Design Talks: Building Community with Elementary Engineering

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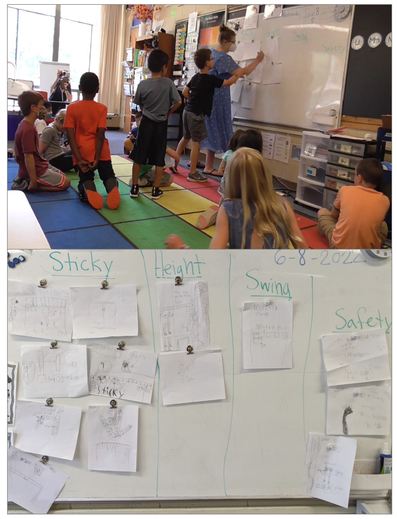
Whole-class conversations that support engineering sensemaking

We aim for Design Talks that:

- Represent distinct genres of intentionally facilitated, whole-class engineering design conversations in 1st-6th grade classrooms
- Position design decision-making as not just a technical task, but as a critical socio-technical activity (McGowan & Bell, 2020) that requires a perspective of care (Gunckel & Tolbert, 2018) to navigate its ethical, economic, and political dimensions
- Make engineering a site of knowledge building by supporting students' sense-making about engineering design problems and solutions (Haverly et al., 2020; Schwarz et al., 2021)
- Position students with epistemic authority to contribute to the class's collective thinking (Carlone et al., 2021; Engle & Conant, 2002)

In this multiple case study of Design Talks in 1st grade, we ask:

1. **How can Design Talks make space for early elementary students to participate in sense-making about engineering designs?**
2. **What teacher moves support early elementary students to take up epistemic authority in Design Talks?**



Genre	Framing questions
Impact Talks	Should we design this? Who and what will be impacted?
Problem Scoping Talks *Episode 1*	What do we need to consider to solve this problem?
Idea Generation Talks *Episode 2*	What are multiple possibilities for solving the problem?
Design-in-Progress Talks	Why did a design perform as it did? What features should we change?
Design Synthesis Talks *Episode 3*	What are similarities and differences in our designs? What can we learn from these patterns?

EPISODE 1 — Buddy Bench Shade *Problem Scoping Talk*

What does a shade structure design for our buddy bench need to have or do?

		Ms. M.'s Supportive Moves
Ms. M:	So we have this idea. Let's put a tent over it. Isn't that a great idea?	Inspired problem-scoping by inviting reactions to existing (flawed) design
S1:	Kind of! It would block the sun, but no one would see that you needed a friend to help you!	
Ms. M:	Right….So then another idea was just to cover the top. Hmm. Does anyone see a problem with this one?	Specifically asked for critique of another flawed design
S2:	Because the top is too heavy so it might-	
S3:	It might tip over.	
S2:	It might fall. And the front is getting sun.	
Ms. M:	Interesting. So that doesn't prevent some of the sun from coming in. Yes?	Revoiced student ideas about design flaws
S4:	Do you see how it's on the back and this is leaning back? It actually puts way more weight here than there. So, even with the slightest touch, it could just "timber"!	
Ms. M:	So you think that the weight could make this fall ….When we tried this idea, we realized that the bench is still in the sun for most of the day. So this wasn't the best solution either. Can we think about why?	Pressed for sense-making about reasons for design failure
S5:	Maybe because like, um, the front and the back aren't covered, and the part in the middle of the bench is open so the sun still comes in.	
S1:	The part made out of fabric could catch on fire.	Named the focus of student's sense-making: material choices
Ms. M:	Oh, so you're thinking about what materials might be best, and maybe this material might not be best.	

Critiquing prior designs helped students make sense of the problem and prepared them to generate criteria for their own designs.

EPISODE 2 — Playground helper *Idea Generation Talk*

How can we design something to help kindergarteners use the monkey bar structure on the playground?

		Ms. M.'s Supportive Moves
[Displayed pictures of plants and animals for biomimetic inspiration, then invited students to share ideas. Various students describe ideas for gloves and shoes with special features for jumping, stretching, and sticking.]		Encouraged expansive thinking by displaying plants and animals that excel at vertical motion
Ms. M:	So you're thinking like two designs to help the Kindergarteners. You're thinking about the shoes and the sticky gloves. Yes?	Named most recent contributions to idea pool
S1:	Yeah, but if they um get sticky, they can't, what if they can't swing because it's too like sticky?	
Ms. M:	Oh, did everybody hear? He said one of the problems, maybe, with the sticky gloves is what if they're too sticky? And they're not able to swing then from each of the monkey bars? That's an interesting problem. How do you think we could problem solve that?	Made sense-making visible by naming S1's new kind of idea – a problem nested within one possible solution Invited collective problem-solving
S2:	Maybe we could make this cool device that is kind of related to batteries. So then each time when you're about to swing, there's these little slots, that keep out still a couple more of those things, so then you can swing a little better.	
Ms. M:	Okay, so you're saying a device where its battery operated?	Pressed for clarification
S2:	Yes, and …basically, the glove that's really sticky, except there's these auto device that you, that when you swing, there's these little slots that cover some of them, and then you still stick a little, but not [all the way].	

Ms. M.'s moves supported students to generate many early design ideas and to begin to refine them collectively.

EPISODE 3 — Playground helper *Design Synthesis Talk*

How can we summarize our designs into four "big ways" to solve the problem?

		Ms. M.'s Supportive Moves
Ms. M:	So I'm wondering, now that we've heard everyone's designs, can we come up with four big ways that we can help our kindergarteners? We've thought about these designs. What do some of them have in common?	
[Various students suggest the themes "Sticky," "Height," "Swing," and "Safety." Ms. M writes these four words on the board.]		Recorded student-voiced "big ways" on the white board
Ms. M:	So now that we have these four, where do you think your design might go?	
S1:	Mine is sticky but not too sticky.	
S2:	Ooh, this is hard. Mine is both sticky and safe. I think mine is in the middle.	
Ms. M:	Okay, so S2 wants to discuss his a little bit. He said he's having a hard time sorting it into which one. Remember his idea [summarizes design]. Which one do you think we should add S2's to?	Re-voiced a student's uncertainty Invited the class to help their classmate
S3:	Sticky.	
S4:	Safety.	
Ms. M:	You think safety. Why do you think safety? How is it safe?	
S4:	Has a good grip.	Pressed for reasoning about the specific function of a design detail
Ms. M:	Oh, so want do you think that part right there, about a good grip, where do you think that falls? Sticky, height, swing, or safety?	
S4:	Sticky.	

Students analyzed design solutions *other than their own* for common themes and for ways to classify.

Selected references

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