Doing Science With Fidelity to Persons: Instantiations of Caring Participation in Science Practices

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Abstract: This paper builds on an emerging line of argument that STEM education should be guided by not only conceptual and epistemological goals, but also axiological ones: attention to the moral and ethical underpinnings that guide learning and participation in scientific and engineering practices. We draw specifically on Noddings' care theory (1984, 1986), which foregrounds concern for collective well-being and growth. In particular, we explore what a caring orientation can look like in the context of doing science through two paradigmatic cases. These cases highlight how values of receptiveness, responsiveness, and relatedness shape students' social and epistemic practice. These values challenge canonical versions of science practice and invite reflection on the moral underpinnings of learning science.

Rationale and framing

This paper builds on an emerging line of argument that STEM education should be guided by not only conceptual and epistemological goals, but also axiological ones: the moral and ethical underpinnings that guide learning and participation in scientific and engineering practices (Bang et al., 2016; Philip, Gupta, Elby, & Turpen, 2017). We draw specifically on Noddings' care theory (1984, 1986), which highlights an orientation to concern for collective well-being in relationships, such as those formed in learning environments between students, as a central ethic. In particular, we are interested in what a caring orientation looks like *within the context of doing science*, as members of a community attend simultaneously to the conceptual and epistemic dimensions of practice and to the quality of their relationships. As a result of this orientation, our hope is the creation of science learning environments where students are not only motivated to develop powerful scientific explanations, but also to attend to and facilitate opportunities for their peers to fully participate in the process of co-constructing knowledge. This axiological emphasis on foregrounding mutual care is a shift in focus from the often taken-for-granted goals of developing ideas with explanatory power without regards to how people interact with each other to develop those ideas (Roth & Barton, 2004). Attending to relationships allows us to identify ways that students participate and learn that differ from the pervading attention to the conceptual and epistemic dimensions of learning. Moreover, this approach to understanding learning and participation can provide a more nuanced analytical toolkit for describing productive interactions between students, even if those interactions do not fit disciplinary standards for what is conceptually and epistemically productive. We argue that the goal for fostering a caring orientation is not in competition with the conceptual and epistemological goals of science learning; but that shifting our values to focus on the development of the person does have implications for what we count as "good science practice."

In this paper, we present an interpretation of Noddings' work that directs our attention to the goal of developing students who demonstrate care for mutual, collective growth in science understandings and epistemic practices. We then explore the implications of this argument by presenting two illustrative cases that demonstrate what science practice can look like when students orient towards caring for mutual growth. We argue that students in these cases attended to their peers' growth by creating opportunities for one another to participate in substantive epistemic work. We discuss the implications of considering an ethic of caring in science learning environments for researchers and educators, emphasizing the importance of attending to and constructing the environment's axiological commitments. Moreover, we offer implications of this work for the Learning Sciences, highlighting the need to raise awareness about the moral and ethical underpinnings of all types of learning environments.

Current goals of U.S. science education

Research in science education has long prioritized understanding how learners make sense of and co-construct knowledge about the natural world, advocating for learning environments that support students' deep sensemaking around core disciplinary content (e.g., Brown & Campione, 1996). Current reform efforts in US science education aim to support students' participation in science practices (NGSS Lead States, 2013; NRC, 2012). This emphasis is drawn from conceptualizing science as practice (e.g., Pickering, 2010) and conceptualizing learning as rooted in social interaction and collaborative knowledge construction (Greeno, 2006; Rogoff, 1993). Foundational to both perspectives is the idea that *social interactions matter for the fundamental doing and learning of science*.

Following from this foundational assumption, research has aimed to understand the nature of student interactions and their impact on learning, including a focus on understanding how students engage in epistemic

practices of science (e.g., Engle & Conant, 2002; Kelly, 2006), on social discourse practices (e.g., Lemke, 2001) and on processes of disciplinary identity formation (e.g., Brickhouse, Lowery, & Schultz, 2000). Though these strands are complementary and mutually supportive, they have each tended to frame social processes as in service of epistemological goals. We aim to question the ethics of this pattern and to consider alternative possibilities for thinking about the relationship between social interactions and disciplinary work.

Interactions guided by fidelity to knowledge vs. fidelity to persons

We begin by considering how and why students might think they are interacting with each other, in terms of the nature of the interpersonal relationship underlying those interactions. For example, are students arguing with each other to prove whose idea is ultimately right, or are students arguing in order to co-construct a genuinely shared understanding? And what do the nature of their interactions communicate about what counts as growth?

Often, work in science education implicitly assumes that what counts as "growth" is ultimately defined and evaluated by convergence on canonical disciplinary understanding. We do not refute the importance of this point, but we want to point out a way that it is insufficient. When growth is framed this way, there is a lack of attention to the *means for getting to* that disciplinary understanding. And, despite attention to the development of epistemic and social practices in science classrooms, typical US science classrooms promote an individualistic and competitive ethos for what it means to learn and be competent in schooling (Archer et al., 2017; Carlone, Scott, & Lowder, 2014). These values are rooted in an individualist paradigm characteristic of Western Science, where the objective individual discovers the natural world as is (Harding, 1992). Growth, in this sense, is the "uncovering" of truth. Actions that promote this kind of growth embody a *fidelity to knowledge*. This orientation is fundamentally utilitarian, in that it undergirds science learning environments where the ends (i.e., explanatory power) justify the means (i.e., the nature of how members of a community interact to refine the explanatory power). It focuses exclusively on whether the person is committed to abstract principles and propels persons to act out of duty to those principles rather than true commitment to one another (Figure 1a). In classrooms, this plays out when we ask students and teachers to focus their efforts on evaluating and refining explanatory models with attention to fidelity to the epistemic criteria of the discipline, but without attending to the quality of relationships or the process of that model refinement. Other people (e.g., classmates, teachers) are simply the context within which to develop better knowledge.
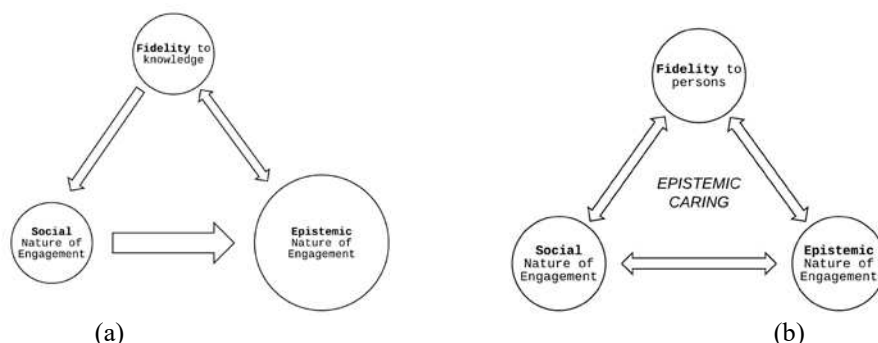

Figure 1. (a) Fidelity to knowledge foregrounds epistemic goals (idea creation). (b) Fidelity to persons leverages both social and epistemic goals to foreground caring relationships.

As an alternative, we draw on Noddings' work advocating for a *fidelity to persons*: the commitment of one person to the growth and well-being another, grounded in a caring relationship. This orientation guides interaction and joint work. In terms of pedagogy, Noddings argues that the "development of the whole person is necessarily [teachers'] concern" (1986, p. 498) and that "caring involves promoting the growth of those for whom we care" (ibid, p. 499). Thus, teachers' pedagogical decisions and strategies should support their students in developing as persons who care and are cared for by each other. While not explicit in her writing, Noddings' focus on caring and attending to the quality of relationships can also be extended to student-to-student interactions: when students are epistemic agents, they are responsible for shaping and supporting each other's learning. In other words, students' interactions should also be guided by a fidelity to persons.

Importantly, fidelity to persons is not a *replacement* for fidelity to knowledge. Instead, orienting to fidelity to persons brings a mutual attention to both the epistemological and social nature of interactions: rather than using people to get better ideas, it uses the context of co-constructing ideas to develop ethical, caring relationships. It is then through interactions based in these relationships that genuinely shared epistemological commitments and consensus ideas can emerge (Figure 1b).

How might the object of fidelity shape disciplinary work?

We argue that one's axiological orientation to fidelity—to what the object of fidelity is—has implications for the social and epistemic practices of science. Different objects of fidelity (e.g., getting it right, inviting others into conversation) determine how growth is defined and what interactions are prioritized. For example, participation guided by a fidelity to knowledge can create situations where the priority becomes constructing a coherent explanation, under the assumption that reaching that explanation will be most beneficial for the group regardless of who contributed to that process or how. Alternatively, participation guided by a fidelity to persons can create spaces where most, if not all, students can participate in the sensemaking process, with growth reflected in the extent to which students interact with each other with receptivity and responsiveness.

Building from these theorized possibilities, we seek to explore: *what might it look like for an orientation to fidelity of persons to guide the social and epistemic activity of students doing science?* We explore this question in two cases, both instances of disagreement that arose in student-to-student conversation around a model of a scientific phenomenon. We chose to look at moments of disagreement because they are when the social and epistemic dimensions of science practice can be in tension: one could choose to abandon, for example, an epistemological commitment to explanatory coherence in order to keep peace with a peer. Alternatively, one could abandon a social commitment to reciprocal relationship in order to preserve the quality of an idea. In other words, it is in these moments of disagreement that the guiding axiological commitments become visible in the nature of students' interactions. We present two cases that we argue each illustrate a form of fidelity to persons in which students maintain both social and epistemological commitments in a mutually reinforcing way.

Methodological approach: Identifying and analyzing paradigmatic cases

The two cases presented below come from two unrelated research projects. One comes from a corpus of video data collected in an out-of-school science program hosted in a library for elementary-aged bilingual children (ages 7-9) that was focused on leveraging students' language resources in scientific sensemaking. The second comes from a corpus of video data collected in middle school (ages 11-14) science classrooms aiming to support students' meaningful participation in science practices. We consider these to be *paradigmatic cases* (Mills, Durepos, & Wiebe, 2010): we use them to illustrate and explore the phenomenon of students demonstrating fidelity to persons in building science knowledge. In addition, we present cases from two distinct settings to demonstrate replication of the phenomenon across contexts (Yin, 2013).

We identified these cases through independent analyses. Suárez conducted discourse analysis of video data from the out-of-school setting looking for markers of disagreement (Suárez, 2017). The out-of-school case presented here was identified because of its distinctive markers for attenuation of conflict and invitation into epistemic practice. This way of engaging in disagreements signaled that students were holding each other's ideas accountable in ways that did not push peers away. Independently, Krist conducted an analysis aiming to demonstrate how middle school students' participation in science practices developed over the course of those three years, with a focus on their use of epistemic considerations (Krist, 2016). The middle school case presented here was identified because students used disciplinarily sophisticated epistemic criteria, but the social norms guiding their interactions were markedly different than those in other class periods.

We began looking at these cases side-by-side during conversations on Noddings' work. We used fidelity to persons as a "sensitizing concept": an idea that is not yet clearly defined or operationalized, but that "gives the user a general sense of reference and guidance in approaching empirical instances" and "suggest[s] directions along which to look" (Blumer, 1954, p. 7). We brought these cases together as empirical instances that we had been sensitized to through our previous analytic efforts, and we began looking at them together in order to further refine and elaborate what it looks like for a fidelity to persons to play out in science. In particular, as we compared the cases, we looked for indicators of *caring occasions*: moments when students were participating in ways that demonstrated social and/or epistemic care for one another. We sought to identify in more operational detail the features of their participation that indicated this kind of caring. We drew on science education literature, critical perspectives of science, and Noddings' descriptors of "responsiveness, receptivity, and relatedness" (Noddings, 1984) to refine the features. The features we identified include:

- **Asking questions that follow ideas**: students are refining their thinking and questioning in response to what others are contributing.

- **Engaging in "idea play"**: students entertain an idea and follow it through to its logical conclusion before evaluating it as right or wrong, or as productive or not.

- **Using data to invite conversation**: students draw on various forms of data to invite dialogic conversation, rather than attempting to "win" an argument, and in contrast to "pseudoargumentation."

We described how each of these features played out in moment-to-moment participation in analytic memos, paying attention to how they were connected to the social and epistemic dimensions of science practice.

Findings

In each of the cases presented here, students were trying to answer a specific question about natural phenomena and had arrived a point where there were multiple possible explanatory models on the table. These multiple possibilities created opportunities for students to attend to each other's reasoning and logic while also orienting towards a group growth characterized by relatedness, receptivity, and responsiveness. In both cases, students *asked questions that followed ideas*, demonstrating that they had a sense of accountability to ideas and responsiveness as they were carefully attending to and addressing one another. The out-of-school case highlights students *engaging in idea play* as a form of receptivity to others' ideas. The middle school case highlights students *using data to invite conversation* in ways that foregrounded relatedness in that their use of data was in service of supporting mutual growth and understanding. We present each of these cases, highlighting the interconnectedness of these reflections of a fidelity to persons to the social and epistemic dimensions of science practice.

Circuits case: Engaging in "idea play" as a step toward consensus

The circuit case took place in an out-of-school-time learning environment that created opportunities for students to investigate and problematize electrical phenomena. The case presented here occurred during Session 4 of the program, when four students (Yesenia, Elio, Toben, and Grace) built circuits with batteries, wires, and lamps and explained how they thought electricity flowed to light up a lamp. As they presented explanatory models, differences in their ideas emerged. First, Yesenia and Elio stated electricity traveled in a circular motion from end of the battery to the next; Toben and Grace thought electricity left from each side of the battery and met at the lamp. Second, Yesenia and Elio argued that disconnecting the circuit from the battery would make the electricity "freeze" in the wire because there would be nothing to continue pushing it through; Toben and Grace argued that disconnecting the circuit from the battery would make the electricity in the wire return to the battery, leaving the wires empty of any electricity. They spent the next 8 minutes trying to understand and resolve these differences.

The excerpt we analyze here begins with Yesenia asking Toben and Grace what they thought would happen to the electricity as soon as they disconnected the battery from the circuit:

1	Yesenia:	How would it (circuit) work? Would it (electricity) freeze? Would it (electricity) still keep running?
2	Instructor:	oh it's circular
3	Yesenia:	or would it (circuit) turn off?
4	Grace:	It (circuit) would turn off.
5	Instructor:	It (circuit) would turn off.
6	Yesenia:	And what happens to the uh - to the energy?
7	Grace:	Um, um, there would - there would - there would be no – no energy, um –
8	Toben:	Why?
9	Yesenia:	Why? Why wouldn't there be any energy?
10	Grace:	It's because if – if it don't – it don't – if you take off the battery um the energy
11		goes to the battery, to the light bulb, or both. And if the wires were connected ((brings index fingers together))
12		the battery uh the electricity could go through here (wire clamps) and make the light bulb worked.
13	Yesenia:	But how does the -
14	Toben:	Why?
15	Yesenia:	the – how does the energy um cross the light bulb and back into
16		the battery, and then do it again and again? How does it cross?

Through her questions, Yesenia requested more information about Toben and Grace's model, inviting them to explain what was going on with the battery, wires, and electricity once the battery was disconnected. Additionally, the three questions Yesenia presented contained possibility modals ("Would it (electricity) freeze? Would it (electricity) still keep running? Or would it (circuit) turn off?"; lines 1 and 3), which provided options for Grace and/or Toben to choose from when answering them. With her first remark, Yesenia did productive epistemic work by wanting to find out more about Toben and Grace's thinking. In addition, she attended to Toben and Grace's involvement in the sensemaking process by asking them questions with scenarios to consider and choose from to continue thinking together. Moreover, while the directness and timing of her questions suggested opposition from Yesenia (Scott, 2002), offering Toben and Grace choices to address her questions could be interpreted as an attempt to provide help and attenuate the disagreement.

Grace answered Yesenia's question, "It (circuit) would turn off," (line 4), addressing the outcome of the disconnect, which aligned with Yesenia's idea that the light bulb would turn off. However, Grace did not explain what happened to the electricity. This lack of an explanation prompted Yesenia to ask, "and what happens to the energy?" (line 6). In this moment, Yesenia demonstrated responsiveness to Grace's idea and was again using questions both as a tool for both finding out more about Grace's thinking and assuring Grace's continued participation in sensemaking. Grace claimed that disconnecting the wires would result in "no energy" (line 7), suggesting the wires would be free of electricity. Yesenia's next question (line 9) is particularly interesting because of the complex discursive work it does. For one, Yesenia constructed a question that requested information, using a prediction modal with a negation ("wouldn't"), followed by an absolute statement about the energy ("any energy"). The presence of all these markers of disagreement indicate that Yesenia was disputing Grace's explanation (Scott, 2002). At the same time, the question itself is an invitation for Grace to continue being part of the sensemaking process and present the reasoning behind her claim. In this moment, Yesenia seemed intent on being receptive and responsive to Grace to work through differences in their models and reach consensus.

Grace offered a more complete, mechanistic explanation that expanded on her previous ideas about what happened when the battery was disconnected (line 10). Specifically, Grace described in detail how the electricity "goes to the battery, to the light bulb, or both" (line 11), providing the activity that Yesenia had asked for. Additionally, Grace contrasted how the electricity behaved in an open circuit to how electricity flowed through a complete circuit, allowing the currents to meet at and activate the light bulb (lines 11-12). Grace's expanded contributions are an example of the process of idea refinement when undergirded by a fidelity to persons. Specifically, Yesenia's questions seemed to play the double function of keeping Grace engaged in the discussion, while at the same time creating an opportunity for Grace to elaborate on her reasoning and state more explicitly why she thought there would be no electricity in the wires. Yesenia was holding Grace's ideas accountable, but not at the expense of pushing away or silencing Grace. Still, Yesenia thought something was missing from Grace's explanation: what made the electricity return to the battery once the wire was disconnected (lines 13-14)? Yesenia started her question with a "but" that indicated disagreement (Scott, 2002), but then presented an extension of Grace's idea (i.e., moving through the battery "again and again"), and a question (line 14) that offered Grace an opportunity to reconsider and refine her model. In effect, Yesenia offering a new scenario for consideration could be interpreted as an attempt to relate to Grace and her reasoning, following the ideas through before evaluating it.

The exchange between these students was full of linguistic features that highlighted differences and opposition between models, making it clear that they disagreed with each other. These explicit disagreements kept students accountable to each other, listening to and engaging with each other's explanations, and accountable to standards of reasoning, evaluating the plausibility of the two mechanistic models. But while students foregrounded their disagreements, they also made discursive choices that served to decrease the intensity of the opposition and to communicate receptivity and responsiveness to each other. In effect, they were discursively balancing acknowledging the differences between their models with signaling to their peers that their intention was not to be inconsiderate. Through managing the explicitness of disagreements, these students exercised an ethic of caring, attending to each other's presence and participation in their discussion. For these students, this was not a competition for who was right, but rather a community-based enterprise where the exchange of ideas was key.

Plate tectonics case: Using data to invite conversation around a discrepancy

The plate tectonics case took place in an 8th grade science classroom in January 2015, at the end of a 3-month Earth Sciences unit. This unit had students develop models of tectonic plate boundaries and interactions (e.g., convergent, divergent, transform, and subduction) in order to explain how the Earth is changing. The last lesson of the unit involved students selecting two to three focal case sites and conjecturing about the tectonic activity that formed the geologic features in that area. For the first two days of the lesson, students researched their case sites in small groups and formed candidate claims. The following three days students presented their claims to

each other using a "fishbowl" discussion format: two to four students who had researched the same sites sat in the center of the room—in the "fishbowl"—while the rest of the students sat around them in a circle. The students in the fishbowl presented their initial claims to each other and had several minutes to ask questions and work on coming to consensus. Then the "audience" could ask questions or make comments to the people in the fishbowl.

For the first "fishbowl" discussion, two students, Benny and Kaatje, discussed how the Andes Mountains formed. Benny claimed that they were formed by oceanic-continental subduction and used his hands, each representing a plate, to show the plates' interactions. His gestures made it ambiguous as to which way he thought the plates were moving. Kaatje paused, then asked, "Wouldn't it be convergent then?" They spent several minutes attempting to clarify which way Benny thought the plates were moving. Throughout this exchange, Kaatje was not comfortable with what Benny was proposing, but it is not entirely clear what she was uncomfortable about. As part of one of her responses, Kaatje pointed out a sliver of shallow water in between a trench off the west coast of South America and the coastline (Figure 2a). She said this sliver was troubling to her because if it were subduction, the trench should be exactly along the plate boundary, not offset from the coast.

After about 5 minutes of discussion, the teacher (Mr. M) paused them, affirmed the work they had been doing, and then opened up the "fishbowl" for audience questions. After Mr. M finished, Kaatje nodded to Sara:

Sara: So, in like this packet how we have - it - on the front page it shows, um, the direction of where the plates are moving. *((walks over and crouches down next to Kaatje, showing her the packet))* You can see that, like, um, right here--

Mr. M interrupted Sara, asking her to project the packet from the document camera so that everyone could see what she was showing Kaatje (Figure 2b). Sara continued, speaking from the front of the room:

Sara: Um, so like, right here, this is where you're talking about, this is where the Andes are. See how the plate edges is like, a little bit off the coast, so then that's why there's like the light blue *((pointing to the skinny strip in between the continent and the Nazca plate))* and then the trench *((pointing to the Nazca plate boundary))*. So, it's still like - its' - this plate is like, like mostly like continental over here, and then it's oceanic, so um, I lean towards Benny on that *((pause; returns to seat))*. Because of that.

(a)   (b)
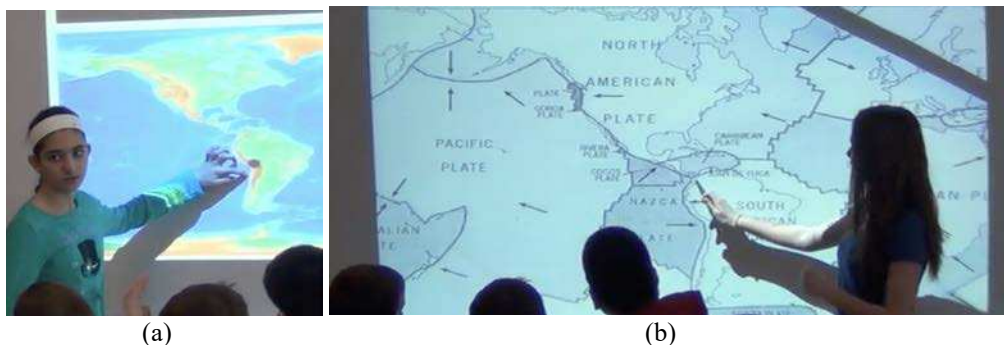
Figure 2. (a) Kaatje pointing to a sliver of shallow water. (b) Sara presenting the plate boundary map to Kaatje.

Using their map of plate boundaries, Sara responded directly to Kaatje's concern about the sliver of shallow water between the trench and the coast, pointing out the skinny strip of South American Plate in between the western edge of the continent and the beginning of the Nazca Plate. She interpreted this slight misalignment to explain the shallow area that Kaatje was concerned about. She also mimicked Mr. M's language, saying that she "leans towards Benny," softly stating her agreement with his claim of oceanic-continental subduction.

In her response, Sara was doing sophisticated intellectual work. She listened and attended closely to Kaatje's concern about the location of the trench. She then pointed to a *specific* piece of information on a *specific* map, and she interpreted it in light of another representation (the elevation map). She connected these interpretations back to how they addressed Kaatje's *specific* concern, and to the larger conversation that the class was having by clarifying how it was influencing her thinking: she "leans towards Benny." This phrasing mirrored Mr. M's language and overall framing of the task as one where their claims are tentative and shiftable.

Throughout this exchange, Sara was also doing sophisticated social work that communicated caring. By crouching down next to Kaatje, she indicated that she genuinely wanted Kaatje to see and understand the information she was sharing with her. In addition, the specificity of her information showed that she had

understood Kaatje and was choosing to respond in terms of Kaatje's idea, delving in and reacting to it, rather than presenting an alternative argument. Finally, her attenuation of her own stance as a tentative "leaning" maintained their positions as mutual explorers of this idea, rather than positioning of Sara as "right" and Kaatje as "proven wrong." Taken together, Sara demonstrated fidelity to persons—in this case, to Kaatje—as she interacted with her to try to co-construct a more satisfying explanation.

This interaction invited continued conversation. Mr. M said that Benny or Kaatje should respond to Sara, who said that she "just wanted to hear [Kaatje's] response." Kaatje walked up to the board and said:

> Kaatje: Oh, I see where you're going with it but like, you see like how there are some like, how this part like right here *((pointing to the shallow strip))*, how it's a thinner part, and then it gets thicker in some areas, so like, doesn't that kind of change the divergence?

Kaatje responded by pointing out that the sliver of plate between the Nazca plate and the coast of South America varied in thickness: it was narrower in some places and wider in others. She asked if that changed the "divergence." Her statement pointed out another observation that complicated the clean interpretation that Sara had just made from the plate boundary map, which she also presented with attenuation: "like, doesn't that kind of change the divergence?" Like Sara, Kaatje interacted in a way that demonstrated receptivity to Sara's idea, responsiveness to the particulars of that idea, and maintained their relationship as one of mutual co-constructors.

Discussion

With these cases, we showed two examples of what making sense of the natural world while guided by a fidelity to persons can look like. In each of these cases, we saw how interactions that communicated receptivity, responsiveness, and relatedness to one another functioned to communicate care for the nature of the relationship *and* care for the developing idea. These interactions brought learners and their ideas to the table, giving them space and respect to be carefully explored. At the same time, this exploration was not at the expense of disciplinary accountability. In fact, we would argue that the features highlighted in these cases—asking questions that follow ideas, idea play, and use of evidence to invite conversation—parallel the disciplinary practices and work of science (e.g., presenting and evaluating an argument, playing out abstract models and thought experiments, revising ideas based on new evidence and interpretation). Taking on these caring dispositions does not diminish the quality of the epistemic work these learners engaged in, nor the quality of the knowledge products they co-constructed.

At the same time, the features we highlighted push back on some of the norms and values undergirding disciplinary science. An orientation to fidelity of persons emphasizes caring ways of relating to peers and their ideas, a mode of interaction often relegated in disciplinary practice (Barton, 1998; Harding, 2016). In highlighting and advocating for science practice and learning that is guided by a fidelity to persons, we argue that as a field— as learning scientists, as science education researchers, and as teacher educators—we should go beyond a version of epistemic work that focuses exclusively on the quality of ideas and does not attend to the quality of relationships. We acknowledge that a fidelity to knowledge can support epistemic work undergirded by affective, intellectual, and epistemological entanglement, but at what cost? In our current context, the goal and practices for developing caring people is obfuscated by the emphasis on training future members of STEM disciplinary communities. As a field, we have been concerned with getting students to seek mechanisms and to support claims with evidence, often without bothering to attend to *how* students engage in epistemic work. If the status quo remains, we run the risk of continuing to alienate students who do not identify with and/or would want to engage in epistemic practices that neglect the nature of the relationship between learners, making them feel dispensable.

We call the instantiation of an ethic of caring that values fidelity to persons in science knowledge-building contexts *epistemic caring*. By highlighting the ways that sensemaking was organized by a fidelity to persons, our goal is to create awareness among STEM educators about the need to interrogate the axiological commitments that guide their research and learning environments. Ultimately, we hope for a STEM education that is axiologically grounded in epistemic caring. Future research should examine other ways this could play out and explore design innovations that support interactions characterized by epistemic caring. An attention to epistemic caring requires us to think deeply about the moral and ethical messages that we are communicating with each instructional and design decision we make, perhaps even forging new practices and structures for interaction that allow these values to be played out (Bang & Vossoughi, 2016).

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