

Coupling Epistemology and Identity in Explaining Student Interest in Science

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Abstract. In this paper, we present the case of Estevan, an eighth-grader from Honduras whose interest in science lies primarily at the intersection of personal epistemology and identity. Drawing on video data from classroom interactions as well as interviews with Estevan and his teacher, Ms. K, we show how Estevan's passionate engagement in sensemaking about the seasons arose from an alignment between his epistemological stance that science involves *figuring things out for yourself* and his enacted identity as *someone who faces challenges head-on*. We use Estevan's case to highlight the importance of remaining open to the multiplicity of connections that might exist between interest in science and students' identities and to motivate looking deeper into such issues before prescribing how to engage students in science.

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INTRODUCTION

A critical goal in science education is to encourage minority students' continued interest and engagement in science. Previous work has emphasized helping underrepresented students pursue scientific topics that connect to their cultural backgrounds [1] or other aspects of their lived experiences and identities [2-4]. For instance, Calabrese Barton [3] described an after-school program in which the topics explored, such as pollution, emerged from relevant aspects of students' experiences, including frequent discussion of their unsanitary neighborhood. The case we present here suggests that, for some students, the strongest connections to science can be found not through their identifying with a particular topic, but with a particular way of approaching knowledge and learning in science, i.e., a particular personal epistemological stance [5-6].

Other work has emphasized the importance of making epistemological connections to promote minority students' engagement in science by incorporating culturally-relevant ways of thinking and interacting [7-9]. For example, Bang and Medin [7] discussed curricula organized around an epistemological stance that living things are all related; this epistemological orientation is rooted in practices and beliefs of the Indigenous communities for whom the curriculum was being designed. However, we expand beyond a focus on epistemological stances associated with students' community cultures to

consider more individualized connections between aspects of students' identities and their learning in science.

In this paper, we provide a case study of an eighth-grade student from Honduras, Estevan¹, for whom figuring things out in science taps into his love of challenges. In Estevan's case, we argue that his engagement in science largely stems from a connection between a particular personal epistemological stance toward science, namely that science involves *figuring things out for yourself* (as opposed to just taking in information) and his enacted identity [10] as *someone who faces challenges head-on*.

THE SEASONS DISCUSSION

Estevan was selected as an exemplar case² of student persistence in the pursuit of understanding a scientific phenomenon. In particular, Estevan stood out as a student who at times became frustrated when trying to understand content in his science class, but who persisted until he reached an understanding that satisfied him. In a focal episode illustrating this persistence, Estevan's teacher, Ms. K, had instructed students to split into groups and create models of how interactions between the earth and sun result in the

¹ All student and teacher names are pseudonyms.

² The data for this case study consist of several videotaped classes of Ms. K's, as well as videotaped interviews with Ms. K and Estevan.

seasons. During class, Estevan became increasingly frustrated by a diagram in the textbook of how the earth is tilted as it revolves around the sun. Despite being comfortable with how the Northern hemisphere was tilted away from the Sun in the winter and toward the Sun in the summer, Estevan noted that “something was missing.”

According to Ms. K, Estevan was trying to reconcile how the earth could be tilted in the fall and spring when both hemispheres were receiving equal amounts of sun. After struggling for a while, he eventually figured out that “it wasn’t tilting forward or backward [toward or away from the sun], it was tilting from side to side.” This understanding was also reflected in Estevan’s presentation of his model to the class:

Estevan: In June, the North side is actually in summer and, um, the earth is actually tilted toward the sun. The North side is getting a lot of sun. The other, um, part, the South, is not actually close to the sun, which means it’s winter. Um, keep rotating and rotating until we get to, um, September, that means that we are in fall. The earth is not actually tilted toward the sun, it’s actually tilted the other way.

Ms. K: Oh, it’s tilted away from the sun.

Estevan: It’s not actually away from the sun, it’s kind of like not really close to the sun because both, both like North and South, are actually getting the same amount of energy from the sun.

Ms. K: So show me how that would be in relation to the sun.

Estevan: Um, that actually would be like tilted this way ((*tilts blown-up globe sideways*)), like they’re both getting the same amount ((*gestures toward North and South hemispheres*)). It’s not actually tilted that way ((*tilts globe toward ball representing sun*)) or the other way ((*tilts globe away from sun*)).

Thus, by the end of class, Estevan had a detailed and coherent story for how the earth was tilted in relation to the sun during the seasons. However, this understanding was not easy to come by – Estevan struggled for the majority of class to get to this point. We next turn to why Estevan persisted in the way that he did throughout the class – what sustained his interest in figuring out how we have seasons?

UNDERSTANDING ESTEVAN’S PERSISTENCE

An extended interview with Estevan uncovered several important themes related to his interest in the seasons discussion and science more generally, which we discuss below.

For Estevan, Science Involves Figuring Things Out for Yourself

At the very beginning of the interview, Jen³ said that “it was pretty cool to watch the other day, what was going on,” referring to the seasons discussion in Ms. K’s class. In response, Estevan emphasized that part of what he liked about Ms. K’s class was that he was expected to think for himself:

Estevan: I knew something was missing though.

Because the explanation didn’t kind of make sense. Until- you saw she didn’t give me no answer, though. She just stood there and look at me like you gotta make it up, you gotta think about it. I mean, I like that about her, though. I love all that about her because she just made us think about everything. She don’t give us the answer. And that’s what make it fun.

Here, Estevan reiterated his sense from class that “something was missing” because what he was grappling with did not “make sense.” He then described how Ms. K did not give him the answer; rather, she expected him to “think about it,” which he qualified as “fun.” Later in the interview, Estevan associated *figuring things out for yourself* not just with Ms. K, but with science: “She don’t give us no answers, she just, ‘Figure it out for yourself. And then you come to me. Then I’ll correct you if you’re wrong.’ *I like that a lot about science though.*” (Emphasis added.) He later contrasted Ms. K’s class with previous science classes in which the teachers “didn’t let us do what we wanted to do with the science, you know, find out.”

In these and other statements throughout the interview, Estevan demonstrated a personal epistemological stance that *science is something that should make sense, something that you can figure out*. For Estevan, this experience of science was also affectively charged. He found it “fun” when Ms. K would not give him the answer, and he described the moment when “you just found all the pieces, and you put it all together, and you’re actually right” as “the best feeling you can get.” Notice too that his complaint

³ The first author, Jen, was the interviewer.

about former teachers, that they didn't "let us do what we wanted," referred not to a specific science topic but to "find[ing] out," i.e., figuring things out.

We now explore how Estevan's enjoyment of figuring things out in science connects to his more general love of challenges, which he portrayed as critical to his sense of self.

Estevan Identifies as Someone Who Likes to Face Challenges

During the interview, Jen probed why Estevan kept trying to figure out the seasons in class, despite his demonstrated frustration:

Jen: I've been in positions I think where I've been trying to figure something out, and I knew something was missing, and I'm trying to figure something out, and I've gotten so frustrated ((*Estevan laughs*)) that I actually haven't been able to, like, keep going with it? But you kept going with it, so-

Estevan: I mean, yeah, I mean that's something about me, like about me, I like challenges though... I mean, for me, that's, that's the thing that actually most I love. Challenges, I mean, every single day challenge that I can get- that's why I tell you ((*smiles*)), I mean, I, last time we were doing everything, and she was asking me questions, and I challenged her, like, ask some harder questions so I can, you know- I like challenges, that's the thing about me. I mean, I don't quit so easily though. I won't, until I find something.

Jen: Yeah. No, that totally makes sense- so you were actually asking her for harder questions?

Estevan: Yeah, I came, because she like, she told me, give me like a little review or explanation, and then she started asking questions, right? And I'm like, I answer all her questions then I'm like, ((*leans back slightly and cocks head to side*)) you got another question, like harder than that? ((*both laugh*)) She actually gave me a harder one, though, she actually told me why we're closer to the sun. That's when I'm like oh, okay, ((*cocks head to side*)) I'm about to figure this one out too.

The exchange above brings out the sense that tackling challenges is something that defines Estevan's sense of self [10-11]. His repeated references to himself, using phrases like "that's something about me" and "for me," indicate that his love of challenges is something specific about *him*, something that sets him apart. As he talked about challenging Ms. K to ask

him harder questions, and as he recapped their interactions, his physical movement of leaning back slightly in his chair and cocking his head to the side demonstrated a sense of bravado as he asked if Ms. K had another question "harder than that?" Interestingly, in the interview with Ms. K, her body language and intonation were similar as she recalled Estevan coming back for more – "he would say, ((*juts chin up*)) ask me another question." This suggests that Estevan was conveying a challenging stance not only upon recollection in the interview but also in his actual interactions with Ms. K during class. Both in his classroom interactions and in interview recollections (his own and Ms. K's), including episodes we lack space to include here, Estevan comes across as someone whose identity is tied up in facing challenges with perseverance.

Additionally, there is evidence that for Estevan, figuring things out in science *is* a kind of challenge. Note how when Ms. K provided Estevan with a harder question (likely about being closer to the sun in the winter), his response again included a bit of bravado as he stated, "I'm about to figure this one out too" – he took her question as a challenge that he could face head-on. Later in the interview, he explicitly made the link between figuring things out in science and facing challenges:

Estevan: How is just the earth actually standing without no, um, stuff behind it, like, how is that magnetical field created about it, you know? If you actually got some questions and you need an answer, you need to put your challenge to it, get some kind of challenge because, that's for me, though, I get my challenge to find out how does that happen, learn how, why does it do that, how can it do that, what caused to do that?

Here, Estevan identified the kinds of scientific questions he wonders about, which are mostly about "how" or "why" something happens, "what caused" it to happen? He also discussed finding answers to these sorts of questions as one way in which he "get[s] [his] challenge" – again, reiterating "that's for me, though." For Estevan, if you need an answer to a question, "you need to put your challenge to it." Thus, in this passage and throughout the interview, Estevan links figuring things out in science to facing challenges, which he enjoys and at which he persists.

DISCUSSION

In conclusion, we argue that Estevan's interest in science lies primarily at the intersection of personal epistemology and identity. As demonstrated above,

Estevan perceived as *challenges* (1) making sense of the tilt of the earth in the fall and spring and (2) grappling with Ms. K's question about why the sun is closer to us in the winter than in the summer. His enacted identity as someone who faces challenges head-on is coupled, at least in these instances, with his personal epistemological stance that you can figure things out in science.

Based on the data we presented, one might think that Estevan has a particular interest in topics related to the earth and/or the movement of celestial bodies, including how we have seasons, and that this topic-specific interest explains his enjoyment and persistence. However, during the course of the interview, Estevan also raised questions about chemicals, plants, rocks, etc. Additionally, in one of the classroom sessions we videotaped besides the "seasons" episode, Estevan enthusiastically engaged in making sense of a physics question about a girl on a swing. What is common across these various topics, that made them engaging for Estevan, is that they provided him with the challenging opportunity to figure out complex problems.

Our case study adds to the literature on engaging underrepresented students in science, providing another way in which epistemology can serve as a link between interest in science and learners' identity. The personal epistemological link in our study differs from the epistemological links described in previous work, which has focused on tying *culturally-relevant* ways of knowing to students' identities. Here, Estevan's enjoyment of figuring things out in science does not necessarily tie to his cultural background as an immigrant from Honduras. Rather, it ties to another aspect of his identity, his love of challenges.

In terms of implications for the science classroom, we highlight the importance of remaining open to the multiplicity of connections that might exist between interest in science and students' cultural backgrounds or other aspects of their lived experiences and identities. These connections may involve either scientific topics or epistemic practices and may or may not draw upon particular cultural aspects of students' identities. Although we believe that both content and epistemological links are important to consider, we note that the *specificity* of content links might make them less suited to sustaining students' interest in science over time. For instance, imagine that the primary link to Estevan's interest in science was medicinal plants – a topic he used to discuss with his father, who, according to Estevan, has a wealth of knowledge about the topic. Estevan might be invested during a unit on plants, but he might disengage once the topic shifts. However, the epistemological link of figuring things out for himself is something Ms. K tapped into across a wide range of scientific topics.

This might have been particularly effective with Estevan, whose love of science was strongly associated with particular ways of thinking about and doing science.

In brief, we need to look deeper into what connects (or could connect) individuals to science before prescribing how to engage students in science. In some cases, the links might very well pivot on specific content, while in other cases (such as Estevan's) the salient connections might be epistemological in nature. We must be alert for other types of connections, too.

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