Isaac's theory of wheels: A third-grade class's stability in doing science

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Abstract

We present excerpts from a 25-minute, third-grade discussion about the motion of a toy car, focused on one student's explanation of how wheels work, with his classmates considering and questioning his idea. In this discussion, we argue, the students begin to engage in science in several respects, including in the phenomena they choose to explain and in how they assess the quality and appropriateness of explanations. We also argue that these assessments and negotiations are responsible, in part, for stabilizing the discussion around scientific inquiry.

Background

Project: 'Learning Progressions in Scientific Inquiry: A Model Implementation in the Context of Energy'

3rd-6th grade teachers participated in professional development that focused on attending and responding to the substance of students' ideas.[2, 5]

Data: Day 14 (5 weeks into unit)

They have been discussing what factors make a difference in the motion of a toy car (weight and size, steepness of ramp, surface material).

Theory: 'Doing science' involves recruiting particular conceptual, epistemological, affective, and social resources in pursuit of coherent, mechanistic understanding of the world. The ways students frame[4] an activity impact the resources students invoke, and the kinds of resources in play, in turn impact the ways in which students frame the activity. This reflexive process[8] emerges from and gets sustained by the participants' interaction.

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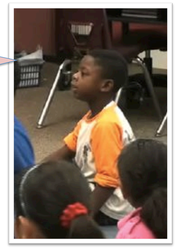
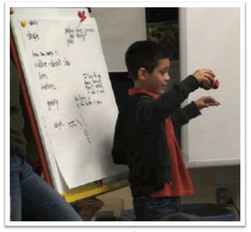
Isaac's Idea

Because like the wheels, they'll turn, and then this part will land right here and push it. **Because when you push the car, then like this part will land right there and then the wheel will push it into the next part to land**…Because the wheels work by pushing the car. If it didn't have wheels, it would just rag and stop

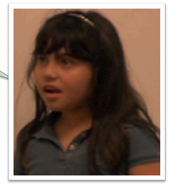
Jourdan: But I, um, does it--you just push it on the carpet like that and it goes like that and **it doesn't stop until the wheels try to stop?**



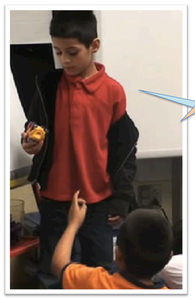


Isaac: No, not really because **the wheels get tired** and it stops. On a real car, it just presses a button so the car can keep on getting energy. And it keeps on going.

Scarlett: How could the wheels get tired?



Isaac: Because **they didn't push that hard to get enough energy** and it doesn't have electricity like a remote car.



Jamir: I still don't get it if the wheels get tired **because if you get tired it's like you can't run no more and you stop for a little bit and then you keep on running.**

Isaac: Because like, the little strings holding the wheels together so they wouldn't fall off, it's like a little hole made of rubber, or metal **that scratches with the stick….and that's why it keeps on stopping and stopping.**

Discussion

We claim that:

(1)The kinds of resources the students recruit indicate the beginnings of doing science.

- Isaac constructs a coherent, mechanistic account[7] of rolling-without-slipping.
- The conceptual substance of the conversation stabilizes around a material account[3] of how wheels work.
- Students recruit resources from their everyday experiences relating to slipping/traction, pushing/pulling, dissipation of energy, and friction.
- They begin to participate in the practices of science—making claims, argumentation, justification, holding each other accountable to ideas, assessing ideas, etc.[1]
- Their affective drive—curiosity, coherence seeking, urge to communicate an idea, etc.—mirrors that of scientists'.[6]

(2)The students are stably framing the activity as a scientific conversation, and we see the dynamics of that stability in students' moves to maintain it.

We can see what students deem appropriate by what they bring into the conversation and what they deem inappropriate by what they explicitly negotiate. Here, they make epistemological negotiations that help stabilize the conversation around scientific inquiry:

- Scarlett and Jamir's challenge of the word *tired* indicates that Isaac violated their sense of what the conversation is about, which, in turn, implies that they *have* a sense of what the conversation is about.
- The way one epistemologically frames a conversation impacts the kinds of conceptual substance allowed into the conversation, so talking about being *tired*, a characteristically human trait, does not fit conceptually into a conversation about the motion of cars—inanimate objects. Scarlett and Jamir hold Isaac accountable to his reasoning.
- Isaac responds by dropping the anthropomorphized language and returning to an explanation about the mechanical aspects of the car's motion. This moment of negotiation both establishes and reinforces the kind of conversation they are having, thus helping to stabilize the activity around scientific inquiry.

Conclusion

When given the space and guidance to pursue their own ideas, these third-grade students are capable not only of having scientific conversations, but of making moves to stabilize their pursuit around scientific inquiry. This data illustrates the kinds of conversations that third-graders can have when priority is given to understanding the substance of student thinking.