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"That's Just Gonna Make Them Upset": Youth Authoring Emerging Epistemic Ideals Through Rightful Presence

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ABSTRACT

There is a growing body of scholarship in science education that attends to the role of affect as shaping youths' negotiation of and experiences with disciplinary science practices. As part of the special issue Centering Affect and Emotion Toward Justice and Dignity in Science Education, in this paper we examine how power and affect shape epistemic negotiations as youth and adults designed a community survey during a 7th grade biology unit on stress. We used interaction analysis methods to examine how care for the survey takers co-operatively emerged as an epistemic ideal when creating a community ethnography. The epistemic ideal was shaped by disrupting disciplinary practices, negotiating multidirectional powered adult-youth relations in the classroom, and youths' positionings in relation with macro-sociopolitical worlds. How youth characterized care was not neutral but involved youth experiencing politicized empathy towards survey takers coupled with them taking action against survey takers potentially experiencing harm through a tool of Eurocentric science (i.e., the survey). Overall, this work contributes to a critically nuanced understanding of how affect is entangled with and visible through the complex powered dynamics that youth and adults negotiate when engaging in sociopolitical allyship towards more just ways of knowing, examined through the emergence of epistemic ideals within an explicitly justice-oriented middle school science curriculum.

1 | Introduction

A growing body of scholarship in science education attends to the importance of epistemic education in youths' understanding of knowledge creation in classroom settings. For example, Barzilai and Chinn (2018) argue that students should engage in negotiating the epistemic aims, ideals (standards), and reliable process of science, whereby epistemic aspects of knowledge creation are woven into their science learning activities. These social processes of deciding what knowledge is worth pursuing and how to pursue it, that is, what is elevated as legitimized knowledge and methods (and who gets to decide) are not neutral. Inequitable powered dynamics (i.e., racism, colonialism, white supremacy, sexism etc.) have historically structured Eurocentric epistemologies into the backbone of school systems and science standards at the expense of recognizing and elevating minoritized communities' ways of knowing (Bang et al. 2012; Morales-Doyle 2019; Pierson et al. 2022; Tan, Calabrese Barton, and Benavides 2019). Therefore, working towards equity in school science by disrupting the hegemony of Eurocentric ways of knowing requires both making visible the ways in which sociopolitical and sociocultural systems of oppression shape the processes of knowledge creation, and explicitly valuing youths' ways of knowing and being in school science. One way to accomplish this is through the design and enactment of justice-oriented curricula (Tan, Calabrese Barton, and Benavides 2019).

In this study, we investigated the ways power and positionality shaped epistemic negotiations as youth and adults designed a

community survey during a 7th grade biology unit on stress. Our analysis of classroom interactions focused on how affect was entangled in meaning-making (Jaber and Hammer 2016a) around epistemic considerations as youth and adults negotiated multidirectional powered dynamics in the classroom space. We asked: *How does affect and power shape epistemic negotiations when developing a community survey in the context of a justice-oriented curricular unit?* Through interaction analysis (Jordan and Henderson 1995) of two lessons in which adults (teachers and researchers) and youth (7th grade students) were constructing a community survey to identify community stressors, we traced how affect and power shaped the ways that different participants enacted their Rightful Presence in their epistemic engagement (Calabrese Barton and Tan 2019). Our analysis reveals how youth and adults decided on *care for survey takers* as an epistemic ideal, which guided what questions they asked on the survey. How youth characterized care was not neutral but involved youths' politicized empathy towards survey takers and acting to prevent them being harmed through a tool of Eurocentric science (i.e., the survey). This work contributes to a critically nuanced understanding of how affect is entangled with and visible through the complex powered dynamics that youth and adults negotiate when engaging in sociopolitical allyship towards more just ways of knowing.

2 | Theoretical Framing and Review of the Literature

2.1 | Equity as an Epistemic Issue

The U.S. science standards policy document The *Next Generation Science Standards* (NGSS) defines science as a "set of practices and the historical accumulation of knowledge" that form a foundation for youth to develop a "way of explaining the natural world" (National Research Council 2013). The ways of knowing and being that are privileged in this framing reflect Eurocentric ontologies and epistemologies, sedimented into U.S. schools and the national standards through a history of settler colonialism (Bang et al. 2012; Bang and Marin 2015; Morales-Doyle 2019; Takeuchi and Marin 2022). Assumptions regarding the position of humans outside of, rather than within ecological systems (Cajete 2000; Kimmerer 2013) and notions of neutrality and objectivity in science are reflected in the sanctioned forms of evidence and disciplinary practices (Haraway 1988; Keller 1992). Being successful in school science, therefore, requires students assimilating into a Eurocentric ontological worldview that privileges Eurocentric epistemologies and methodologies.

Consequently, our understanding of equity necessitates grappling with issues of epistemology, namely, "whose knowledge counts? Why? How?" (Tan, Calabrese Barton, and Benavides 2019, p. 3) and towards what ends (Vossoughi and Vakil 2018)? Learning environments are also not neutral; rather they are shaped by race, class, sexuality, gender and more (Philip and Azevedo 2017). Therefore, we need to examine the social processes of knowledge creation that shape the ways of knowing and being legitimated in learning spaces, and the consequences of such for minoritized youths' science learning. Equity in education is thus concerned with both *what types of knowledge* matter towards knowledge co-creation and *how* those social processes unfold in the classroom. We see an equity-oriented approach to knowledge creation as explicitly pushing against settled Eurocentric epistemologies embedded in science teaching and learning to expand what counts as meaningful and productive epistemic engagement in science (Tan, Calabrese Barton, and Benavides 2019).

We draw on the Aims, Ideals, and Reliable processes (AIR) framework for epistemic cognition (Chinn, Rinehart, and Buckland, and Samarapungavan 2011, 2014) to characterize the nature of students' epistemic reasoning. We draw on Jaber and Hammer (2016a) to discuss how epistemic affect—feelings like frustration or empathy that emerge during epistemic negotiations—are entangled with students' engagement in science and epistemic practices. Through the Rightful Presence (RP; Calabrese Barton and Tan 2020) framework, we attend to how power and positionality shape the social processes of epistemic engagement in knowledge creation. Together, these frameworks provided complementary lenses for us to attend to the affective dimensions of youth and adults' engagement with the practice of developing a survey and in particular, negotiating the epistemic aims, ideals, and reliable processes that mattered to the community of learners. Such negotiations involved multi-directional powered dynamics and revealed care for survey takers as a politicized emotion and action (Chen 2023; Gunckel and Tolbert 2018; McKinney de Royston et al. 2017) to disrupt Eurocentric epistemologies in favor of epistemic heterogeneity in the science classroom space.

2.2 | Epistemic Education in Science Classrooms

2.2.1 | The Role of Epistemic Aims, Ideals and Reliable Processes (Air)

Barzilai and Chinn (2018) argue that epistemic education entails a "deliberate effort to promote learners' epistemic growth"—and should be an explicit objective in science teaching (p. 354). They draw on the AIR model of epistemic cognition (Chinn, Rinehart, and Buckland, and Samarapungavan 2011, 2014) and advocate that students' epistemic reasoning should focus on three epistemic components- **A**ims, **I**deals, and **R**eliable Processes (AIR). According to the AIR model: a) epistemic aims and values relate to the kinds of epistemic products (e.g., explanations, models, arguments) that a community would like to attain and the value that the community places on such; b) epistemic ideals are the criteria, or standards, by which the epistemic products are evaluated to determine if the aims have been met (e.g., fit with evidence, parsimony); and c) reliable epistemic processes are the various methods and processes by which individuals or a community achieve the desired epistemic aim (e.g., surveys, experimental designs etc.). In the case of our classroom community of 7th graders, their teachers and researchers, we: a) established that the epistemic aim for the unit was obtaining knowledge regarding what causes stress in our community; b) negotiated shared epistemic ideals (criteria) by which we determine whether the aims have been achieved (e.g., identifying a comprehensive list of

stressors); c) developed reliable processes—methodological approaches and tools—for attaining the aims (e.g., deciding what and how to ask questions for a community survey about stressors).

Much of the work to date on analyzing and promoting epistemic engagement in science classrooms has focused on scientific practices such as modeling, evidence evaluation, and argumentation (Duncan, Tate, and Chinn 2014; Berland et al. 2016; Ke and Schwarz 2021; Kelly and Takao 2002; Krist 2020; List 2023; Murphy et al. 2021; Pluta, Chinn, and Duncan 2011; Ryu and Sandoval 2012; Sandoval 2003). In this scholarship, the epistemic aims, ideals, and reliable processes legitimated and accomplished by youth were often aligned with Eurocentric disciplinary norms and ways of knowing, and the expectations of the NGSS (e.g., Duncan, Chinn, and Barzilai 2018; Berland et al. 2016; Krist 2020; Ryu and Sandoval 2012). The AIR framework for epistemic cognition does not inherently privilege particular ways of knowing. However, the kinds of aims, ideals, and reliable processes that are often encouraged and supported in science curricula and science education research have often privileged Eurocentric epistemologies, sometimes at the expense of supporting epistemic heterogeneity that legitimates youths' cultural and community epistemologies (Pierson et al. 2022). Furthermore, while the aims, ideals, and reliable processes that undergird cultural and community-based epistemologies may not be at odds with Eurocentric science, the structures that shape U.S. public school learning spaces (e.g., the standards, teacher-student relationalities, etc.) are largely designed to marginalize non-dominant communities' ways of knowing and their epistemological premises (Morales-Doyle 2019).

Pierson, Brady and Lee (2023) argue that promoting epistemic heterogeneity to desettle Eurocentric epistemologies in science classrooms requires taking learners' epistemic commitments—defined as dynamic and shifting values that motivate and inform students' epistemic negotiations—as a starting point for engaging in scientific practices. They illustrate the important role that affect, defined by them as students' feelings of care for different aspects of modeling, shapes youths' engagement in science practices in different learning configurations and over time. Our work builds on this research by attending to the role that affect and multidirectional powered relations played, when adults and youth negotiated developing the epistemic ideal—care for the survey takers—while crafting questions for the community survey.

2.2.2 | The Role of Epistemic Affect

Scientific inquiry is not a neutral practice, with affect shaping the directions and actions learners take in their inquiry, and informing how their engagement is stabilized across science learning experiences (Jaber and Hammer 2016b; Lanouette 2022; Zembylas 2016). As Jaber and Hammer (2016b) indicate, "epistemic affect" refers to feelings such as frustration and joy involved in the doing of science and is an integral aspect of science social processes, specifically those that concern engaging in epistemic activities (i.e., concerning knowledge creation and critique). From this purview, youths' feelings are inseparable from their engagement in knowledge creation both in the moment and across time (Davidson, Jaber, and Southerland 2020; Jaber and Hammer 2016a, 2016b). For example, Lanouette (2022) illustrated how youths' love for certain parts of the schoolyard was informed by their past experiences and shaped their choice of sampling site along with what and how they observed both in the moment and across the unit. This study showed how epistemic affect and science practice are entangled (i.e., choice of reliable epistemic processes for sampling and observing) and shaped by sociocultural and historical relations. Similarly, in their study of 6th grade students' inquiry with a physical biosphere model, Pierson, Brady and Lee (2023) describe how learners' feelings of care for the fish and plants played an important role in shaping classroom-wide investigations. Across these studies, youth engaged in science practices similar to scientists who may have a "gut feeling" that informs their use of a particular reliable process, or those who express deep connection with the object of study (feeling for the organism) that informs the aims and ideals involved in their work (Keller 1992).

In conceptualizing affect as an integral part of scientists' and students' inquiry practices and epistemic negotiations, we draw on a critical feminist lens (Ahmed 2014) to emphasize the sociopolitical nature of affect in meaning-making interactions. We consider affect as encompassing feeling—to experience a felt intensity (Pierson, Brady, and Lee 2023). We see emotions as interpretations of feelings, sociocultural and situated, shaped sociohistorically (Boler 1999; Davidson, Jaber, and Southerland 2020; Lanouette 2022). Explicitly recognizing emotions as non-neutral and shaped by histories and ideologies from larger social worlds reveals how power structures the ways in which people are in relation with the world (Ahmed 2014). For example, a feeling of anxiety while taking a test can be interpreted as an emotion of despair if there is a history of failure due to biased questions on prior tests; or it can be interpreted as excitement if there is a sense of a surmountable challenge and past successes. Emotions are political expressions of how people are in contact with the classroom world and beyond (Curnow et al. 2021). We consider epistemic affect as shaping within science practices (Jaber and Hammer 2016b) and attend to the sociopolitical powered dynamics embroiled in the affective dimensions of youths' epistemic negotiations.

Recognizing epistemic affect as sociopolitical does not inherently address the powered differentials that shape *whose* experiences, values, and emotions are legitimated as productive in learning spaces. As Tan, Calabrese Barton and Benavides (2019) argue, "who one is, who one is considered to be, whether and how one has authority to decide, directly influences the pieces of knowledge that get distilled as significant" (p. 4). Therefore, *who* decides the aims and ideals, and what counts as reliable processes in knowledge creation is not neutral but a consequence of existing powered social and epistemic hierarchies and processes. By focusing on these social processes, we examine the powered dynamics that shape how and when forms of epistemic affect emerged and were entangled with the development of legitimized epistemic aims, ideals, and reliable processes. We argue that a better understanding of epistemic engagement in classrooms hinges on analyses that illuminate the role of affect and the dynamics of power and privilege,

without which we limit the possibilities for equitable epistemic education. To do so, we draw on the RP framework (Calabrese Barton and Tan 2020) to guide both our design of equitable learning environments and our critical analyses of knowledge creation in these environments.

2.3 | Rightful Presence: Beyond Equity as Epistemic Inclusion

2.3.1 | Tenets of the Rightful Presence Framework

The RP framework (Calabrese Barton and Tan 2020) frames equity as beyond inclusion and explicitly focuses on disrupting the sociocultural and political powered dynamics that shape how participants engage in knowledge creation (i.e., who is recognized as a knower), what epistemologies are privileged within learning spaces and towards what ends (Tan, Calabrese Barton, and Benavides 2019). Schools and classrooms are deeply politicized spaces where teachers and adults (re)produce historically entrenched powered dynamics through their role as "hosts" extending rights to "guests" (students): deciding who is allowed into the space, how the "guests" (i.e., the youth) must participate/behave, and what kinds of knowledge are legitimized in those spaces (Calabrese Barton and Tan 2020).

Working towards youths' RP in learning spaces involves adults working as sociopolitical allies who cede power to youth to re-author the "rules of the game" (Calabrese Barton and Tan 2019). This entails: a) recognizing learning as a political struggle where teachers work as allies with youth in reauthoring and transforming what it means to participate in science; b) making visible the intersectional axes of sociocultural and political injustices that youth experience while amplifying the possibilities for new transformative futures; and c) a collective disruption of guest/host relationalities whereby powered hierarchies are challenged through disrupting what it means to know and do science in schools (Calabrese Barton and Tan 2020). Across these three tenets is an understanding that issues of equity that emerge in learning spaces are at once sociopolitical, multi-scalar (at the micro-interactional, group-classroom, and macro-community/national/global scales), and deeply entangled with epistemology (Tan, Calabrese Barton, and Benavides 2019). The RP framework provides a critically informed theoretical lens for supporting more equitable ways to engage youth in epistemic education.

2.3.2 | Rightful Presence: Making Present Practices to Support Epistemic Heterogeneity

Key to enacting the RP tenets is the design of curricula that "make present" the many systemic oppressions that are manifest in classrooms through local science teaching and learning practices (Calabrese Barton and Tan 2019). "Making present practices" are designed into curricula to make explicit and intentionally engage with how historically sedimented sociopolitical powered dynamics emerge in and shape local classroom practices (Calabrese Barton and Tan 2019). Some examples of making present practices include youth and adults collaborating on the design and analysis of a community ethnography to learn about and take action against injustices structured in their school community. Calabrese Barton and Tan (2019) describe how the engineering curricula they developed incorporated epistemic toolsets to make present youths' ways of knowing and being in the world that are often missing in schools as a result of systemic injustices. The overall curriculum focused on how to "make my classroom more sustainable." Here, sustainable indicated a space where youth could bring their whole selves into the learning and fully participate in it. In the unit, youth and adults pursued epistemic aims of identifying and characterizing community experiences of injustices so that the final unit project involved finding solutions to the sustainability problems identified (Tan, Calabrese Barton, and Benavides 2019). Epistemic toolsets in the curriculum, such as a community ethnography through which youth surfaced and learned about local injustices, made present youths' voices and centered their concerns (Calabrese Barton and Tan 2019). Through the unit, youth and adults negotiated multiple epistemologies (e.g., student community-based epistemology, Eurocentric science and engineering epistemology) to: 1) make explicit connections between macro-sociopolitical structures of oppression (racial discrimination) and their local experiences of those injustices (race-based bullying) and 2) scaffold the transformation of their classrooms into less violent and more sustainable spaces[1] (Tan, Calabrese Barton, and Benavides 2019, p. 30).

Enacting RP during epistemic negotiations requires that teachers and youth confront their powered positionalities to address the sociopolitical issues that were made visible when community and youths' epistemologies were elevated in the classroom space (Tan and Calabrese Barton 2017). We see RP as providing a critical theoretical and analytical lens in informing our design of a learning environment that aspired to disrupt the powered hierarchies that often shape how epistemic ideals and reliable processes emerge in classroom spaces and privilege a Eurocentric epistemology. As such, the curriculum that youth engaged with in this study (described next) was grounded in both the RP and AIR framework.

3 | Study Context

This work is part of a larger grant-funded project to develop a middle-school science unit through critical participatory design research methods (Bang and Vossoughi 2016) in collaboration with youth and teachers from the local district in a sanctuary city in the NE-US. After a year of collaborating online, the design team of middle-school youth, teachers, and university researchers developed a 7th grade science unit on stress in our community (Duncan et al. 2023). The unit investigated stress as a non-neutral biological phenomenon affecting multiple body systems, shaped through various systems of oppression (racism, classism, sexism etc.); it included 6 lesson sets and lasted 8-weeks (80-min science classes). The unit was piloted in Spring 2022, in one 7th grade science classroom at Oak elementary school with 19 students. The design team of 7th grade youth were selected by the teachers on the team and were from the same school district as Oak elementary (but not the same school). Oak elementary is in a medium sized district with multiple K-8 schools that serves a predominantly immigrant population where 90% of the students identify as Hispanic[2] and most families (77%) are eligible for free and reduced lunch. Most of the students in the classroom did not verbally communicate their identity as non-cisgender, with one youth identifying as a transgender person

(the youth did not consent to be part of the study, so we have excluded analysis of that relational positioning in the paper). Youth self-selected to be part of the study and chose their own pseudonyms.

Grounded in the RP framework (Calabrese Barton and Tan 2019) the unit engaged students in: a) learning about the biology of short term and long term (chronic) stress; b) identifying stressors in their community through community ethnography practices to design for valuing the youths' community's ways of understanding stress; c) linking local stressors to broader sociopolitical policies and structures (e.g., racist immigration policies, housing segregation, and educational inequities); d) linking local stressors to inequitable policies and structures in their school and district; and e) developing "proposals for change" targeted at unfair policies and structures, such as a new dress code policy to replace the uniform and a new universal bathroom policy to promote equitable and consistent policies. The unit toggled between youths' individual embodied experiences (e.g., mapping how stress feels in our bodies) and local and national sociopolitical contexts (e.g., health disparities caused by the stress of racism in the town and nationally). The unit attended to youths' RP by making sociopolitical and sociocultural injustices that they experience everyday explicitly visible and consequential for science learning. The proposals for change were the culminating design outcome of the unit that entangled biological processes with local and macro-historical and sociopolitical structural inequities. Changing unfair policies and practices in the school required adults work with youth as sociopolitical allies towards transforming the reproduction of inequity in their schools.

In this article we present our analyses of episodes that occurred 2 weeks into the unit, when youth were tasked with creating a community survey to collect data on "what causes stress in the community." Over 2 days, Rishi and Ravit co-facilitated the class's creation of a pilot survey through a combination of small and whole-class group work. The initial survey was piloted with other 7th graders in the school, revised by the class, and sent out to middle and high school students and teachers in the district. Episodes analyzed include the pilot survey creation (episode 1) and revision (episode 2) lessons. Before the pilot survey creation episode, the adults told the youth they would create a survey to find out what causes stress for people in their community. The youth then worked in groups to propose questions for the survey. The whole-class engaged in a discussion on each groups' suggestions to decide whether they would ask the question on the survey or not. The adults did not explicitly tell youth they were to develop reliable processes for achieving the epistemic aim, but did encourage the youth to consider whether each question would "help us learn about stress in the community." Therefore, in each episode, youth and adult facilitators engaged in group discussions to decide what and how to ask questions in their survey. At the time of this study, the lead (science) teacher—a cis-female immigrant from a Middle Eastern country—had taught the youth for half a year in-person. The support teacher—a Black and African American cis-female—began working at the school a week before the unit enactment. In addition, two university researchers—Rishi a genderqueer (they/them) South Indian Canadian immigrant, and Ravit a white cis-female Israeli immigrant and naturalized US citizen—helped facilitate discussions.

4 | Methods

Data for this study includes field notes, PowerPoint slides, and audio and video recordings of whole-class and small-group discussions. Youth recorded as part of small-group discussion (Batman, Ren, Bella, Travisloot, Darlenis, Micky, Juan White Wall, Rose, MBC1B) were focal youth for the larger study. We analyzed episodes that involved meaning-making around the creation (episode 1) and revision (episode 2) of the survey. We used interaction analysis methods (Jordan and Henderson 1995) to trace the emergence of care as an epistemic ideal when deciding reliable processes for learning about stress in the community. We identified hot-spots (Jordan and Henderson 1995) as moments when epistemic affect became entangled with and sustained through epistemic negotiations. These were identified when reviewing the data as moments when youths' expressed feelings of resistance (Travisloot in episode 1) or excitement (class chatter in episode 2) were sustained through the interaction. We then traced how meaning-making around care for survey takers' feelings was co-operatively constructed (Goodwin 2017) through youths' and adults' body positioning and utterances in the whole-class space and youths' small-group interactions across the lessons. Care as an epistemic ideal and construct was not chosen a priori but emerged as important when we paid attention to the moments when affect shaped epistemic negotiations.

Co-operative action refers to the co-operative construction of something (in this case an epistemic ideal) through joint-activity that involves humans "performing specific operations" such as "decomposition and reuse with transformation—on materials provided by another" (Goodwin 2017, p. 6). We identified how youth and adults took up substrates—the "local public configuration of action that is operated on to build the next action" (Goodwin 2013, p. 11), and transformed them towards the co-operative construction of care as an epistemic ideal. Tracing the take up, transformation and re-use of substrates aided in following how participants built on each other's utterances during epistemic negotiations. This identified what kinds of and whose epistemic questions were elevated (or not) to whole-group spaces, revealing the powered dynamics that shaped which epistemologies were legitimized in the classroom.

Analyzing the co-operative production of participants' speaker roles and actions helped trace how participants were aligned (or not) with each other (Goodwin 2007). This revealed how adults and youth negotiated powered dynamics through meaning-making as a joint-activity. For example, this study occurred in a conventionally structured public-school classroom where the adult facilitators occupied the front of the class, and the youth were seated at their desks (Figure 2). We noted moments when participants shifted their talk and action against this structure as an expression of affect as sociopolitical emotion, or resistance (Boler 1999). These shifts in the participation framework were indicative of disruptions to the settled powered dynamics that shape classroom spaces and made visible how affect was entangled with epistemic negotiations (e.g., when youth loudly disagreed with adults—Travisloot episode

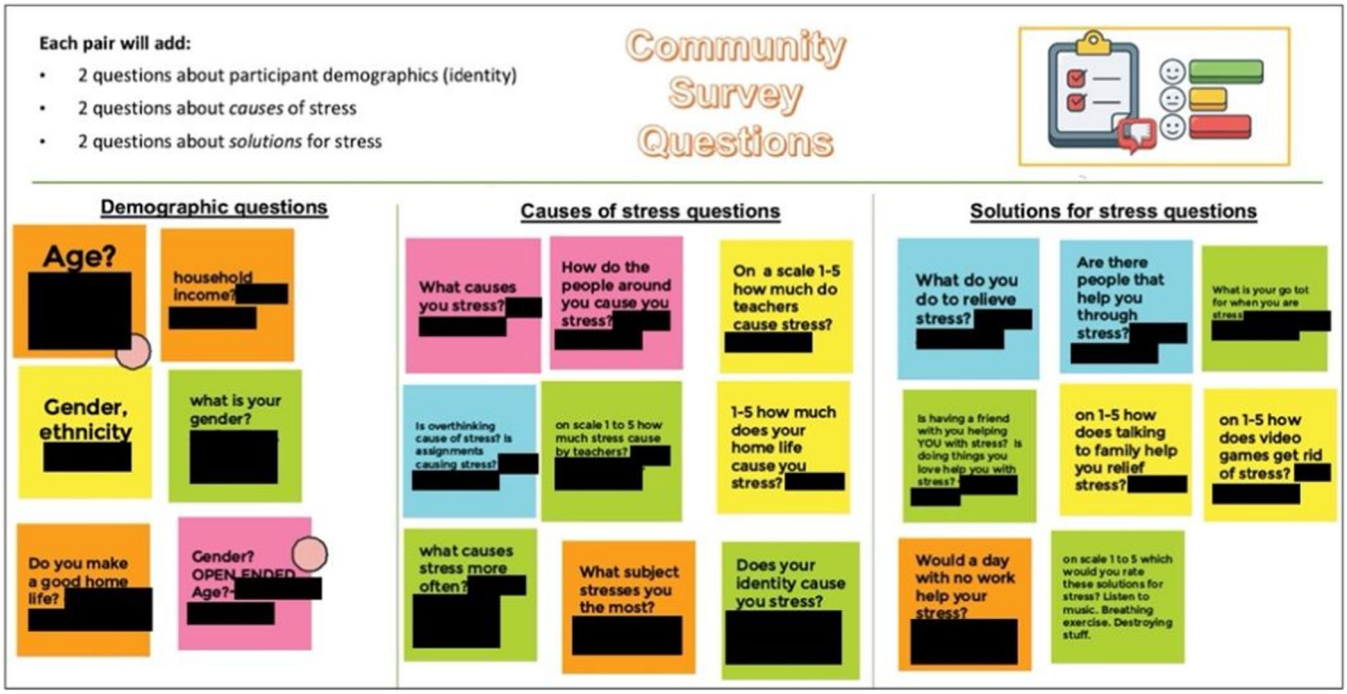

FIGURE 1 | Slide displayed in front of the class with each group's proposed questions.

1—or adults hesitated by moving their bodies and gaze away from the youth—line 54).

5 | Data Analysis and Findings

5.1 | Episode 1: "That's Just Gonna Make Them Upset": Care for Survey Takers as an Epistemic Ideal

We present our analyses of two episodes that occurred when the class was developing the survey, as part of the community ethnography tools used, to determine what causes stress to members of their community. Episode 1 occurred during the initial development of the pilot survey and focused on a question about income. Episode 2 focused on a question about survey takers' gender and occurred during the pilot survey questions revisions lesson (before it was sent out to the entire district). Taken together the episodes illustrate how: a) meaning making and epistemic negotiations were shaped by epistemic affect, b) extractive (Eurocentric) data collection practices were desettled by youth and adults disrupting teacher-student powered differentials, c) epistemic affect materialized as politicized care (McKinney de Royston et al. 2017) that informed the emergent epistemic ideal of care for survey takers, and d) multidirectional powered dynamics and positionalities in the classroom and macro-sociopolitical worlds shaped forms of allied political struggle and Rightful Presence in the space.

The first episode began when Ravit oriented the class to a proposed question about survey takers' income (See Figure 1). In this episode, adults and youth discussed whether to ask about income on the survey. We use it to illustrate how youth and adults' feelings of discomfort with asking about income emerged as politicized emotions that informed the development of care as an epistemic ideal. This prompted action through a refusal to ask the question on the survey.

Transcripts follow Jeffersonian notation (Jefferson 1984). Briefly, capitalized words indicate emphasis in speech, [] indicate overlapping talk, actions and changes in pitch are noted in (()).

[1] Ravit: Ummm there was also a question about income. Do we wanna be asking about income. Do. We. Do we know what income means [everybody]
[2] Travisloot: [Money]
[3] Rishi: Yeah
[4] Ravit: Right. How much money [you got.] income-
[5] Travisloot: [paycheck]
[6] Ravit: Do we want to ask about that?
[7] Travisloot: [NOO] ((high pitched))
[8] Juan White Wall: [Yes]
[9] Ravit: Remember we will be asking middle schoolers and high schoolers and teachers.

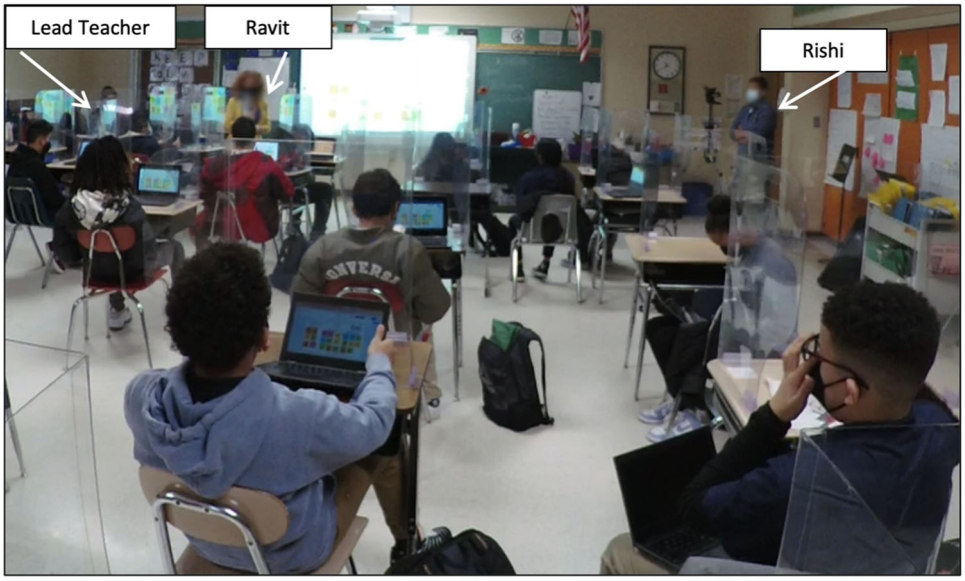

FIGURE 2 | Rishi, Ravit, and the lead science teacher positioned at the front of the class with youth seated at their individual desks. Each desk had plexiglass attached to it.

Ravit facilitated the discussion with an invitation for youth to contribute to epistemic negotiations—here, what information is necessary to better understand stress in the community (i.e. survey takers' income) and *how* to best collect that information. This is visible when Ravit's question [1] initially positioned the youth as tasked with deciding whether they "wanted" to ask about income, but then shifted to authoring a clarifying question first: did they know what income meant? Embedded in this approach to eliciting youths' input was also an invitation for youths' rightful participation in the survey design, visible here through Ravit's body movement away from the board and towards the youth (Figure 2), and through both adults' subsequent encouragement of youth to share their perspectives. In these initial meaning-making interactions around the word "income," Ravit's utterance "right" [4] took up Travisloot's substrate "money" [2] as aligned with her expectations. The initial question was then re-animated [6] and discussed. Did they want to ask survey takers: 1) what their income was, and 2) how to ask the question.

Within the curricular framing of the survey as a tool to "find out" what causes stress in the community (epistemic aim), Ravit's question [6] served as an invitation for the youth to consider whether asking about income would be a reliable process for achieving this epistemic aim. That is, Ravit invited youth to engage in an epistemic negotiation—considering what knowledge about survey takers (i.e. their income) should count as part of a reliable process to learn about community stressors. Immediately, there was a vocalized difference of opinion [7, 8]. Travisloot's increased [7] pitch indicated strong disagreement and a counter-positioning relative to other youth who agreed [8]. Ravit's utterance acknowledged this disagreement by urging youth to consider *who* the survey takers would be and reanimated the three groups the class had decided to survey [9]. In these moments, both the aims and processes associated with "learning what causes stress" were shaped through Ravit's powered enactment of a reminder—that the youth ought to consider the survey takers' age grouping.

[10] Travisloot: No that is weird cause then middle schoolers can't answer that it's not like (inaudible))
[11] Rishi: So Ren yeah?
[12] Juan White Wall: Wait we can have it and just have an option down there. uh…Not an adult.
[13] Ravit: ((gazing at Juan White Wall)) Not an adult.
[14] Juan White Wall: yeah.
[15] Ravit: Alright. Here's… Ok here is the issue ((gazes at Rishi)) …was there more in the back?
[16] Rishi: Yeah. Ren what did you wanna say?
[17] Ren: I was going to say that we could. we could do it because it could understand that if people have a lower amount of income if that stresses them out.
[18] Rishi: Right. It's true so if your family has a lower amount of income. Maybe that stresses you out. So maybe. what if we ask the question like um ((kisses teeth)) we ask a question about income, and, we give the option you know, it doesn't apply to me because I don't earn anything.if. if we want to. But how do you ask that question like how do you ask people about income like what do you say?

Youths' participation in the epistemic negotiation was encouraged through the facilitators' body movements and utterances: they took up Travisloot's resistance and meaning-making around reliable processes during the discussion [11, 13, 15, 16], moved their bodies towards the youth, shifted their gaze to each youth speaking, and animated (re-voiced) youths' contributions to the whole class [13, 18]. Each of these moves contributed to disrupting historically entrenched powered differentials where adults are the only deciders of who is a knowledge expert in the classroom. Here, the adults' moves encouraged youth discussion around what knowledge should count and how.

The youth began to structure in a consideration for survey takers' experience—and not just considerations of what information would be useful data—as part of what would make for a reliable process. their goal (survey data collection) no longer concerned an unknown "other," but rather the youth in the classroom and their families. This was accompanied with Rishi enacting power around the development of reliable processes in transforming the issue at hand from *whether* to *how* to ask about income.

Few youth suggested asking the question "straight on" or in blunt ways. Travisloot then suggested "teleporting" survey takers to "three separate quizzes", "depending what age they're like". Despite having initially resisted including the question in the survey [7], Travisloot's subsequent utterances and the class's acceptance of a "teleporting" function as a reliable way to solve the dilemma led the group to the verge of a resolution. Ravit, however, called for the class to pause.

[19] Ravit: I still think we need to think a little bit about income. Do you think. People I wanna trouble this. Do you think people are going be comfortable about writing exactly how much money, they make-
[20] Batman: -No-
[21] Ravit: -on a survey mm?
[22] Recorder Boy: no
[23] Travisloot: [No cause they can steal all their] information
[24] Ravit: [maybe we]
[25] Mario: [Too much information]
[26] Ravit: [We wanna ask about] it in like a less specific
[27] Juan White Wall: Why don't we just say the survey isn't going to be shared with anybody.
[28] Ravit: But it is, cause people are going to look at it ((Travisloot laughs))
[29] Juan White Wall: Yeah but like most companies do do that.
[30] Ravit: No. true. Yes. it is true. that that. That kind of thing is true people may still feel uncomfortable even if we say that
[31] Travisloot: Yeah because yeah because there's some access to your information bro
[32] Rishi: Exactly

When negotiating reliable processes, Travisloot took up the condition posed by Ravit regarding *who* survey takers would be [9] and the initial meaning-making around income that was related to the amount of money a person "got" or their "paycheck" [4,5]. He transformed it into a reason for why the question would not serve as a reliable process towards their aims: it would be "weird" because it was not a question that middle schoolers could answer, assuming they did not earn an income [10]. In contrast, Ren's utterance reasoned in favor of asking the question about income [17]. He recruited substrate from an earlier lesson where youth studied graphs that illustrated the relationship between higher stress and lower income. He positioned that as a justification for why asking about income would result in a more reliable process for obtaining information about stress. *Who* the survey takers were and what appropriate (non-weird) questions would be, mattered. By changing the format of the question [12], the class could still ask about income as a reliable way to collect data *and* do so without subjecting the survey takers to "weird" questions.

Rishi's reanimation [18] of Ren's utterance then transformed the aims of the survey from considering lower income as causing stress for "people" or "them," to "your family" and "you." Here, Rishi reconfigured the aim of the task from gaining information about a generalized "them," to a more personal "you" and "your family." The ethics entangled in Ravit's question [19] built on a consideration for survey takers' experience and leveraged affect (i.e. a feeling of potential discomfort for survey takers), to "trouble" the group's decision to ask "exactly how much money" people make. In this move, Ravit explicitly recruited affect as an important consideration in data collection; she invited the youth to consider how survey takers would *feel*, as important in developing reliable processes towards the epistemic aims. This led to a consideration of the ethics of data collection, as macro-sociopolitical powered dynamics became entangled with the class's epistemic negotiations.

Meaning-making around survey takers' "comfort" when engaging with a data collection tool (the survey) was shaped through the youths' relations with systemic powered dynamics concerning data surveillance and privacy. They raised issues around data theft [23] and cited excessive data extraction practices [25] that are often abused by "companies" [29] who could "steal all their (survey taker's) information" [23]. Indeed, prior research has shown that youth understand data and statistics that they analyze as non-neutral and socially situated resources (Radke et al. 2023; Stornaiuolo 2020). This exchange illustrates how youths' prior knowledge about the sociopolitical aspects of data science mattered as part of their epistemic negotiations. The affective impact and ethical consequences of the epistemic tool they were creating were not separate from the sociopolitical dimensions. And adults

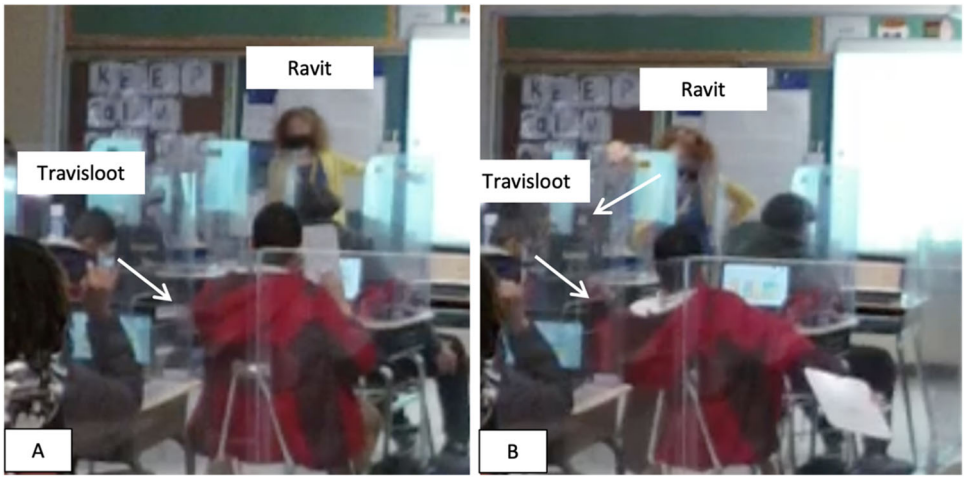

FIGURE 3 | (A) Travisloot utters a soft "no", gazing down and (B) Ravit moves towards Travisloot [33].

ratifying and encouraging those entanglements as legitimate concerns [28, 30, 32] supported youths' RP by making present (Calabrese Barton and Tan 2019) systemic injustices as integral to youths' epistemic practices in the classroom. Considering the affective impact on the survey taker when developing reliable processes made visible sociopolitical powered dynamics that contribute to the reproduction of extractive data collection practices. Survey takers' experience—their feeling of stress—emerged as a non-neutral politicized emotion, reflective of youths' experiences with the politics of data surveillance and privacy. Analysis of the subsequent interaction shows how this led to care emerging as an epistemic ideal that involved empathy for the survey takers.

As the interaction continued, youth and adults considered how a question on income might be asked in a "less specific way" [26], to avoid extractive practices that "companies" use. However, tensions soon emerged within the group. A few youth argued to keep the question on income by asking it in a generalized way (e.g., income ranges) so that it could protect survey takers' privacy while also meeting the epistemic aim. Others, like Travisloot, did not agree. When Rishi asked the class "do we feel good about asking income like this: not enough, enough, and a lot?" Travisloot responded with a loud "NO." His misalignment with Rishi and discomfort were made visible through the raised volume of his utterance, his gaze that shifted up from his desk towards Ravit, and the "no.. I don't know about.." that followed, mumbled softly while looking down at his desk. Ravit, now positioned in the front of the class, shifted her gaze to Travisloot, moved towards him and placed her hand on top of the plexiglass around his table (Figure 3).

[33] Ravit: Why not Travisloot. What is your reservation?
[34] Travisloot: Cause like don't like most people like if they wanna like. paycheck has to come like they're like stressed and like you like ask like is your income like low high like then like if their income is like low that just going to make them upset and they're not gonna want to continue to like.. because… they are not going to want to ((cut off by Ravit, [35]))

As Jaber and Hammer (2016a) have illustrated, youths' feelings play an important role in how they engage in epistemic practices. Here, Travisloot's initial response—the loud "NO"—followed by the shift in gaze and soft "no" indicated that he felt discomfort with the process that the class was about to agree on. His stance on the issue was also a minoritized position in relation with the majority of youth and Rishi, who vocally supported asking the question on income. Analytically focusing on Travisloot's expressed feelings (through his body movements and the volume and tone of his utterance) indicated how he and the adults negotiated powered differentials to support his RP. Travisloot's initial gaze at Ravit and subsequent gaze at his desk (Figure 3) served as an invitation for her to engage with him as a sociopolitical ally in the moment (Calabrese Barton and Tan 2020), and honor his discomfort (i.e. epistemic affect) as important in the discussion. Ravit's ratification of Travisloot's affective experience as relevant to the epistemic negotiation [33] supported his RP in the space.

When prompted to share his "reservation" [33], Travisloot animated the feelings of stress around getting paid that a survey taker might experience if their income is low. He argued that *not* attending to survey takers' experience would lead to unreliable processes (i.e., incomplete data because survey takers would get stressed and not fill out the survey) and result in a failure to meet the epistemic aim (learning what causes their community stress). Furthermore, as the youth were learning in the unit, stress was not an innocuous discomfort but responsible for causing serious long-term health issues, with racialized communities being overrepresented in those who experience those harms. Here, Travisloot was pushing for the class to not only be empathetic towards survey takers who might experience stress, but also take action against that possibility by not asking about income.

Eurocentric framings of data collection position the negotiation of harm caused to research "subjects" as important (e.g., IRB protocols to protect subjects), but balanced against

FIGURE 4 | Mario holding a whiteboard above his head and chanting "take it out."

what is seen as *necessary* for the reliability of the process of data collection and meeting research epistemic aims. Asking about income to ascertain whether it is a source of stress was seen as relevant to the aim here, hence arguably necessary, for a reliable process. Here, Travisloot, centered affect (survey takers' feelings of stress) in challenging the standards (ideals) governing what counts as a reliable process (i.e., what was appropriate and sensible to ask [34]). Furthermore, the affective dimensions (loud 'no' when reasoning about the income question) that emerged as part of Travisloot's *within* science practices (Jaber and Hammer 2016b) pushed the class to show care (Gunkel and Tolbert, 2023) towards survey takers. Through the unfolding interactions [23–34], care was co-operatively constructed (Goodwin 2017) as a politicized feeling (McKinney de Royston et al. 2017), informed by the sociopolitical [23–32], that involved youth taking action [34] to address perceptions of reliability of the survey.

[35] Ravit: We can leave that question to the end.
[36] Travisloot: They're not gonna wanna continue
[37] Ravit: That's a good point
[38] Juan White Wall: Or we can just put like a money questions at the end so that then they do the rest
[39] Ravit: It's a bit of a trick but it could..

Initially, Ravit argued that "we can leave that question to the end" [35], a practice she admitted was a "bit of a trick" [39] to ensure participants would continue the survey despite the emotional cost. Although initially ratifying Travisloot's resistance as a "good point" [37], Ravit authored [35] and Juan White Wall re-animated [38] a solution that reified extractive practices in data collection, misaligned with meaning-making around the sedimenting ideal of care for survey takers' experience of stress. While a "good point" [37], the aspect of Travisloot's resistance ratified as significant here, was that of having a reliable process—making sure the survey takers did not leave the survey. Therefore the "bit of a trick" [39] Ravit proposed by moving the question to the end illustrated one form of deceptive practices. Such practices were and continue to be used in Eurocentric approaches to data collection. If "we" "leave the question to the end," then "they"—the survey takers—can "do the rest," allowing the class to ask about income while maneuvering around the ideal of care for participants to not feel stress. Travisloot then responded, "if we put it at the end then we're gonna run into the same problem. They might just like leave the quiz like unanswered and we'll never get their answer." That is, survey takers' experience of stress would lead to unanswered surveys (quizzes); the class could both cause potentially stress to survey takers while also not accomplishing the aim.

A short pause in the group dialogue ensued, when Mario gazed up at Ravit and said "let's take that out." Ravit took up this substrate by suggesting the class had two options; to take the question out or put it in the end. She then positioned the epistemic negotiation they were engaged in as concerning "how critical the (income) information (was) for us". In this move, the emerging epistemic ideal of care for survey takers was pitted against an epistemic ideal of having complete and accurate data to fulfill the epistemic aim (finding out what causes stress). Mario held a small white board above his head that read "take it out" (Figure 4) and began to chant "Take. It. Out." This literal in-the-classroom protest galvanized the students against the income question. Shortly after the chanting began, Rishi asked the class to vote on whether they wanted to ask the question or not and the majority of youth voted to take the question out. In this episode, adult and youths' refusal to ask the question in their survey allowed their community to not-participate (Switzer 2020) in an activity that could cause harm, possibly missing out on relevant information about causes of stress. An emergent epistemic ideal, reflexive of multiple epistemologies and focused on care for the survey takers only came to be through sociopolitical struggle.

Care for survey takers was ratified by the adults (in positions of power) as an ideal informing reliable processes for developing the community survey when this epistemic ideal was aligned with the curricular epistemic aims. Importantly, unlike Juan White Wall and Travisloot's earlier suggestions of offering survey takers the option to opt out of answering the question, the refusal to ask the question entirely was: a) not neutral but rather shaped by youths' and adults' affective dimensions (i.e., youths' feelings of discomfort and adults experience of stress)—politicized emotions reflective of complex histories and sociopolitical powered dynamics around data privacy and surveillance; b) illustrated the importance of disrupting and reshaping powered dynamics in classrooms towards enacting care as empathy and action for their community; and c) challenged what knowledge counts as part of rigorous epistemic science practices (Tan, Calabrese Barton, and Benavides 2019) thereby disrupting Eurocentric approaches to data extraction in the science classroom.

In the next episode, care for survey takers emerged as a sedimented ideal informing reliable processes for data collection and was recruited by Rishi towards advocating for the well-being of gender-minoritized community members.

5.2 | Episode 2: "What If Someone Wants to Be a T-Rex?": Care for the 'Other' Gendered Survey Taker

The next day, youth analyzed the pilot survey results (having distributed it to a selection of other 7th graders at their school) and refined the questions to create the final survey. This episode focused on the class's analysis of responses to the open-ended survey question "what is your gender", where one of the responders wrote in "transformer" (See Figure 5). The analysis focused on the whole class discussion and three focal groups' small-group interactions. We illustrate how youth and adults negotiated complex multi-directional powered dynamics to develop reliable processes that would adhere to the epistemic ideal—care for the gender-minoritized survey taker. The transcript is organized in tables to indicate simultaneous interactions in various spaces. Whole-group discussion line numbers are noted in numbers [41-57], Ren and Batman's interactions in alphabets [A–U], and other groups in roman numerals [i–x].

Initially, youth in the whole class [40–48] (Figure 6) and small group interactional spaces [Batman and Ren – A–D] positioned some of the survey responses as not "valid" [47], where "the fact that someone put transformers" [B] was an illustration of survey takers having "fooled around" [47]. In the whole-class discussion, Rishi re-animated Juan White Wall's utterance but re-authored him as "not wanting to judge peoples' gender" which positioned "transformer" as a potentially valid gender option [48]. Rishi enacted power—as an insider who is trans and an adult in the room—when they[3] animated Juan White Wall's utterance to the whole-class and authored his meaning-making around transformer

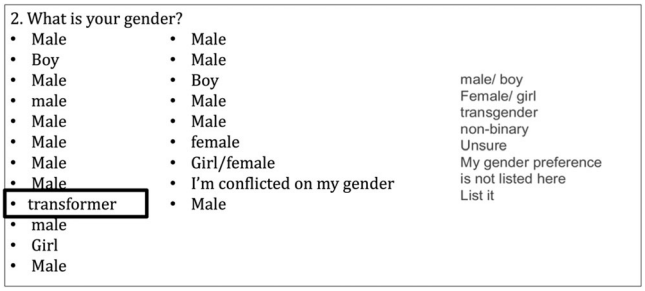

FIGURE 5 | Slide displayed in the front with pilot survey results to the question "what is your gender." *(Box around transformer added for emphasis).*

as him *not* wanting to enact a deficit positioning of survey takers' intentions. Here, Rishi transformed Juan White Wall's substrate [47] to author empathy towards survey takers—that survey takers are not judged by their identity descriptors.

While this empathy for survey takers was framed as important, "transformer" remained an invalid option and the question had to be amended to be "helpful" [48]. Asking an open-ended question about gender was seen as an unreliable process because it resulted in responses perceived as less helpful towards the epistemic aims (collecting data about participants' gender). In doing so, the boundaries around gender options that *would* be valid were defined by whether they were "helpful" or not: Male/boy, Female/girl [47], options offered by Juan White Wall, and "transgender and not sure" offered by Rose in the next turn of talk. Next, Rishi addressed the whole class and asked, "how do folks feel about those four categories?" and the class erupted into several small-group interactions. The small-group chatter was significantly more animated and louder than their discussions regarding any of the other questions on the pilot survey they analyzed that day. This suggested youth felt excited and had an interest in engaging in this epistemic negotiation (Figure 7).

Ren's giggling [F, L] and Batman's performance of a surprised whisper [H] indicate how their interactions involved affect—here expressed through play and humor—that led to a more serious consideration for their decisions, that is, epistemic negotiations regarding reliable processes—what response options to provide. Batman and Ren [F–N] reasoned through the options for gender taking up substrate from the whole class discussion towards a serious consideration of "not judging" survey takers' intentions [48]. Batman argued for keeping an open option—"other" [J] – because "what if someone wants to be a T Rex?" [K]. Initially received as a humorous response—evidenced through Ren's giggling [L]—Batman then re-animated his question, "what if someone wants to be" [M]. While his utterance was cut off by Rishi speaking into the whole class space [49], Batman built on the play he and Ren engaged in [F–H] where transformers could be a possible and valid option. If so [K], then providing an open space for survey takers to express an unlisted or unexpected gender would be necessary, as evidenced through his support to "just do other" [J].

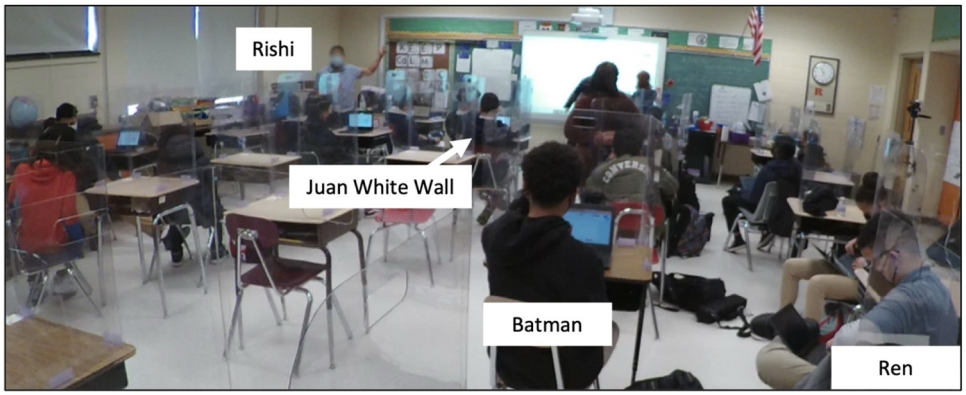

FIGURE 6 | Rishi at the front, and Batman and Ren seated at the back corner at the start of this episode.

Whole Class	Ren, Batman
[40] Rishi: Ok so with this question, what is your gender, who which groups had suggestions for this question. Who was not happy with it?	
[41] Recorderboy: me	**[A] Batman:** hmm ((sigh chuckle)) transformer ((looking up at board)) ((Ren raises his hand, Batman smirks and turns to Ren))
[42] **Rishi:** Ok lets start with you, Recorderboy.	
[43] Recorderboy: ((points to Juan White Wall)) no, him	**[B] Ren**: The [fact] that someone put transformer ((turned towards Batman, laptop in his lap))
[44] Rishi: No you say it!	**[C] Batman:** [nah] ((nods no))
[45] Recorderboy: Him	
[46] Rishi: ((nods)) ok	
[47] Juan White Wall: Okay. Uh people fooled around and not putting a valid answer so uh I said we could just have three categories. Male/Boy. Female/Girl. And others and have a text box of options.	**[D] Batman:** What do you mean?
[48] Rishi: Ok so we have one option from Juan White Wall who says people start to fool around. I saw a transformers there I don't wanna judge peoples gender, you can identify as a transformer if you want to, but maybe that's not so helpful for our survey. That's a suggestion here. So Juan White Wall is saying lets have three categories, lets have Boy/ (1.0) Male? Girl/Female, and then an Other. What do other folks think of this. Rose you had your hand up	**[E] Batman:** ((taps left fist on table, looks at Ren)) ah Yeah. ((Grabs plexiglass and slides hand down)) I-I like that one

Yet while open to providing space for survey takers' identities (say, if they identify as a T Rex), the positionality of "other" gendered people in relation to heteronormative genders was not neutral. As Bella suggested [i] and indeed reflected in earlier utterances [47, 48], survey takers were to be offered male/boy, female/girl and "THEN" options such as "not sure" and "other" [i]. Neither of the gender binary categories were questioned (boy/male; girl/female). They emerged as obvious options, indicating an assumed acceptance and shared orientation around heteronormativity structured into their collective understandings of gender (Ahmed 2006). This emergent gender hierarchy is also mirrored in broader data collection practices (and assumed reliable processes) that (re)produce harm by maintaining the invisibility of non-cisgender identifying communities through the heteronormativity that structures quantitative methods and often excludes those outside the borders (Guyan 2022). In the classroom, students considered the conditions of reliability—*whether and how* to include or account for the nonnormative "other" in their survey. Negotiations around this question were propelled by epistemic affect (empathy and playfulness) about responses and what would count as a valid response.

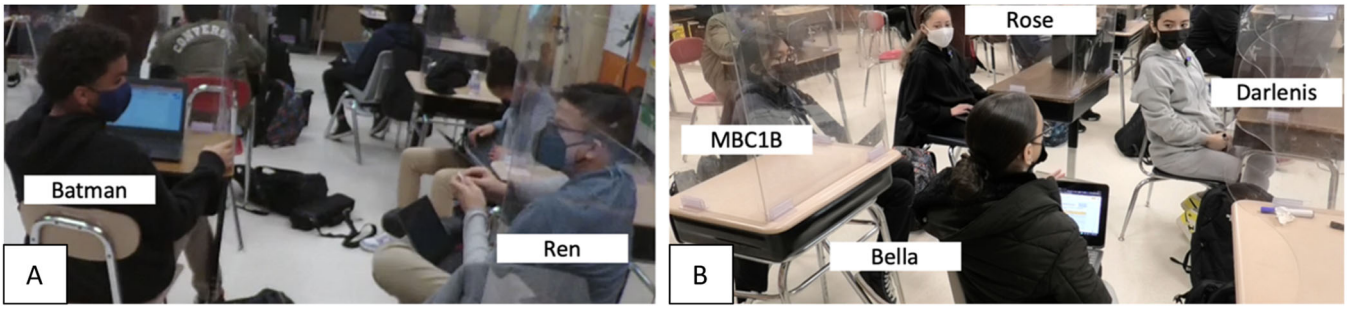

FIGURE 7 | (A) Batman and Ren engaged in conversation [F–N]. (B) Bella addressing Darlenis, Rose and MBC1B [i].

Ren, Batman	Bella, Darlenis, Rose, MBC1B
[F] Batman: I'm a T-Rex. ((Ren giggles, fidgeting with his pen)) **[G] Ren:** I'm an attack helicopter! **[H] Batman:** You're an other? ((Whispered surprised tone, turns to Ren)) **[I] Ren:** Other? (2.0) Can you be like LGBTQ- **[J] Batman:** -((clicks teeth)) No just do other ((points hand at board)) **[K] Batman**: I sure, not sure and then you coulda ha-you should have other still [because what if] somebody wants to be a T rex? **[L] Ren:** [Because someone] ((Ren giggles)) **[M] Ren:** What if someone wants to be a T (.) rex (.) ((Batman leans into Ren)) **[N] Batman**: No but actually WHAT if someone wants to be som-	**[i] Bella**: I would put female slash male. I mean female slash girl. Male slash boy, and THEN you could put not sure and other.((Gazes at Darlenis who gazes back at her. Rose and MBC1B also gaze at Bella. Darlenis looks back at her laptop))

Rishi recruited care as an epistemic ideal (from the previous day), and through these emerging interactions began to make present (Calabrese Barton and Tan 2019) injustices that non-cis-gender identifying people experienced (i.e., being minoritized through the gender hierarchy). Batman and Ren's interactions illustrated the ways that some youth reasoned around how to care for survey takers—showing empathy by not judging their chosen gender and taking action by making space for their right to gender self-determination through survey options (i.e., having a space for 'other' as suggested by Batman [J]). By enacting care as action towards gender self-determination, youth and adults were also negotiating survey takers' RP within the structures of a Eurocentric epistemology.

Whole Class
[49] Rishi: Ok so we have one more. Y'all this a really important question, right, and I am saying this as someone who is trans, like when I have to pick my gender on a on a survey, often the option I want is not there. cause I identify as genderqueer. That's actually like what I call my gender, and so this question is actually really important because we're asking about stress. We're asking about how people identify, and as Travisloot said last time we don't wanna ask questions in a way that may cause stress. Right? So we gotta think real carefully about how we phrase these questions. what options we give people so that we can consider how it might make them feel to answer them right? And so I like what you are saying we should have lots of options. We can have male, female. No sorry male or boy, girl or female, transgender, unsure, and then you said nonbinary, right? Are there any other, cause I don't know how y'all talk about gender right? how your generation talks about gender. Are there any other ways that people identify that you know of?

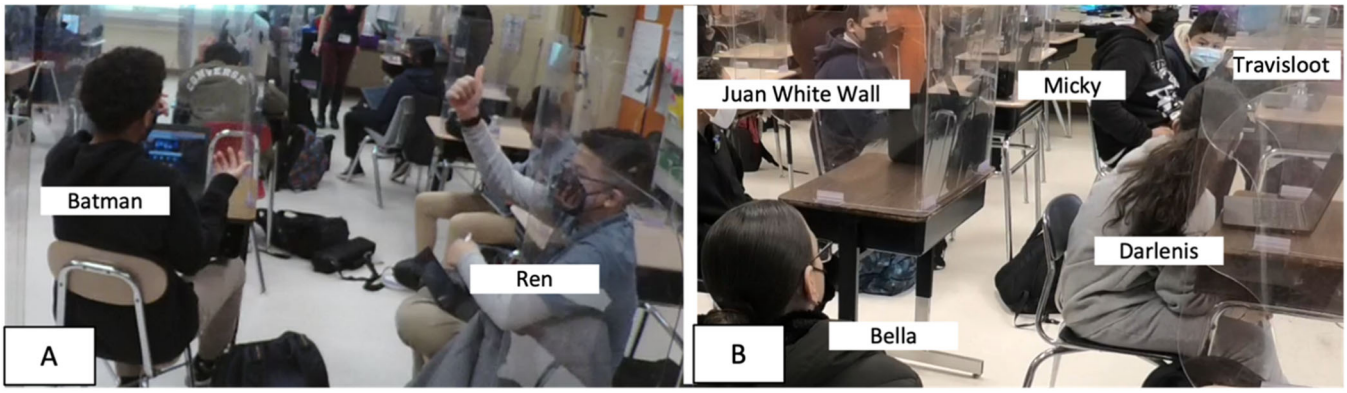

FIGURE 8 | (A) Batman and Ren engaged in conversation [O–U]. (B) Travisloot, Darlenis, Micky and Juan White Wall discussing gender and sexuality [ii–x].

Rishi authored themselves as an explicit insider and knower of a specific survey taker's experience—a genderqueer person who did not have their gender identity listed on a survey [49]. They framed this context and insider knowledge (i.e. the stress that might be caused by not having one's gender listed as an option) as important by shifting their positionality from the in-the-flesh gender minoritized survey taker, to that of a survey designer—with the youth ('we')—making a survey about stress. Furthermore, Travisloot's contributions the previous day and the sedimenting epistemic ideal of care were recruited as consequential for survey design. "We"—the survey designers in a position of power—didn't "wanna ask questions in a way that may cause stress." Therefore "we" had to carefully consider *how* to account for the minoritized survey taker—embodied by Rishi in this context. In this way, Rishi recruited their positionality as a gender-minoritized person towards making present (Calabrese Barton and Tan 2019) the injustices that non-cisgender people experience when engaging with Eurocentric data collection tools (i.e., multiple-choice questions about gender). By authoring themselves as an explicit insider, Rishi positioned the youth and adults as needing to consider the feelings of people like them—a gender minoritized adult in the room—as part of designing reliable processes[4]. Youth were tasked with considering *their* power in being able to cause stress through the survey they were designing. Rishi worked in the capacity of a sociopolitical ally for non-cisgender community members, when they recruited the class in recognizing their (the youths') power to potentially cause harm without a careful consideration of the options offered in the survey. Rishi did so while also acknowledging that there might be a generational difference in how the youth frame categories of gender—an invitation for multiple epistemologies regarding gender construction and identity. Yet the youths' task of realizing their powered positioning was not simple.

Ren, Batman	Travisloot, Darlenis, Micky, Juan White Wall
[O] Ren: ((turned towards Batman)) Pansexual, Bisexual…Asexual ((Batman nods his head no then shrugs shoulders, points forward)) **[P] Batman**: I feel like. I feel like you should just say other, like. you should just say male female, don't know or other and then write it. because for.. it didn't have like a long list **[Q] Ren:** Pansexual, asexual, bisexual **[R] Batman:** Because I don't think we will be able to fit all…. I don't know **[S] Batman:** ((typing)) don't know. And other. That's what I feel. **[T] Ren:** pansexual, asexual.. **[U] Batman:** There should be like boy male female don't know and other.	**[ii] Travisloot**: ((leans over Micky, points at board)) Gay? **[iii] Darlenis:** ((To Travisloot)) that's a sexuality! ((Laughs)) **[iv] Travisloot**: it is? **[v] Darlenis:** yess-uh. Gay is a sexuality! **[vi] Travisloot:** Yeah we should put gay up there. **[vii] Darlenis:** Nooo! ((Breaths out a chuckle)) **[viii] Juan White Wall**: Yeah! Homosexual **[ix] Bella:** That's what I mean..[I don't even know… what.. non binary…] **[x] Micky:** [I don't even know what gender is..]

Despite Rishi situating the youth as knowledgeable about "other ways that people identify" [49], across both groups (Figure 8) youth didn't "even know what gender is" [x], further illustrating the heteronormativity structured into the sociocultural milieu of the classroom space. Across the two interactional groups [O–U, ii–x]: Ren offered a list of sexualities [O,Q,T] that Batman rejected because "it didn't have (to be) a long list" that might not fit in the space provided for the survey; and Micky and Juan White Wall advocated for "gay" [ii] and "homosexual" [vii] which Darlenis explained was a sexuality [v]. Their animated discussions and recruitment of terms (pansexual, gay etc.) indicated an awareness around non-heteronormative identities and a desire for people who identified as such to be included in their survey. Arguably there could have been a richer conversation on the meanings of those terms and the relationality between gender and sexuality. However, the potential of collective sociopolitical allyship struggle was attenuated by intersecting power dynamics, visible when the negotiation was then brought to the whole class space.

Whole Class
[50] Rishi: So ok how about this I am going to suggest something that I have seen done in a survey. ((Figure 9A)) So I like these. I like these options right? ((reads off the board)) you have male/boy, female/girl, transgender, nonbinary, unsure. **[51] Travisloot**: wait ms. **[52] Rishi**: Oh yeah? ((hops quickly towards Travisloot and bends down – Figure 9B)) **[53] Travisloot**: you can add gay. **[54] Rishi**: Gay? So. So. (2.0) ((takes two slow steps away from Travisloot, gazes down and then at Ravit)) okay.. So. ((gazes at the floor – Figure 9C)) there is? So. When folks often describe themselves as gay ((gazes up at Travisloot then ahead at the class)) they may not necessarily be describing their gender. They may. They may. be describing their sexual preference ((Turns to Teacher sitting at her desk – Figure 9D)) **[55] Teacher**: Yep ((nods at Rishi)) **[56] Rishi:** ((walks away from Travisloot, down the classroom)) And so in this question we are really curious about gender. So one of the things that I have seen done in a survey that I kind of like and kind of want to suggest it, let me know what you think, there's like a box at the end so after all these categories, after unsure, it could say my gender preference is not listed here and we can leave a box for people to type in their gender.

Travisloot's utterance [50] animated and elevated the confusion many youth in the class felt around gender and sexuality—what each term meant and the difference between these terms—to the whole class space. Rishi's initial expression of enthusiasm to invite Travisloot's question—moving quickly towards him and bending down to listen (Figure 9B)—followed by their pause, stuttering [54], and shifting gaze towards the floor (Figure 9C), then to Ravit and finally the lead teacher (Figure 9D), indicated a shift in their affective experience and footing (Goffman 1981) in relation to the youth. Rishi shifted from the confident knower and evaluator of the options for gender (evidenced in body position—Figure 9A—and non-hesitant speech when uttering "I am going to suggest" and "I like these" [50]) to visibly uncomfortable (Figure 9B,C), feeling unsure about how to answer the question posed [54], and gazing at the lead teacher (Figure 9D) for approval [55] once they responded to Travisloot.

Rishi's talk and action suggested they were comfortable with embodying the fleshed out non-gender conforming survey taker and sharing their experiences of stress and why they were important to consider when making the survey [49]. However, Rishi shifted out of this insider positioning to hesitating when having to explain the difference between sexuality and gender and they did not share their knowledge as an insider in this regard. During the daily debrief between Rishi and Ravit, Rishi noted that Travisloot's question made them "anxious and stressed in the moment" as they weren't "sure what is allowed in terms of sexuality talk at the middle school level". Furthermore, they noted that asking about sexuality felt very personal—as the only adult in the room who was openly queer-identified—and that they weren't ready for that conversation with the youth yet.

Disclosing and embodying non-heteronormative identities often puts queer and trans-identified adults at risk in school settings (Keenan 2022). Rishi's hesitation [54] illustrates the multi-directional powered negotiations that queer adults face, when working towards youths' RP in classroom spaces. Rishi's affective disposition (i.e., their hesitation) indicated their complex positioning within the space: 1) as the epistemic authority on issues of gender and sexuality by virtue of their identity, 2) as a powered adult facilitator in relation with the youth, and 3) as a researcher 'guest' in relation with the teacher and school 'hosts'. Being out as genderqueer and making present injustices that gender-minoritized people experience was consequential to Rishi's role as a sociopolitical ally to other gender-minoritized youth both in the classroom and the youths' larger social worlds. However, this necessitated they negotiate the powered dynamics that emerged through their positionality as a minoritized person in relation with the other adults and youth in the classroom, and as a researcher 'guest' who was *not* the lead teacher in the classroom. Even as the lead teacher affirmed Rishi's tentative response on distinguishing gender from sexuality, on receiving the teacher's nod, Rishi returned to emphasizing that it was gender the survey was concerned about, sidestepping the potential awkwardness of a community outsider unexpectedly engaging in a potentially complex discussion on

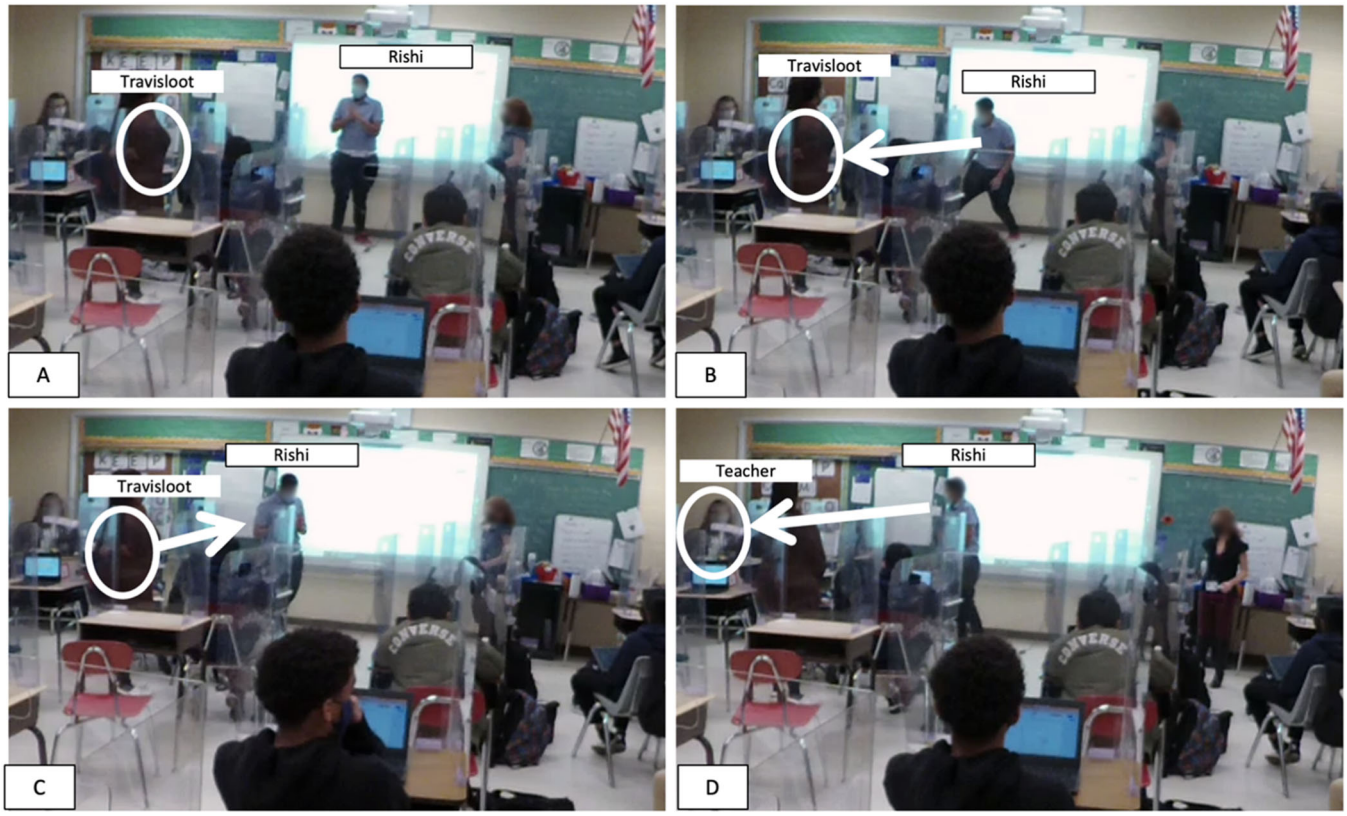

FIGURE 9 | (A) Rishi positioned at the front of the class, Travisloot seated at his desk (behind the support teacher). (B) Travisloot calls out to Rishi who moves towards him (white arrow) [52–53]. (C) Rishi moves away (white arrow) from Travisloot and gazes down [55]. (D) Rishi turns to gaze (white arrow) at the teacher [55].

gender and sexuality with middle schoolers, where one of their classmates identified as transgender.

Ideally, figuring out a reliable process to ask survey takers about gender would involve meaning-making around gender and sexuality with the myriad of relevant terms youth collectively raised. However, leading this public discussion rested on Rishi, the genderqueer adult who was also in real time, processing their own ongoing struggle with becoming fully visible in their salient identities in the study context. Here, epistemic affect visible through Rishi's discomfort and uncertainty reflected the live-and-active struggles of lifelong oppressive axes (LGBTQIAS2+ rights) on a person. This affect shaped the epistemic negotiations by essentially curbing the potential discussion and sense making. Allied political struggles necessitate more intentional co-laboring between a direct oppressive-axis-bearing ally with one who is not (say between Rishi, Ravit, and the teachers, all positioned as knowledgeable adult authority figures) so that the burdens of the sociopolitical allyship could have been more distributed. This could have meant that Ravit and/or the teachers contribute to the discussion on gender and sexuality, as cisgender adult allies in the space. Students might then have had the opportunities to struggle through their sensemaking on care for the survey takers in the context of asking questions related to gender and sexuality, and why these are also relevant stressors in the community given the current climate of anti-LGBTQIAS2+ youth policies increasingly enacted in education and healthcare (Gilbert and Gray 2023; Mangin et al. 2022). They might have reasoned that "T-Rex" is not that impossible an adjective to describe oneself when one feels completely dehumanized by antiqueer, moralizing rhetoric.

Finally, the class agreed on Rishi's proposed "my gender is not listed here" as an option that would "honor that we did not know" someone's gender identity. This option served as a reliable process that allowed the survey taker agency to describe their gender the way they wanted. Rather than the "other" category, this option voiced an acknowledgement of whose knowledge counts, where and how; the survey creators (youth and facilitators) were not the only knowers of gender options and through the question, animated a recognition of that epistemic stance to their community both within the classroom and outside.

In this episode, care for the survey taker—when literally fleshed out in their classroom through Rishi—required not only that youth carefully consider survey takers' experiences of stress, but also required the adult (Rishi) negotiate powered differentials that emerged through heteronormativity structured into the background (Ahmed 2006) of this—and a majority of—classroom space(s). Enacting RP while engaging youth in designing reliable processes to learn about stress in their community entailed more than simply offering youth a voice to author the options for gender in the survey. As we illustrated, powered differentials were not unidirectional and therefore materialization of a reliable process to meet the sedimented epistemic ideal—care for survey takers—required negotiating when, where, and to what extent adults were willing and able to

cede power, while also protecting themselves when in positions of minoritization[5]. Unresolved through the episode, is an illustration of how (non-transgender) adults might face the risks involved in enacting politicized care (McKinney de Royston et al. 2017) while fighting for the RP of gender-minoritized people; an issue particularly important now, given the rise in anti-trans legislation across the US that includes calls to "end trans and gender nonconforming teachers" (Reed 2024) in classrooms.

6 | Discussion and Significance

In this study, we drew on the AIR model of epistemic cognition (Chinn, Rinehart, and Buckland 2014) and the RP framework (Calabrese Barton and Tan 2020) to examine how we might disrupt the dominance of a Eurocentric epistemology in school science by paying attention to the ways in which epistemic affect and power shaped the development of epistemic ideals and reliable processes.

We examined how epistemic affect was informed by the sociopolitical and shaped care as a politicized emotion—a coupling of empathy (feeling) and action. This action involved negotiations and consequential changes to the survey, a reliable process for attaining the epistemic aim of knowledge about stressors in the community. The AIR model (Chinn, Rinehart, and Buckland 2014) provided a lens to view the substance, of the epistemic negotiations as being about aims, ideals, and reliable epistemic processes. Epistemic affect and its subsequent rendering as politicized emotion, motivated and set in motion these negotiations. The politicized emotion of care with its concomitant resistance voiced by the youth or adults, interrupted and problematized the substance of the discussions - resistance to including a question on income or resistance to including sexual orientation as "options" for gender. Multidirectional powered relations between youth and adults shaped epistemic engagement - whose ideas were taken up and how. The RP framework (Calabrese Barton and Tan 2020) provided a lens to understand these powered relations and how youth and adults negotiated moments of allied political struggle. Figure 10 illustrates the complementary lenses of our three theoretical frameworks in illuminating different angles of the phenomenon—the emergence of an ideal that explicitly troubled Eurocentric aims and processes of knowledge production

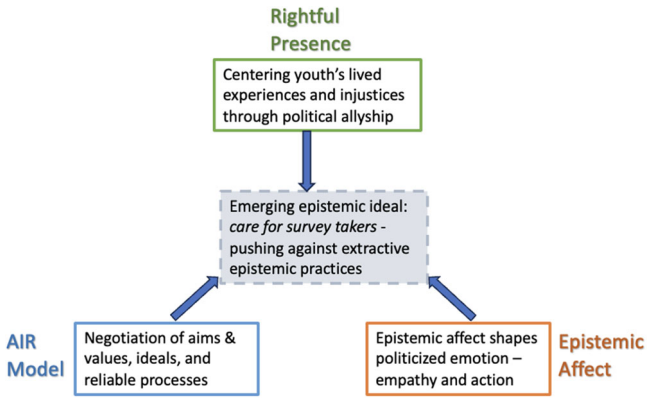

FIGURE 10 | Complementary theoretical lenses.

which maximizes information extraction. This ideal came to be through epistemic negotiations that were informed by epistemic affect, legitimated through fighting for RP in the space, resulting in a politicized emotion which shaped what questions were care-fully asked of respondents in the youths' community. Analytically, paying attention to how affect was entangled in epistemic negotiations revealed some of the complex powered dynamics that structure the social processes of knowledge creation.

Across both episodes, the legitimacy of youths' embodied epistemic affect *had to be ratified through allied political struggle*. This sociopolitical allyship struggle played out through the recruitment of different allies and made present systemic injustices that survey takers might experience. In the first episode, this was witnessed initially through Ravit inviting youth to consider survey takers' feelings when answering a question on income. Later in the episode, Travisloot's loud "NO" followed by his recruiting Ravit as a sociopolitical ally toward enacting his right to refuse asking the income question resulted in his making present the stress and injustices survey takers would experience when having to answer the question. Travisloot's emphatic refusal was legitimated as part of the class's epistemic negotiations when Ravit invited him to share his reservations, which opened space for Mario to join Travisloot as an ally by beginning a literal protest for care for the survey takers. Enacting care for the survey taker in removing the income question involved allied political struggle in differing configurations. Ravit as an adult researcher and co-teacher was allied with Travisloot, then Travisloot was allied with Mario, followed by many students allying with Travisloot and Mario to collectively chant the protest "Take. It. Out.", directed at the adults in the classroom. The process that characterized this episode's allied political struggle was how the students and adult teachers collectively reauthored epistemic ideals and reliable processes in creating their community stress survey.

In the second episode, Rishi explicitly made present the injustices that gender-minoritized survey takers would feel and recruited youth to show up as sociopolitical allies. Here, allied political struggle took the form of an unexpected (yet arguably also not surprising) encounter with a murky domain—middle schoolers' understanding and meaning-making of gender, sexuality, and how they might be related, nested in concerns of privacy and vulnerabilities inherent in discussing these identifiers. This episode also illustrated another kind of struggle in the lost opportunities for sociopolitical allyship between the adults in the room (i.e. the teachers, Ravit, and Rishi), to take up a more nuanced discussion on the difference between gender and sexuality without the burden and risk falling completely on Rishi. Nevertheless, the class's recruitment of "care" as a sedimented epistemic ideal supported gender-minoritized survey takers' right to self-determination in the survey because, 'what if someone wants to be a T-rex'?

Tracing powered dynamics across classroom interactions revealed the sociopolitical dimensions entangled with the affective dimensions of youths' epistemic negotiations. Affect-laden epistemic negotiations in science are an integral aspect of the social processes of meaning-making and challenge the view of science as "objective" or "neutral" (Haraway 1988). We

illustrated how the youth and adults not only showed feelings of care (or empathy) for the survey takers but took a political stance against survey takers experiencing harm when engaging with a Eurocentric tool for data collection (i.e. the survey).

Studies on epistemic affect in science education do illustrate how the relationship between the subject (youth) and object shapes how scientific practices evolve. Jaber and Hammer (2016a, 2016b), Lanouette (2022) and Pierson, Brady, and Lee (2023) show how epistemic affect and feelings of care shape small group and whole class discussions and investigations. However, as Pierson et al. (2022) indicates, paying attention to how affect shapes epistemic negotiations reveals underlying tensions between promoting epistemic heterogeneity as its own educational goal and the current practices of convergence on disciplinary ways of knowing prevalent in science research and practice in NGSS-aligned learning spaces. Pierson et al. (2022) show how care for the object of their investigations (guppies) was not explicitly elevated to and stabilized as an epistemic ideal in the classroom. Feeling care for the subject of study however, is integral to Indigenous, non-Eurocentric and feminist epistemologists, countering the masculine framings of neutrality, distance (from the 'researched'), and objectivity that govern Eurocentric science (Bang and Marin 2015; Haraway 1988; Keller 1992; Kimmerer 2021; Krishnamoorthy et al. 2023; Tolbert 2019). While the particularities of how care is understood through each lineage of knowledge are different, resonant across them is a recognition of and accountability to the non-neutral relationship between the "researcher" and "researched." In this sense, the commitment to caring noted by Pierson et al. (2022) did not align with the historically sedimented masculinist disciplinary ways of knowing and was therefore not rendered as a legitimated epistemic ideal informing reliable processes in Eurocentric science. The results of their study exemplify the binary created between emotion and reason, which reflects tendrils of Eurocentric epistemologies baked into present day school science (Zembylas 2016).

We positioned care for the survey takers as an epistemic ideal on the grounds that it provided a standard by which to decide whether an epistemic aim had been achieved—obtaining information about stressors in the community. This epistemic aim and its value shifted somewhat during the process of developing the survey—from a more extractive aim and valuing information gained even at the expense of causing some harm (stressing respondents), to a less extractive aim and valuing information gained without causing harm. This shift was contingent on some corresponding change in ideals; the emerging ideal of care for the survey taker helped to guide reliable processes (survey design) that were less likely to cause harm and thus meet an aim that was less extractive.

We also note that caring about epistemic engagement and performance is a goal of epistemic cognition (Barzilai and Chinn 2018). Such caring involves "forming inclinations and intentions to pursue epistemic aims; experiencing productive epistemic emotions, such as curiosity" (Barzilai and Chinn 2018, p. 366). The sustained and animated engagement with the survey design strongly suggests that youth and adults cared about, 1) developing an epistemically reliable data collection instrument, and 2) the well-being of their community survey takers. They cared that the instrument they were developing to achieve their epistemic aim did not cause harm. That these two forms of care operated in resonance is an important insight in terms of the ways that non-Eurocentric ways of knowing may be supported through epistemic education that supports caring about apt epistemic performance.

The recruitment and validation of youths' epistemologies as legitimate in this NGSS aligned science classroom was contingent on allied political struggle. Paying attention to and tracing how powered dynamics shape epistemic negotiations revealed the sociopolitical allyship necessary to push against the dominance of Eurocentric epistemologies in developing epistemic ideals. It also revealed care as not just a feeling directed towards the survey taker, but as necessitating action too—a protest against asking the question on income, and a task to reframe the question on gender. Responding to calls by Gunckel and Tolbert (2018) and Chen (2023) to attend to care as a sociopolitical action beyond empathy, our paper highlights the politicized nature of care (McKinney de Royston et al. 2017) that emerged in adult and youths' epistemic negotiations. When coupled with a form of action, feelings of empathy for the survey taker illustrated an ethical consideration and responsibility to not cause harm to others through a Eurocentric science tool (i.e. the survey). This made visible how youth and adults exemplified what Haraway (2016) describes as response-ability to shift our relations with disciplinary learning towards right relations that lessen the violence caused by school education—in our case, school science.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Endnotes

[1] See Calabrese Barton and Tan 2019, Tan, Calabrese Barton, and Benavides 2019 and Tan and Calabrese Barton 2017 for further details on their curriculum design and enactment.

[2] None of the youth in the class identified as white, and a majority identified broadly as Hispanic, though they preferred more specific country-based identities (e.g., Dominican, Puerto Rican, Ecuadorian etc.). While from the same school district, the design team youth involved in curriculum design were not in the same class or school where the curriculum was piloted.

[3] Rishi uses they/them pronouns.

[4] One youth in the class identified as a transgender person. However, they did not consent to be part of the study. As such, we have excluded an analysis of that relational positioning in this paper. All other youth and adults communicated their identity as cis-gender at the time.

[5]The (in)visible tendrils of powered dynamics the majority cis-identifying youth experienced with their transgender classmate were evidenced through their classmate's silence and avoidance of eye gaze with Rishi and other classmates during the discussion – an aspect of the episode intentionally not analyze for this study.

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