I heard this...it sounded like...
- I felt this...

Small details
- I saw a detail, maybe it's not important but I want to state it anyway...
- Something seemed missing...

Scaffolds
Let’s develop a list of “starter” ideas:
Under what conditions would the glass break? [A-B “Structured talk” to support this]

- “We think it has something to do with _____.”
- “We think ________ caused the glass to break.”
- “We are wondering ________.”

How might the teacher framing be thought of as an equity move—increasing participation?

- Any ideas or puzzlements from Kelanie that could be used as resources for reasoning by her peers?

Modeling to make thinking visible: Is this share-out more than just sharing?

Principle 2 for expanding participation

Make student thinking visible, use multiple modalities
Encourage drawing + talking + gesturing + writing

AP Chem: Where does heat go in my coffee?
How can small seed grow to become Douglas fir? (High School)

Consensus model by kindergarteners: How can someone little bump someone big off the end of a playground slide?

Compression waves:

There are some science ideas students cannot “discover”

We might use interactive direct instruction followed by lab activity to teach this idea

Day 3

“I kind of agree and disagree with Ricardo.

I thought that you could only make an echo in a big wide-open space.

But when I just moved into my house, there was an echo there because nothing was in there, it was empty.

I said ‘It smells nice in here’ and I could hear myself echo.”

How can a teacher visit tables and foster participation while pressing for sensemaking?
Example of student-generated sentence starters
(Ask a clarifying question)

"Between desks instruction" > Kikan-shidō

Talk moves...

PROBING: What do you think about...?

PRIMING: Would you be willing to share that idea?

FOLLOW-UPS: Can you say more about that?

REVOICING: What I think I hear you saying is...

LEAVING QUESTION:
"I heard a couple things from you that might affect sound and echoes: Whether the space is big, and if the space is empty."
"Do both of those matter? Why?"

Principle 3 for expanding participation

3 Design safe spaces for talk in small groups and whole class settings.
Day later—puzzlement about sound moving through box, but not air particles

In this video...

- Who has opportunities to talk in this routine?
- What groundwork for talk has likely been laid by the teacher earlier this year? Is there scaffolding or structuring of this conversation that you see evidence for?

Revising models: How has our thinking changed?

- Revise
- Add
- Remove
- Still have questions

Principle 4 for expanding participation

Make explicit 1) the structure of authentic science practices, 2) “hidden rules” about science talk.
Revising explanations and models

Resonance and other topics

Days 10-14

The question we are answering by drawing this model and writing our explanations: How did the singer break the glass with his voice?

Directions:
1. In the three panels below, draw what is happening that you can and cannot see that is causing the glass to shatter. Use Zoom-INS.
2. Use the drawings to help you write an explanation about what is happening at each point in time.
3. For each picture, be sure to include the ideas from the Gotta-Have Checklist:
   - How compression waves move energy
   - How frequency and amplitude play a role in the glass breaking
   - The full story of energy transfers from person to glass
   - How resonance plays a role in the story

4. After completing your model, provide evidence from one class activity that supports one of your claims. Write the evidence on a sticky note and place on the relevant drawing.

Names _______________________________________________________________________________________
Period ____________________

Before

A final model template

End of unit: Transferring knowledge to new situation
Principle 5 for expanding participation

5. Provide opportunities for students to use new academic language in the context of science conversations (don’t front-load vocabulary).

Expanding opportunities to be smart

1. Create links between science topic and students’ everyday experiences, use their ideas as resources.
2. Make student thinking visible, use multiple modalities.
3. Make explicit 1) the structure of authentic science practices, 2) “hidden rules” about science talk.
4. Provide opportunities for students to use new academic language in the context of science conversations (don’t front-load vocabulary).
5. Design safe spaces for talk in small groups and whole class settings.

There is more…

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