Attention to Student Emotions and Teacher Vulnerability as Tools to Maintain Student Disciplinary Engagement

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Abstract

Research on students' engagement suggests that epistemic affect--that is, the feelings and emotions experienced in the epistemic work of making sense of phenomena-- should be recognized as a central component of meaningful disciplinary engagement in science. These feelings and emotions are not tangential by-products, but are essential components of disciplinary engagement. Yet, there is still much to understand about how educators can attend and respond to students' emotions in ways that support disciplinary engagement in science. To inform these efforts, we follow one high school Biology teacher, Amelia, to answer the following question: *How does Amelia attend to and support her students' emotions in ways that support their disciplinary engagement?* Data examined include teacher interviews and classroom recordings of two multi-day science lessons. We found that the teacher worked to support her students' emotions in moments of uncertainty in at least two ways: (1) *by attending to these emotions* directly, and (2) *by sharing her personal experiences and feelings in engaging in similar activities as a science learner*. We describe how Amelia made herself vulnerable to students, describing her own struggles in making sense of phenomena, in turn supporting her students to normalize these experiences as part of doing science.

Subject & Problem

Science Education has transitioned from a portrait of science learning as one driven by the recognition of "facts" to that in which students are to engage in sensemaking about the natural world (NRC, 2012)--learning to "figure things out" (Passmore, 2014). "Figuring things out" requires that students engage with science in ways that echo the work of scientists (Davidson et al., 2020). This emphasis on students' authentic engagement in the discipline entails that students use the big ideas, cross cutting concepts, and practices of science to create evidenced-based explanations that they critique and hone as a classroom community (Berland & Reiser, 2009).

One emerging area of focus, and that at the center of this effort, is the emotional work involved in students' disciplinary engagement. Recent research on students' engagement suggests that epistemic affect--that is, the feelings and emotions experienced in the epistemic work of formulating, critiquing, and communicating ideas and arguments to make sense of phenomena-- should be recognized as a central component of meaningful disciplinary engagement in science (e.g., Davidson et al., 2020; Lanouette, 2022; Radoff, 2017; Radoff et al., 2019). There is a growing recognition that these feelings and emotions are not just tangential by-products, but are essential components of the work of science, something that suggests that students' epistemic affect must be attended to and cultivated if we are to support students' learning in science (Davidson et al., 2020; Radoff et al., 2019).

Evidence of students' affect in learning science is documented in a number of studies centered on students' disciplinary engagement. Much of the extant research focuses on the role of emotions in propelling or enhancing such engagement. For instance, Engle and Conant (2002) describe students as passionate in their debates about Orcas. This notion of passion is described by others (Berland & Hammer, 2012), and has been identified as essential in maintaining students' continued engagement in the face of uncertainties (Zion et al., 2004). Several authors have described how wonder, excitement, and curiosity can act in similar ways (Anderson et al., 2019; Davidson et al., 2021; Gilbert & Byers, 2017).

While much of this work portrays positive emotions, doing science is also imbued with what may be depicted as negative affect, such as feelings of frustration and vexation (Davidson et al., 2021). Hagan and colleagues (2022) describe this wobbliness between emotions in the context of students' wrestling with uncertainty, where students' experience with "epistemic vexations" can ebb and flow in light of uncertainty. When such vexations are prolonged, are out of the reach of students and/or their classroom communities, or are amplified by social and epistemological tensions (Krishnan et al., 2021, 2022), they can lead to feelings of anxiety, distress, or loss of interest, ultimately causing students to disengage. Teachers can play an important role in keeping students engaged as they encounter and navigate epistemic vexations. It is our argument that an essential component of this engagement involves working within their vexation boundaries, by attuning and responding to "students' intellectual and emotional experiences" (Davidson et al., 2021, p.7).

That said, much work remains in terms of understanding how teachers can attend and respond to student emotions in the science classroom in ways that support them to productively navigate epistemic vexation. Our work focuses on how teachers can maintain students' disciplinary engagement by "staying with", normalizing, and validating vexation. We have argued elsewhere that if educators are to support students' disciplinary engagement, they must learn to "listen and validate students' feelings and emotions and to help students come to see that uncertainty is a normal and natural part of disciplinary engagement in science" (Davidson et al., 2021, p. 7). This study, therefore, focuses on one teacher's efforts to attend to and validate her students' emotions

in moments of uncertainty, guided by the following research question: *How does one teacher attend to and support her students' emotions in ways that support their disciplinary engagement?*

Design & Procedures

Using a naturalistic, qualitative design we followed one high school teacher, Amelia, to understand how she managed and responded to students' affective responses to scientific uncertainty. Data for this study come from a larger professional development (PD) project focused on supporting teachers to foster student sensemaking. Here, we focus on Amelia's work in this PD as she implemented two lessons. The lessons, *Characteristics of Viruses* and *Genetics* drawn from Sampson and Schleigh (2013) comprise argumentation activities centered on a launch question ("Should a virus be classified as a living thing?" and "What model of inheritance best explains the inheritance patterns of two specific traits of fruit flies?"). Students either collected or examined already collected data to generate an argument (including a claim evidence and reasoning). Students spent much of their time in small groups to developing their argument and creating a poster for peer review, critique, and argument revisions.

Data sources for this study include classroom audio and video recordings and teacher interviews. All lesson interactions between the teacher and students were analyzed using a constructivist grounded theory approach (Charmaz, 2017). To identify moments when Amelia attended to students' affect the first author examined video and audio recordings of whole group and small group work. She tagged moments when Amelia attended to student vexations. These moments were then examined to determine if Amelia was attending to student affect, another way of engagement, or a particular instructional strategy. Those moments marked as "attending to student affect" were then isolated and further examined, examinations that were brought forward to the larger author group to be discussed and analyzed. This analysis resulted in identification of themes that occurred across lesson, as described next.

Findings & Analysis

Amelia worked to support her students' emotions in moments of uncertainty in at least two ways: (1) *by attending to these emotions* directly, and (2) *by sharing her personal experiences and feelings in engaging in similar science activities as a science learner*. While attending to student emotion was an explicit focus throughout the *Viruses* lesson, a lesson that occurred at the start of the year, such attention became more targeted in the *Genetics* lesson around moments when students struggled to negotiate knowledge claims with their peer group. We also found that while Amelia shared personal experiences and feelings in science in both lessons, she tended to do so more often in the *Genetics* lesson. We describe these attentions and sharings below.

Attending to Student Emotions

During the *Viruses* lesson, Amelia attended to the social nature of argumentation acknowledging that the social negotiation of ideas can be frustrating and difficult. Amelia highlights that group work can be chaotic especially when multiple people are involved in exploring ideas. She suggests that this is chaotic because there are "more hands in the pot" or "many people in the kitchen". She explained that while large groups can be frustrating and that one person might try to "take over", they do provide a wider range of perspectives.

In response, Amelia attends to group work norms. She describes norms as a way to provide space for all ideas, to create a safe environment, and to support others to overcome their frustrations. She suggests that these norms include encouraging all group members, giving others space to share, respecting what others have to say, and creating a safe time. She explains that her classroom norms include giving "everyone a chance to speak, think time, and listening to what

they have to say". She suggests that group members ask each other clarifying questions such as "Did you mean to say…?". She encourages students to consider looking at "it" from the perspective of others.

In addition to attending to the emotions that occur during the social negotiation of knowledge, Amelia foregrounds students' existing knowledge and experiences as ways to overcome frustration by drawing upon the everyday knowledge they already have that can help them make sense of the phenomenon under consideration, she asks about students' feelings related to changes in their thinking as they develop and negotiate their claims, and she attends to emotions related to peer critique. These strategies were employed less often than those directly addressing the social norms of group negotiations (See Table 1 for exemplars).

Table 1. Attending to Student Emotions Exemplars

Foregrounding students' existing knowledge and experiences - Amelia suggests to one group that they use their prior observations when they are having difficulty finding evidence to classify a fern as a plant or an animal. The group is unsure because they have read that ferns can asexually reproduce, and they think that this might make the fern an animal. The group tells Amelia "We are genuinely stressed out… We don't have good evidence yet." Amelia responds by pointing to her own observations of identifying plants at a garden center and then tells students "we can't forget our god given right of observation" to help them draw upon their prior experiences with ferns as plants.
Asking about feelings related to changes in thinking - Amelia asks students about their feelings related to changes in their ideas after examining different data sets in the first and second day of the lesson. She asks students "Did your thinking change?" followed by "Do you feel more comfortable?" and "How did it make you feel about your depth of thinking?"
Attending to emotions related to peer critique comments - Amelia attends to student emotions around "Grows and Glows" to acknowledge that these comments should be "accepted positively" and to not "take it personally". She says, "Don't take it all offended." She mimics students saying, "I can't believe they wrote that." Instead, she suggests that students accept comments in ways that help them to "support your claim." She asks students "What do you feel after reading some of the Grows and Glows? How does this modify your thinking?"

Amelia's Sharings of Personal Experiences and Feelings

In the *Genetics* lesson, Amelia does not directly attend to students' emotions, such as asking how they were feeling, as she did in the *Viruses* lesson. Instead, she attends to students' emotions (frustrations or possible frustrations that might arise) by aligning her own experiences with those that the students might have or were having. She does this in two ways. First, she *shares her own difficulties and feelings of being overwhelmed when she worked prepared the lesson*. Second, she *shares the experiences that she had working on the task with her own peer group during the PD*.

When Amelia shares the experiences that she had with the task directly prior to the lab, she tells students about her own frustrations and confusion. She shares these experiences as students began working through a shared example of generating and collecting data at the start of the task. She describes that the amount of data generated is "chaos" because there is "a lot of information that comes up at one time". She tells students "You need to make sure you have thing documented before you lose your way because when I was going through it there really isn't a reset button." She describes, "I don't want you to go through what I experienced." In another example, she explains that she "got lost" when she was running multiple trait crosses. She acknowledges that they, the students, might not have similar experiences because "you are smarter than me". However, she acknowledges the complexity of the task saying, "When I did it,

it was so complex....” She describes that “her brain could not handle that [crossing multiple traits at once] so I said, ‘if I can’t handle that some of my students won’t be able to. So, we’re going to do them [traits] separate and then together [multiple traits] to see if we get the same results.”. She further says, “We’re going to leave that chaos until we are comfortable.”

When Amelia shares her experiences from the summer PD, when she and a group of teachers worked through the same lab, she shared that they had similar difficulties and questions to those that students were experiencing. Amelia shares these experiences as students were engaging in the activity itself. For instance, in one group students were struggling with the trait crosses they were exploring. They wondered if the crosses were random. Amelia tells students “Your assigned traits are completely random.” She shares, “My group, the three of us this summer, did that [struggled with and questioned the traits they were given].” She tells the students, “I’m not tricking you. They were completely random.” In another example, she describes that she struggled with the lesson during the summer PD and felt insecure when other teachers in her group more easily interacted with the materials. She says she felt “stupid” but that her group members worked with her to help press and support her understanding.

In these interactions, Amelia aligns herself as a peer sharing in a common experience. She made herself vulnerable to students and validated the struggles and challenges that students were experiencing through these vulnerabilities. When Amelia shared her experiences with students at the start of the lab, she appears to be making herself vulnerable (e.g., “I got lost” an “my brain could not handle it”) to prepare students for the struggles and difficulties that they may experience as they engage in the epistemic work of making sense of complex, “chaotic” data.

In conclusion, encounters with uncertainty inherent in science can be uncomfortable, invoking emotions such as anxiety, frustration, and fear (Anderson et al., 2019) and students can experience similar emotions (Ayalon et al., 2022), which may hinder or halt that engagement. Here, we observed Amelia’s work to help students navigate these emotions to support their disciplinary engagement. First, she attended to the emotions involved in the, sometimes, “chaotic”, “frustrating”, and “complex” space of socially knowledge construction, a space where students must struggle with their vexations and try to make sense of these ideas with their peers. Amelia attempts keep students within productive vexation boundaries by acknowledging the difficulties of engaging in shared knowledge generation and by pressing students to attend to the norms which open up this space for multiple and competing claims to be considered. She describes these spaces as “safe” where multiple ideas are examined opening up the opportunity to learn from multiple perspectives. In addition, she positions students to navigate their vexations by asking that they trust in their own ideas by drawing upon their existing experiences to overcome frustrations, by attending to the discomforts that might exist when their ideas change, and by helping to use peer critiques to push their thinking in productive ways. Second, Amelia attempts to align her personal experiences with those that the students were experiencing. In doing so, she makes herself vulnerable in ways that may validate their own feelings and prepare them for the challenging epistemic work they will engage in.

Contributions & General Interest

Our study provides insight into the work of responding to and cultivating students’ epistemic affect in science to support their disciplinary engagement. We describe how one teacher managed students’ emotions in moments of uncertainty in ways that allowed students to maintain their inquiry. While more research is needed to document and understand how teachers can best attend to and support the emotional work of students' learning science, our analysis contributes empirical insights to the growing body of literature that explores this area of science teaching.

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