

UC Berkeley

UC Berkeley Previously Published Works

Title

Stories of Garlic, Butter, and Ceviche: Racial-Ideological Micro-Contestation and Microaggressions in Secondary STEM Professional Development

Permalink

<https://escholarship.org/uc/item/7tw77116>

Journal

Cognition and Instruction, 39(1)

ISSN

0737-0008

Authors

Sengupta-Irving, Tesha
Tunney, Jessica
Macias, Meghan

Publication Date

2021-01-02

DOI

10.1080/07370008.2020.1812612

Peer reviewed



Stories of Garlic, Butter, and Ceviche: Racial-Ideological Micro-Contestation and Microaggressions in Secondary STEM Professional Development

Tesha Sengupta-Irving , Jessica Tunney & Meghan Macias

To cite this article: Tesha Sengupta-Irving , Jessica Tunney & Meghan Macias (2020):
Stories of Garlic, Butter, and Ceviche: Racial-Ideological Micro-Contestation and
Microaggressions in Secondary STEM Professional Development, Cognition and Instruction, DOI:
[10.1080/07370008.2020.1812612](https://doi.org/10.1080/07370008.2020.1812612)

To link to this article: <https://doi.org/10.1080/07370008.2020.1812612>



Published online: 02 Sep 2020.



Submit your article to this journal [↗](#)



Article views: 21



View related articles [↗](#)



View Crossmark data [↗](#)



Stories of Garlic, Butter, and Ceviche: Racial-Ideological Micro-Contestation and Microaggressions in Secondary STEM Professional Development

Tesha Sengupta-Irving^a , Jessica Tunney^b, and Meghan Macias^c

^aGraduate School of Education, University of California Berkeley, Berkeley, USA; ^bTLC Charter Public School, Orange, USA; ^cGevirtz Graduate School of Education, University of California Santa Barbara, Santa Barbara, USA

ABSTRACT

Heterogeneity is fundamental to learning and when leveraged in instruction, can benefit racially minoritized children. However, finding ways to leverage heterogeneity toward disciplinary teaching is a formidable challenge and teachers can benefit from targeted support to recognize heterogeneity in STEM, and its relationship to race and racism in disciplinary teaching. These data draw from a nine-day professional development seminar for secondary teachers to promote heterogeneity in STEM learning ($n=12$). Drawing on analyses of lesson plans developed by teachers during the seminar, and subsequent video analyses of small group discussions, we present a case of four teachers debating heterogeneity in science. The exchange is significant because it draws into relief the ideological and emotional terrain of disturbing the racial hierarchy in which Western Modern Science (WMS) is steeped, and its implications for the education of racially minoritized youth. In the focus interaction, a dynamic emerged where three teachers exalted WMS, while the fourth grappled with how cultural heterogeneity has or could matter to her science teaching. Drawing on the constructs of racial-ideological micro-contestation and racial microaggressions, this analysis illustrates three important dimensions to the design of professional learning for STEM teachers that center race: (1) how discipline-specific discussions can uniquely surface the latent racial and ideological meanings teachers associate with STEM; (2) the centrality of teachers' storied knowledge in grappling with heterogeneity; and (3) the interplay of micro-contestation and microaggressions in understanding and anticipating the experiences of minoritized teachers when debating issues of race, disciplinary, and teaching.

Mathematics and science are heterogenous cultural practices learned in and out of school (Bricker & Bell, 2014; Nasir & Hand, 2008). In schools, the standards and policies of math/science learning reflect a normative canon of knowledge, values, and practices shaped by colonial and settler colonial histories (Martin, 2013; Medin & Bang, 2014; Mutegi, 2011). From this perspective, learning becomes a process of enculturation where, in Western Modern Science (WMS) for example, empiricism, objectivity, and rationale seem the only legitimate ways of knowing and being (Sorrel, 2013). The harms of this ideological fundamentalism are numerous: it obscures cultural heterogeneity in math and science, degrades learning into a form of racial ideological combat, disavows the epistemic authority of racially minoritized families, and deems strange practices that seem unlike WMS. As Mutegi (2011) explains in the education of African American youth, "to accept [WMS] ... as part of their own intellectual culture, is to indoctrinate them with the very ideas that support their colonization" (p. 305). Of significance to this analysis, the

cultural myopia of school science (and mathematics) threatens not only the education of racially minoritized youth, but also the work of contemporary science and mathematics teachers.

Teaching that engages heterogeneity in mathematics and science improves learning opportunities for racially minoritized students (Nasir, Rosebery, Warren, & Lee, 2006; Rosebery, Ogonowski, DiSchino, & Warren, 2010). By connecting how and what children experience of science beyond school with canonical representations found in schools, teachers recognize racially minoritized students as producers of knowledge and not simply consumers of WMS (e.g., Warren, Ballenger, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001). Although heterogeneity is fundamental to learning, teachers often struggle to recognize what is scientific or mathematical in racially minoritized children's everyday experiences (Bang et al., 2014; Taylor, 2012). It follows, then, that teachers would benefit from targeted support in understanding cultural plurality in STEM, and its relationship to race and racism in disciplinary teaching.

In racially stratified societies like the U.S. (Omni & Winant, 2014), engaging teachers in questions of race, racism, and disciplinary teaching can be a discordant process of unlearning and learning anew. Teachers may find themselves grappling with one another's racial histories and ideologies, while also grappling to understand how the disciplines and their teaching are implicated in questions of racial justice (Philip, 2011; Pollock, Deckman, Mira, & Shalaby, 2010). This analysis draws from data collected during a professional development seminar designed for secondary teachers to advance a view of heterogeneity in STEM learning. As part of the seminar, teachers developed classroom lesson plans. Drawing on lesson plan analyses and subsequent video analyses of peer discussions, we present a case of four teachers debating heterogeneity in science.

In the focus interaction, a dynamic emerged where three teachers exalted WMS, while the fourth grappled with how cultural heterogeneity has or could matter to her science teaching. This analysis makes three important contributions to research with STEM teachers in matters of race and racism. First, we illustrate how teachers' talk surfaced the latent racial and ideological meanings associated with science and teaching (dynamics that Philip, Olivares-Pasillas, & Rocha, 2016 term "racial-ideological micro-contestations"). This speaks to the unique strength of discipline-specific professional development as building on other efforts to engage teachers in questions of racial justice. Second, we demonstrate how destabilizing cultural hegemony in disciplinary learning engages teachers' storied knowledge (Carter, 1993) as a crucial resource of their sensemaking, particularly when adjudicating the value of changes to practice (Sengupta-Irving et al., 2013). In this case, the racial and ideological meanings of science were argued through stories teachers told of their childhoods, past life experiences, their students, and teaching. This calls for greater attention to the purposes of storytelling within justice efforts designed for teachers. Third and finally, we illustrate the corrosiveness of microaggressions in teachers' interactions. This is consequential for understanding the extent to which small group discussions (an otherwise routine practice of professional development) can become sites of vulnerability, scrutiny, and resistance for racially minoritized teachers in the midst of deliberating issues of race, disciplinarity, and teaching with others.

Prior research

In this section we engage three interrelated foci in prior research: (1) *Race and Teaching*, which describes frameworks or approaches to address racial justice and teaching generally; (2) *Race, Disciplinarity, and Teaching*, which integrates talk of race, racism, and discipline-specific teaching; and, (3) *Race and Teachers*, which explores the experiences of racially minoritized teachers in professional learning environments.

Race and teaching

Engaging issues of race and racism is an enduring challenge in teacher education (Cochran-Smith et al., 2016), made more difficult by colorblindness. Colorblindness, or colorblind racial ideology,

is a stance toward racial inequality that posits looking “beyond race, ethnicity and culture” as a viable pathway to racial justice (Gay, 2010, p. 145). As Harris (1993) argued, however, colorblindness is a form of racial subjugation that denies the legacy of white supremacy. In racially stratified societies like the United States, colorblind racial ideology is essentially a refusal to “recognize the obstacles facing people of color or to see that... different ethnic and racial groups may have distinct needs and interests” (Thompson, 1999, p. 143), including students of color in schools. This ideology has exhibited remarkable stability, particularly among white teachers (Stoll, 2014), which undermines them recognizing and dismantling the relationship between teaching and institutionalized racism in schools (Case & Hemmings, 2005).

Race, disciplinarity, and teaching

Research at the intersection of race, disciplinarity, and teaching takes as axiomatic that school mathematics or science are cultural canons of knowledge that reflect whiteness (Dyches & Boyd, 2017; Martin, 2013; Mutegi, 2011) and obscure the heterogeneity of learning otherwise surfaced in racially minoritized children’s everyday sensemaking (Gutstein, 2012; Medin & Bang, 2014; Rosebery et al., 2010; Warren et al., 2001). We begin this section with a brief description of studies that illustrate what is meant by interrelating race, disciplinarity, and teaching before describing the challenges of supporting teacher learning at this intersection.

STEM teachers engaging heterogeneity in learning most often involves eliciting racially minoritized children’s everyday sensemaking. For example, in their studies of racially, linguistically, and socioeconomically diverse primary students in science, Warren, Rosebery and colleagues have shown the varied ways children use language and embodied experiences to make sense of metamorphosis, animal behavior, and even the 2nd law of Thermodynamics (Rosebery et al., 2010; Warren et al., 2001). In the latter case, the authors explain how a child could create “a transformative space in which boundaries between their lived experience and scientific laws could become coordinated in new understandings” (Warren et al., 2001, p. 337). While the authors rightly emphasize the children’s role in seeing cultural practices through the “eyes and language” of WMS, we also recognize the pedagogical work that allows for the equal footing of everyday cultural knowledge and WMS (see also Barajas-López & Bang, 2018). Studies like these, and similar efforts in math (e.g., Taylor, 2009), destabilize racial hierarchies in STEM learning that otherwise leave white supremacy and settler colonialism untroubled.

Supporting teachers to engage cultural heterogeneity through disciplinary teaching is not trivial. Prior research illustrates the challenges of identifying disciplinary content in everyday practices, in treating the everyday and school-based domain knowledge as continuous, and in resisting the subordination of the everyday to school (Moschkovich, 2006; Taylor, 2012; Warren et al., 2001). And yet, when teachers link the everyday with school, they create new “sites for inquiry, and [space] for repositioning ‘minority’ students with respect to knowledge they produce” (Nasir, Hand, & Taylor, 2008, p. 214). In that sense, heterogeneity in STEM not only preserves the integrity of learning but also ratifies the epistemic authority of minoritized children and their families as knowers and doers of science, an authority otherwise ascribed to textbooks and standards of school science. Thus, while there exist programs in practice that encourage such teacher dispositions toward the everyday (e.g., TODOS, the People’s Education Movement, EduColor), there remains much more to learn about how to engender a view of cultural heterogeneity as fundamental to STEM learning. In particular, it may be that differences *among teachers*—by race, lived experiences, racial histories, ideologies, and so on—significantly shape what they see as possible or desirable for racially minoritized youths’ STEM learning.

Race and teachers

In this final section we look at what has been learned from the way racially minoritized teachers experience teacher education to consider what may surface in professional development that engages racially diverse teachers in discussions of race, disciplinarity, and teaching. After all, when teachers learn together they do so as a function of who they are and the histories of race, gender, and other social differences they embody (Haddix, 2012; Philip, Rocha, & Olivares-Pasillas, 2017). It is perhaps unsurprising that racially minoritized teachers see themselves as “insiders to the experiences of racism in schools” (Kohli, 2009, p. 235) in ways their white counterparts do not. This neither presumes commonality of experiences in teachers of color nor that teachers of color are exempt from reinscribing deficit racial ideologies (see Philip et al., 2017). Rather, it draws attention to the significance of race and the variability in how talk of race is experienced, when designing opportunities for teacher learning.

There is a growing body of research that explores the conditions under which racially minoritized teachers might experience aggression or conflict in teacher education. Kohli (2009), for example, finds Asian American, Black, and Latinx teachers experiencing shock, disappointment, and dismay at the ease with which white women in their teacher education program felt comfortable expressing racism or condoning racist behavior. Haddix (2012) describes similar experiences for two Black pre-service teachers, and draws particular attention to their use of “deliberate silence” as a response to the harmful or racist exchanges with white peers. Haddix’s use of “deliberate silence” inverts the trope of Black women as *silenced* to instead assert the women’s silence with white peers as expressing *voice*—as an act of selective, deliberate, and willful protection. These and similar studies that surface the microgenetic or moment-to-moment experiences of racially minoritized teachers are essential to developing a structure and language to describe their experiences and the implications for learning. In this analysis we mobilize two specific constructs—racial microaggressions and racial-ideological micro-contestations—to describe the dynamics that emerged in the focal interaction.

Racial microaggressions

Racial microaggression refers to a category of racist “everyday” interactions characterized as visual, verbal, and nonverbal insults directed toward people of color (Solórzano, Ceja, & Yosso, 2000). Sue and Constantine (2007) describe three forms of racial microaggression: microassaults, microinsults, and microinvalidations. Microassaults refer to instances of overt racism (e.g., use of a racial slur). Microinvalidations and microinsults are more subtle, referring to instances when a racially minoritized person’s knowledge or experiences are devalued or when done so, involves derisive language (e.g., “stupid” or “weird”). As a hypothetical, imagine an Asian Indian teacher describing Ayurveda as scientific practice, to which a colleague scoffs and says, “that folk stuff isn’t for school.” The dismissive tone and pejorative use of “folk stuff” serve as an insult, while denying her idea as appropriate invalidates what she sees as legitimate. In this analysis, as perhaps with real life, parsing microinsult from microinvalidation is less significant than recognizing the racial microaggression directed toward the Asian Indian teacher. While the construct of microaggression helps describe the exchange as harmful and disparaging, it does not yet fully characterize the racial and ideological meanings associated with science and teaching implicit in the exchange. For that, we look to the language of racial-ideological micro-contestation.

Racial-ideological micro-contestations

Philip and colleagues (2016) propose the notion of racial-ideological micro-contestations to address the analytical limitations of racial microaggressions. The authors build from Omni and Winant (2014) view of race as a constantly contested concept that “signifies and symbolizes social

conflicts and interests by referring to different types of human bodies” (p. 110). As an interpretive framework, racial-ideological micro-contestations concern interactions in which racial meanings are being contested. The *in situ* view offered through racial-ideological micro-contestations redress the limitations of racial microaggressions as requiring a “post-hoc” account by the targeted person or researchers using observation protocols, or as interactions extracted from the specific dynamics or contexts in which they emerged.

The explanatory power of racial-ideological micro-contestations lies in surfacing for analysts the “complex contestations over meanings of race in interactional spaces” (p. 363). As a theory of change, for example, the rearticulation of science with cultural heterogeneity is a move toward racial justice for minoritized youth. In practice, the temporal edges of racial-ideological micro-contestations can become a matter of interpretation as they unfold through a sequence of verbal and nonverbal assertions, comments, rejections, amendments, or extensions to one another’s thinking. This discursive and embodied construction of interlocutors brings into relief the peaks and valleys of sensemaking about racial hierarchy. Returning now to the hypothetical exchange concerning Ayurveda, while racial microaggressions well characterize the embodied and emotional dimensions of the Asian Indian teacher’s experiences, the debate is not simply about the debaters (Asian Indian vs. non-Asian Indian), the ideas under debate (X practice vs. Y practice), or how the teacher reports feeling about the exchanges. Rather, such an exchange must also be identified for the implicit racial and ideological meanings: for the exalting of WMS over Ayurveda as though it were the only way to know or be scientific.

Drawing on Hall’s theory of ideology, telescoped to the microgenetic level, Philip and colleagues (2016) explain that in the midst of racial-ideological micro-contestations come opportunities for people to rearticulate social phenomena, like teaching and learning. This means that as teachers affirm, reject, or remake one another’s thinking, the strength with which they associate science exclusively with WMS can fracture. If it were to happen, this fracture is not the function of a single hit: it is an accretion of exchanges that destabilize a chain of associations and create the conditions for rearticulation or new associations (Hall, 1985, p. 104). As Hall argues, the displacing, rupturing, contesting, or supplanting of one set of terms can eventually transform their meaning to another (more positive) set. Here, rearticulation or new associations of science with heterogeneity, the racially minoritized knower with epistemic authority, and the science teacher with being a student of others’ science practices.

In sum, this analysis builds on four key insights from prior research: (1) the power of colorblind racial ideologies, (2) heterogeneity as fundamental to disciplinary learning and as related to epistemic authority, and (3) the role of racial microaggressions and racial-ideological micro-contestations in studies of teacher learning.

Methods

These data draw from a nine-day professional development seminar designed for STEM teachers ($n = 12$) by faculty from a large public university’s School of Education and School of Engineering in a mid-sized suburb of Southern California. The seminar was advertised as expanding teachers’ professional practices in light of engineering practice standards in the newly adopted K-12 science education standards (NGSS Lead States, 2013).

The seminar had four interrelated foci: *Rigor*, *Standards Alignment*, *Feasibility*, and *Relevance*. Rigor referred to task design and assessment; Standards Alignment concerned the new organization of standards; Feasibility referred to what additional supports were needed to do engineering design projects with students; and Relevance referred to connecting disciplinary concepts or practices to children’s everyday sensemaking or experiences. Of significance to this analysis was

interrelation of Rigor and Relevance, for which the seminar leveraged the reform's definition of engineering as solving *human* problems to assert:

1. Cultural heterogeneity is fundamental to disciplinary learning;
2. Cultural heterogeneity can be meaningfully leveraged in disciplinary teaching; and
3. Cultural heterogeneity engages the epistemic authority of racially minoritized children.

Together, these assertions were a bid to integrate racially minoritized students' cultural knowledge and experiences of the disciplines in formal instruction.

Most days of the seminar were organized around three sessions of doing, reflecting, and planning. In morning sessions, engineering faculty introduced teachers to research projects that addressed human problems (e.g., energy depletion, heart disease). This modeled ways of talking about STEM learning as also always contending with human diversity. Mid-day sessions involved small and large group discussions of research describing how teachers leveraged heterogeneity in math and science (e.g., Gutstein, 2012; Tzou & Bell, 2010). Teachers were randomly assigned to groups or by disciplinary expertise. The third session involved two unstructured hours of collaborative lesson planning in service of practice.

The teachers represented a range of STEM disciplines, and all but two teachers taught a majority of racially minoritized students. They were seven middle and five high school teachers; seven taught science, four taught mathematics, and one was an after-school engineering club instructor. Ethnically and racially, the teachers identified as three white males, three white females, one Pilipino, one Pilipina, one Chicano, an Asian Indian man, a Vietnamese man, and a Chinese-American man. Teachers received \$500 for participating in the seminar.

Lesson plan analysis and the choice to focal follow

Each day teachers outlined a lesson plan based on the engineering module, and as inspired by the research case studies. At the end of the seminar, teachers finalized and submitted two lesson plans to implement. In analyzing the 24 final lesson plans, two independent investigators coded them in relation to engineering design and the integration of youths' knowledge/experiences beyond school (Table 1). The investigators reached a 95.3% inter-rater reliability and discrepancies were resolved through discussion.

Table 1 shows that *only one lesson plan* reflected an attempt to integrate students' knowledge or practices beyond school with disciplinary content, as promoted in the seminar.

As designers, we entertained multiple hypotheses to explain the lesson plan analysis outcomes. For example, standards, policies, and accountability systems may constrain teachers' innovating on their practices in this way. Other possibilities included: (1) teachers were unconvinced by the seminar's proposition of heterogeneity in STEM as fundamental to learning; (2) while teachers were convinced of heterogeneity in STEM they found it less relevant to teaching; or, (3) convinced of its value and relevance, teachers were not well supported to translate that into formal lesson plans.

Table 1. Lesson plan analysis results ($n = 24$ lesson plans).

Code	Definition	Number of lesson plans (% of total)
Engineering only	An engineering project in school	19 (79%)
Social worlds	A disciplinary (non-engineering) project based on experiences/knowledge beyond school	0 (0%)
Integrated	An engineering project that integrates experiences/knowledge beyond school	1 (4%)
Neither	A disciplinary (non-engineering) project in school	4 (17%)

As one step in exploring the lesson plan outcomes, we borrowed from the sampling methods of studying animal behavior to do a form of “focal follow,” where the talk and interactions of a single participant are centered for analysis. In this case, that meant engaging data related to the one teacher whose lesson plan most aligned with the intentions of the seminar. Rosa wrote the lesson, titled *Microfluidics of the Heart*. Rosa wanted students to interview family or friends impacted by heart disease, and then visit a local hospital to speak with patients or medical staff. In class, students would model different sized heart valve channels using a gelatin mold, sticks of spaghetti, yarn, and twine to explore laminar flow (the activity presented by bioengineering faculty). To conclude, students would draw connections between what they learned from people at home or in the hospital, and their heart models.

The focus interaction and participants

In a more conventional focal follow, the fieldworker observes one subject/participant for an extended period of time and records their behaviors closely, before moving on to do the same with another (e.g., Karniski et al., 2015). As a modified focal follow, we analyzed all of Rosa’s talk and interactions in small group discussions during the nine-day seminar ($n=6$ hours: see Data Analysis), her lesson plans, and her interview. From the video data, we present one of the discussions, which lasted nearly one hour and involved Rosa, Scott, Brad, and Abraham. This discussion is the best empirical window into understanding the racial and ideological meanings teachers associated with science and teaching at play in the seminar, and away from the ready-facilitation of engineering or education faculty. This view of the ideological, racial, and emotional terrain teachers traversed is important in taking steps to meaningfully strengthen future designs of professional learning that better anticipate and respond to their experiences.

The focal interaction occurred on the third day, when teachers were reflecting on a case study of elementary teaching that integrated students’ cultural knowledge and practices in a health science unit. As the teachers grappled with the ideas raised in the article, they offered a number of stories about themselves, students, and their teaching to argue the merits of integrating cultural knowledge in science instruction. While Rosa’s stories affirmed the value of heterogeneity in science teaching, her peers’ stories largely rejected the idea. In this way, the stories surface the racial and ideological meanings associated with science that come with rearticulating the discipline as a culturally heterogeneous practice.

The four teachers had diverse professional and personal histories. They did not know one another prior to the seminar, had been grouped together randomly, and this was their small group together. **Rosa** had 14 years of experience teaching Biology and Chemistry. Unlike her peers, she was educated in the Philippines and came to the U.S. as an adult, to teach science. Rosa taught in a high school of predominantly working-class Latinx and African American students. As she explained in her focus group interview, she designed *Microfluidics of the Heart* because the county her school was in had one of the highest rates of heart disease in California. She wanted students to learn how and why heart disease occurs in relation to blood flow, and what it means to live with the disease. Not having integrated science field trips before, her rationale was that it would help students “appreciate” and “understand” laminar flow better than what she described as her more typical “conceptual approach,” where connections between content and students’ personal experiences were not prioritized. **Scott** was a white male science teacher educated in the U.S., who had seven years of experience teaching multiple levels of Physics. Scott had a background in engineering, and was teaching at a predominantly white and Asian high school in a middle/upper-middle class planned community. **Brad** was a white male Education Technology teacher with 25 years of experience, who was educated in the U.S. Brad had a background in Physical Education, Biology, and Life Sciences. He taught at a middle school with a majority of Latinx students in a predominantly working-class community. Finally, **Abraham**

was a Pilipino mathematics teacher with nine years of experience teaching Algebra, Geometry, and Computer Aided Drafting and Design. Abraham was educated in the U.S. and was teaching at a middle school with a majority of Latinx students in the same city as Brad.

The case study being deliberated

In Tzou and Bell (2010) case study, at the heart of the focus interaction, the authors propose that teachers investigate children's everyday knowledge and practices for their relevance to school science content and as legitimate cognitive resources for teaching. They describe a seven-week intervention (*Micros and Me*) involving linguistically, culturally, and racially diverse elementary children with two objectives: First, to render science "more personally consequential to students' lives and cultural membership" (p. 1127); and second, to connect authentic scientific practices with students' everyday practices. The article reported on two iterations of the intervention. In the first, students shared what the authors described as "mainstream" health practices (e.g., eating vitamins, washing hands). In the second, after the teacher shared chicken soup as a family remedy, a range of health science practices surfaced, including drinking mangosteen for immunity, coining for sickness, and dancing for wellness.

Data analysis

All six hours of video representing Rosa's small group deliberations were analyzed. Video analyses followed what Powell, Francisco, and Maher (2003) describe as unfolding over seven phases: (1) Viewing attentively, (2) Description, (3) Identifying critical events, (4) Transcription, (5) Coding, (6) Constructing storyline, and (7) Composing narrative (p. 413). Using video content logs (Derry et al., 2010) for description, the first three phases of video analysis surfaced multiple episodes of talk in which the group grappled with race, science, and teaching. These episodes, identified as "critical events," showed Rosa associating science with heterogeneity or defending the epistemic authority of others (Table 2).

As part of the fourth and fifth phase of video analysis (Transcription, Coding), transcripts of the groups talk were chunked into exchanges—topically related turns of talk—that were often bookended by teachers interpreting the article and then telling stories about health science remedies or their teaching experiences. Each exchange was subject to content analysis and interpretation. Interpretations in qualitative content analysis are understood as a "co-creation of the researchers and the text" (Graneheim, Lindgren, & Lundman, 2017, p. 29)—where "text" here refers to the transcript and video of episodes—which is understood as having more than one meaning (i.e., latent meaning beyond the literal; Sandelowski, 2011). Thus, our analysis involved both the manifest content of what teachers said *and* what we interpreted as their possible latent

Table 2. Example analysis of manifest content and latent meaning.

Turn	Speaker	Manifest content	Latent meaning
89	Rosa	Yeah, somehow in our country we use this Vicks VapoRub. And, you know, Vicks VapoRub? Once you put it right there (<i>motions applying to her back</i>) it gonna heal your flu or your colds because of the, what? May be the absorption of the mint into our body?	<i>Health practice associated with the Philippines asserted as akin to ones described in the article; assertion aligns with the central argument.</i>
90	Scott	I've never heard of rubbing on your back. I've heard of rubbing it on your chest so that the vapors go through your nose	<i>Assertion challenges prior turn of talk; challenge to the science legitimacy of the practice and/or an invitation to clarify</i>

meaning within the conversational flow. Moving between manifest content and latent meaning meant interpreting the relationship between each successive story and the case study's central argument of heterogeneity in science (example in Table 2). The latent meaning often surfaced teachers' racial and ideological associations with science and teaching.

Table 2 is organized by turns of talk, speaker, and the interpretation of manifest content and latent meaning in context. This process built to an overall analytic storyline, reflecting what Powell and colleagues (2013) describe as the sixth stage of video analysis. Arranged chronologically by exchanges, the storyline (stage 7) presented next, preserves the conversational flow as we provide excerpts of the manifest content (transcript) and interpretations of their latent meaning.

Analysis

The analysis is presented across five exchanges. Exchanges 1 and 2 illustrate the dynamics emerging in the group: verbal and nonverbal assertions, disputes, and reassertions as conveyed through stories of garlic, butter, and *ceviche*. These exchanges are the context and substance of a racial-ideological micro-contestation over cultural heterogeneity and the epistemic authority of racially minoritized people in science. The dynamic pits Rosa against Brad and Scott most explicitly, and she becomes vulnerable to microaggressions. Exchange 3 reflects a brief respite within the racial-ideological micro-contestation, which is important to understanding the conversational flow, as Exchange 4 returns the group to their disputes. While the fifth exchange maintains the racial-ideological micro-contestation (and marks the end of the discussion), unlike the previous exchanges, it surfaced teachers' stances toward colorblind racial ideology in science teaching.

Exchange 1: a story of garlic

In this exchange, Brad, Scott and Rosa discuss the relationship between garlic and the human body. Rosa explained that garlic is a natural agent that boosts body temperature, an idea longstanding in Traditional Chinese Medicine, Ayurveda, and homeopathy. Brad and Scott disputed the idea and rejected its value as a topic of discussion in human biology.

To begin, Rosa drew a connection between the health science practices of children in the article and her childhood experiences in the Philippines:

When I was reading our assignment about the culture it came into my mind about the different things ... in our country (*gestures to herself and Abraham*) ... They said garlic, if the students did not want to go to class, what they going to do is to put this garlic under their armpits and then the temperature, the body temperature, will be higher so that means to say it could have been a fever. So, that can be used as a reason of the student not to get into the class ... I came to give that [idea] as a lesson to [my biology] class ... What is it in garlic that made the body temperature rises?

Rosa framed the use of garlic to raise body temperature as a cultural practice of children in the Philippines. Rosa seemed to recruit Abraham in her position by gesturing to him when saying "our country," suggesting she expected alignment from him as someone also from the Philippines. Abraham, however, remained silent throughout this and subsequent exchanges until the final exchange. In sharing her reflections on the article, Rosa identified a relationship between garlic and biology ("the body temperature will be higher") and used it to justify scientific inquiry ("What is it in the garlic that made the body temperature rises?"). She ended by affirming the use of children's cultural practices as a basis for science instruction ("give that ... as a lesson").

Next, Brad (with Scott) disputed the scientific legitimacy of Rosa's garlic story and its value as an instructional activity:

We interpret Brad and Scott's laughter, incredulous tone, and shared glances (Turns 12, 16, 18) as disputing Rosa's assertion that garlic had a legitimate relationship to human biology (i.e., dis-

Turn	Teacher	Talk
12	Brad	That's funny. Did [students] think that was funny? That story? I've never heard of that.
13	Scott	I've never heard of that. (<i>Shakes head</i>)
14	Brad	I've never heard that either.
15	Rosa	Oh, yes. That is one of those that has been happening in the Philippines.
16	Brad	(<i>Laughs and looks at Scott questioningly</i>)
17	Rosa	And you know, this cultural processes are actually a good source of science fair projects, you know, science fair projects? Yeah.
18	Brad	To try some of them to see if it really works? You try putting the garlic [in armpits] to see if it really does make your temperature [rise]? Like, to <i>actually</i> do that?
19	Rosa	Yeah, to find out. And it gonna have, you know, different ways, you can see right here – (<i>gestures to screen with article argument summarized</i>) if you're using it and then you're gonna make it into a science fair project using the science subject matter. Yeah, it could be somewhat educational too.

puting her epistemic authority in science). The basis of his dispute, it seemed, was that he had not heard of garlic's relationship to body temperature before (Turns 13, 14). In response, Rosa offered a rearticulation toward heterogeneity in science: She defended garlic's temperature raising properties as known (Turned 15), as worthy science inquiry (Turns 17, 19), and by gesturing to the article itself (Turn 19), asserted her experiences were akin to what the article suggested can be learned from racially minoritized students' home practices (i.e., her epistemic authority based on experiences tied to her childhood in the Philippines).

This exchange, the first in a series, reflects a racial-ideological micro-contestation: On one hand, WMS being asserted by two white men as the rubric of validity and on the other, a Pilipina immigrant whose assertions supported cultural heterogeneity in science. Indeed, when Brad and Scott use what is familiar to them as the norm, Rosa's assertion of what is familiar *to her* is made strange and illegitimate. As Rosa's story of garlic is met with microinsults (Turn 12, 18), and her authority to know its relationship to human biology is met with microinvalidation (Turns 13–14), the racial-ideological micro-contestation seems to also invoke racial microaggressions directed at her¹.

Exchange 2: stories of butter and Ceviche

This extended exchange immediately followed the previous. In it, a sequence of stories were told—about butter, about ceviche—which, when taken together in the overall flow of talk, evidence a continued racial-ideological micro-contestation over what counts as legitimate health science practices. Brad began:

There was a neighbor kid across the street. When he was little, riding his scooter, [he] falls down, Boom!, big bump on his head... so we grabbed him some ice, you know, right away put the ice on him and [his parents] came out, and you know, a few minutes later the ice is off and there's a stick of butter, and the stick of butter is (*motions exaggeratedly as though slapping a stick of butter on his forehead*)... And they said, you know, we put butter on it, on the bump. For some reason. No idea. Butter. So, have you ever heard of *that* one?! (*Gestures towards Abraham and then Scott, who says he heard of butter on burns but not bruises*).

While not associated exclusively with racially minoritized families, butter on a bruise is a natural remedy sometimes associated with Latinx families. When Brad gestured and turned to Abraham and Scott specifically (not Rosa) to ask if they have “ever heard of *that* one,” he seemed to expect alignment from them while also distancing himself from Rosa. Scott ratifies this alignment by saying he too had not heard of butter on bruises. In offering this story, Brad seemed to

¹As we will raise in the discussion, the associations of STEM with whiteness *and* dominant masculinity (Harding, 2016; Leyva, 2017) argue the likelihood that the micro-contestation and microaggressions are implicit with meanings of race *and* gender.

be creating a category of nonsensical “scientific” practices—previously, garlic in the armpit and now butter on a bruise—as though Rosa or his neighbors lacked epistemic authority in science to know better. In response, Rosa then implicitly disputed Brad’s moves by considering how butter on a bruise may have a basis in human biology. Rosa said, “I’m thinking about the cohesion and adhesion of the molecules,” and as the others remained silent she continued:

You know, in my lessons sometimes I think... [about] the art of questioning... and we should, as science teachers, as math teachers, in order for [students] to really use [math/science] in their daily lives... We have to really point it out and [ask], what makes it the butter to really let the bump rest right there, you know, some science? What is it in it? Investigation!

Rosa seemed to strategically repurpose Brad’s story to assert that cultural heterogeneity in science creates opportunities to model and engage youth in scientific inquiry. We highlight two dimensions of Rosa’s discursive (perhaps even pedagogical) move: (1) it sought to reconcile notions of WMS (“Investigation!”) with what children do every day, even if unfamiliar; and (2) by presuming a possible relationship between butter and a bruise, she extended epistemic authority to the parents regarding what heals their child’s body.

Rosa then asked if Brad talked to the parents about butter on a bruise. He said, “Well, I didn’t want to tell the kid his parents were stupid for putting butter on him, you know? I didn’t want to necessarily go talk to them about it either, so I didn’t mention it.” Brad’s use of “stupid” and his reluctance to engage the parents suggests he saw nothing scientific in what they did. Brad then paralleled this to the way his Latinx students often “bring up weird stuff,” which he explained he would listen to, but generally was largely unimportant to science teaching.

While the ethnic or racial heritage of the neighbors went unmarked in this exchange, we interpret this as a story of a nonwhite family’s home health science practice based on Brad’s tone, the placement of his story in the conversational flow, and the dismissive and pejorative language he used that then led him to reference his Latinx students. The story of butter seems to be about people and practices he finds culturally distant from himself and WMS. The story thus maintains the racial-ideological micro-contestation that began in the first exchange. Further, we interpret Brad’s rhetorical use of “weird” and “stupid” within the conversational flow as a racial microaggression directed at Rosa for having entertained the idea that butter has a legitimate relationship to human biology.

The exchange ended with Rosa telling a story about learning to make *ceviche* from a student. *Ceviche* is a dish made from raw seafood, spices, and citrus juice that originated in South America but is often associated with Mexican cuisine in Southern California:

I’m learning through too, you know, their culture is different. I remember another thing about this, what you call, *ceviche*? *Ceviche* is a kind of food in Mexico and then one of my students... She was the one who acted as a teacher to me because I didn’t know, but she was the one who told me how to put it on the *tostada*... so therefore [with] the cultural insights from her, I began to learn.

Rosa’s story of *ceviche* seems yet another bid for rearticulation: a move to build connections between being a science *teacher* and a *student* of cultural practices. This directly challenged Brad’s reference to the “weird stuff” his Latinx students raise. Rosa then connected the story of *ceviche* to the case study:

Because for me, what I experience about these garlic thing they made into the scientific project, and also the *ceviche* for my family – Pilipinos learned something about Hispanics – I believe they are desirable things... If you [want to] know, that’s what I am understanding about this [article]. Getting to the little details and then putting it up for us to, to grow somehow... so for me, I actually learn from them.

This was her most explicit declaration of what she understood from the article and, in a sense, an apt summation of where she stood in the racial-ideological micro-contestation unfolding across the exchanges. For Rosa, the article was an opportunity for rearticulation: to associate science with cultural heterogeneity, to associate the everyday practices of families with the epistemic authority to know science, to associate being a science teacher with being a student of one’s

students. As Rosa explained, teachers can grow the “little details” of children’s lives (e.g., garlic in the armpit, butter on a bruise) to explore their “connections” to science in ways meaningful to both students and teachers (“I actually learn from them”).

Exchange 3: a story of mangosteen

The next exchange concerned drinking mangosteen, something East Asian children in the article described. Although Rosa was familiar with the fruit, none of the teachers had heard of its use as a remedy. Mangosteen is purple with bitter seeds segmented inside, similar to an orange. It has essential nutrients that promote coronary and heart health; its high levels of antioxidants and Vitamin C also help with pain relief, infections, fatigue, allergies, and intestinal distress. Remembering she had heard of mangosteen in the Philippines, Rosa recalled: “They said it’s good for, maybe, I was rather thinking a scientifically-based, it might be some kind of sour so it get Vitamin C, that’s why.” As she had done with butter on a bruise, Rosa presumes drinking mangosteen has a legitimate basis in health and human biology. Unlike the butter story, however, her wonderings were not dismissed. Instead, Scott said, “So, it’d be like us...” to which Brad finished, “eating an orange?” Scott nodded and continued, “Yeah, you’d like drink some orange juice.” The exchange is significant for two reasons. First, it was a respite from the racial-ideological micro-contestation and racial microaggressions of previous exchanges. Since Brad and Scott made the unfamiliar practice seem familiar (to themselves, to WMS) they raised no objections to it. In turn, Rosa did not have to defend the practice or work to rearticulate science, which meant she was never positioned to be insulted or dismissed. Second, the exchange suggests there was some flexibility in Brad and Scott’s views of science, which is fundamental to its rearticulation—to associating science with heterogeneity. What happened next, however, suggests the tenor of agreement achieved in this exchange was short lived as the racial-ideological micro-contestation of the first two exchanges resurfaced in the fourth.

Exchange 4: a story of Vicks VapoRub

In this exchange, Brad and Scott were presented with a known remedy (Vicks VapoRub) used in an unfamiliar way. This exchange contrasts with the first two exchanges about garlic and butter (unfamiliar practices) and the third about mangosteen (unfamiliar practice made familiar). Nonetheless, it resurfaces implicit racial hierarchies in science and thus continues the racial-ideological micro-contestation set in motion in the first two exchanges.

In the article, a child describes a “green oil” rubbed on their backs in times of sickness, a likely reference to coining. Coining is a practice of dermabrasion therapy often associated with East and Southeast Asian families. The skin is lubricated and then a smooth hard-edged object (like a coin) is applied with pressure in downward strokes along the person’s back to relieve negative energy/illness. Brad mistakenly referred to mangosteen as the lubricant and when corrected, it prompted Rosa to recollect a similar practice in the Philippines:

Vicks VapoRub is a viscous substance with ingredients that include camphor, menthol, eucalyptus leaf, and other oils, and is used as aromatherapy to relieve cough and congestion. A prod-

Turn	Teacher	Talk
89	Rosa	Yeah, somehow in our country we use this Vicks VapoRub. And, you know, Vicks VapoRub? Once you put it right there (<i>motions applying to her back</i>) it gonna heal your flu or your colds because of the, what? Maybe the absorption of the mint into our body?
90	Scott	I’ve never heard of rubbing on your back. I’ve heard of rubbing it on your chest so that the vapors go through your nose.
91	Brad	(<i>Nods</i>) Through your nose. (<i>Makes upward sweeping motion with hand from chest to nose as though inhaling</i>)
92	Rosa	Yeah, also on your back, somewhat like that – (<i>gestures to article</i>)
93	Brad	I’ve never heard of that [coining] either. I think the directions say put it on your chest or under your nose.

uct of multinational manufacturer Procter & Gamble, Scott, Brad, and Rosa were all familiar with Vicks VapoRub. For some, the rub is applied to the chest or throat so that the vapors can reach the nose and mouth. Brad and Scott were familiar with this use of it (Turns 90, 91, 93) and disputed Rosa's description of its application and her gestures demonstrating how it is used on the back (Turns 89, 92), a practice she associated with the Philippines. Her use of "our country," as she had in the very first exchange, was a discursive move that once again implied her expected alignment with Abraham during this exchange. Abraham, however, did not speak or otherwise indicate an alignment with Rosa during this exchange.

Here, the racial-ideological micro-contestation resurfaces because although the remedy was familiar, Brad and Scott disputed Rosa's authority to know how to use it correctly/scientifically (i.e., her epistemic authority), and Abraham's silence offered her no support. Thus, they treated what Rosa said and associated with people of the Philippines as *not familiar enough* to go undisputed (as in Exchange 3). Again, deploying the language of "never heard of that" (Turn 90; previously, Turns 13 & 14), Brad and Scott drew an implicit boundary in which their personal experiences and what they recalled of the written directions (Turn 93) had scientific authority over Rosa. This, even as her empirical basis was also personal experience and a reference to text (Turn 92). The exchange again makes visible how the emergent racial-ideological micro-contestation over science carried racial microaggressions directed at Rosa. After all, in arguing their position, Scott and Brad were intimating that Rosa was incapable of following directions or that what people do in the Philippines is meaningless in the U.S.

Exchange 5: a story of history teaching

The fifth and final exchange, which marked the end of their small group deliberation time, stood apart from previous exchanges because it made visible other racial and ideological meanings at play in the group. In the exchange, Scott, Abraham, and Brad asserted that cultural heterogeneity was irrelevant to science teaching and may in fact be a disservice to racially minoritized youth. They argued that: (1) building rapport with students does not require knowledge of cultural practices; (2) engaging the cultural practices/histories of students undermines content learning; and (3) culture is irrelevant because science and mathematics are culturally neutral disciplines.

Scott summarized the article as teachers "learning to connect with the kids of different cultures in order to adjust their teaching styles."² He then argued this was unnecessary for him because he lives "right across the street from the high school" and can regularly talk to students. This was a misinterpretation of the article's argument, but one that prompted Abraham to engage with a story about a history teacher:

Turn	Teacher	Talk
101	Abraham	I substitute at Oaktree Unified School District ... and so one of the teachers there he was ... telling me his frustration because a lot of his kids, a lot of his students, were may be residents of the United States for a few short years – three, four years. So, he was telling me, as he would talk about Thanksgiving and all these events, celebrations, things that he teaches in history, he felt a disconnect. The kids were just, because their culture was -
90	Scott	- there was no cultural foundation.
91	Abraham	Yes, being that they just came -
92	Scott	- a [lack of] mutually shared foundation.
93	Abraham	Yes, being that they just came from Vietnam, etcetera, they just somehow were disconnected with the lessons. He felt that the importance of these events that he would talk about, [they] were just, again, not there. He was very, I guess, discouraged and frustrated and he expressed that to me. So tough, tough.

²Brad's interpretation of the article, offered elsewhere in the conversation, was similar to Scott's as one of teachers needing to build rapport so students will improve their dispositions toward learning science: "I think the point was [for teachers] to try to make a connection with students to get them to feel better about the whole class or the topic."

Abraham's story of the history teacher and Scott's previously stated interpretation of the article both challenge the idea that cultural heterogeneity benefits disciplinary teaching: for Scott, building rapport does not require it; and for Abraham, non-U.S. born children's cultural knowledge (as all children have cultural knowledge) is less valuable or seen as unrelated to children learning about events in U.S. history. Scott's interjection (Turns 90, 92), to which Abraham repeatedly says, "yes" (Turns 91, 93) came with direct eye contact and a lean forward, all of which suggested their shared position in the argument. Abraham then continued, "those kids should now embrace the values that we have here and learn this material," suggesting that the most relevant knowledge for the children is reflected in U.S. school standards. In fact, U.S. history is a global history, including global migration where, for example, the children and their families may have unique knowledge and perspectives on events in U.S. history in relation to their U.S. born counterparts. As important, Abraham's example of Thanksgiving as an historical event or celebration that immigrant children should have known makes clear what is *not* culturally "neutral" about such a stance. The racial and ideological meaning he ascribed to Thanksgiving as something to value normalizes settler colonialism without seeing, as others argue, Thanksgiving as a day of mourning and protest in recognition of Indigenous erasure (see Zotigh, 2019).

In the closing minutes, Scott, Abraham, and Brad cemented their stance within the ongoing racial-ideological micro-contestation about the value of heterogeneity in science as they looked to one another and rapidly built each other's talk. Scott first explained: "I kind of look at it as math and science as being, almost, culturally neutral." Abraham then added, "Math is universal." And, in quick succession, phrases like, "facts and figures," "not, how do you *feel* about it," "no politics," "it's black and white," and "right and wrong," were traded among them until Scott concluded, "So, do I really need to know about the kids' background? I'm more interested in ... their math [achievement] background." After a pause, Rosa argued, "objective" teaching (a word she equated to their use of "culturally neutral") was the undesirable old way of teaching: "Yeah, so we have just, 'this is right', 'this is wrong'—that is being objective. But, in subjective, we will come to know the individual students ... now we are emphasizing giving reasons, giving justifications for whatever you have." Referring both to the case study and the newly released NGSS standards ("now we are emphasizing"), Rosa saw "subjective" science teaching as affording opportunities to engage students in scientific inquiry, reasoning, and justification that can be extended to cultural practices beyond school. Here, as in previous exchanges, her argument was a bid for rearticulation: to associate science with cultural heterogeneity, to associate the everyday practices of children with scientificness, to associate being a teacher with being a learner. In that sense, up to the end, Rosa remained steadfast in her attempt at the rearticulation of science teaching with her peers.

Summary

This analysis explored the interactional dynamics and implicit racial and ideological meanings teachers associated with science in reflecting on a case study of elementary teaching. Table 3 summarizes the racial-ideological micro-contestation that emerged, primarily as a function of Brad and Scott's (un)familiarity with non-WMS health practices. Notably, Brad and Scott dismissed unfamiliar practices that Rosa attested to through personal experiences (garlic, Vicks VapoRub) even as they allowed for an unfamiliar practice to be remade as familiar based on *their* experiences (mangosteen). In that sense, the analysis shows how the racial-ideological micro-contestation made Rosa vulnerable to race and gender microaggressions: how a debate about heterogeneity could devolve into insults directed at the person who most embodied heterogeneity as a woman of color science teacher.

The fifth and final exchange, not depicted in Table 3, saw Brad, Scott, and Abraham explaining cultural neutrality in STEM teaching. As Rosa disputed the viability of such a stance in light of NGSS, she made a final bid to rearticulate science with her peers.

Table 3. Summary of teacher stances and group dynamics by exchange/health practice.

	Rosa			Brad, Scott			Group Dynamic
	Familiar	Unfamiliar	Scientific	Familiar	Unfamiliar	Scientific?	
1: Garlic as Heat Agent X			Yes		X	No	Racial-ideological micro-contestation & microaggressions
2: Butter on Bruise	X		Possibly		X	No	Racial-ideological micro-contestation & microaggressions
3: Drinking Mangosteen	X		Yes	(Oranges)	← X	Yes	Agreement & Affability
4: VapoRub on Back X			Yes		X	No	Racial-ideological micro-contestation & microaggressions

Discussion

This analysis offers one perspective in exploring lesson plan outcomes by bringing forth the racial, ideological, and emotional dynamics that can be at play for teachers in talking about race, disciplinarity, and teaching. This section is organized into four themes related to the focal interaction with an interpretive eye toward meaningfully strengthening future designs of professional learning that better anticipate and respond to the sensemaking and experiences of teachers. The four themes are: (1) the relationship between colorblind racial ideology and culturally neutral STEM teaching; (2) heterogeneity as a challenge to epistemic authority in STEM; (3) the interplay of micro-contestation and microaggressions; and, (4) the significance of teachers' storied knowledge in deliberating changes to practice.

Colorblind racial ideology and STEM teaching

Colorblind racial ideology suggests teachers should “look past” children’s racial identities as an act of racial justice (Gay, 2010). Brad, Scott, and Abraham expressed colorblind racial ideology through the language of “culturally neutral” STEM, and posited it as a better approach than was raised in the case study. In contrast, the seminar (like the case study) argued heterogeneity as fundamental to STEM learning in its design. The focal interaction shows that the premise of the seminar itself was disputed. It seems reasonable, therefore, to conjecture that colorblind racial ideology may have played some role in why the majority of teachers’ lesson plans did not seek to integrate children’s worlds with disciplinary content (Table 1).

We see value in naming the form of colorblind racial ideology that emerged in the focal interaction, “cultureblind STEM teaching” in future work with teachers. While colorblindness implies a blindness toward racial identities of people, cultureblind STEM signals a blindness to the anti-Black, colonial, and settler colonial histories that have shaped WMS (and mathematics) to be anything but “culture-free” (Martin, 2013; Medin & Bang, 2014; Mutegi, 2011). This marks a path toward racial justice as emphasizing heterogeneity and challenging racial hierarchies in the disciplines that cultureblind STEM masks.

Rosa’s contributions offer some guidance in how to approach cultureblind STEM. She shows, for example, what happens when experienced teachers take an investigative or naive stance toward the disciplines. Whether a familiar (garlic) or unfamiliar (butter, mangosteen) health science practice, Rosa sought connections to human biology. This was significant for three reasons. First, while children’s everyday practices are argued as valuable “sites of inquiry” for minoritized students (Nasir et al., 2008), Rosa showed how they are also valuable sites of inquiry for teachers. Second, as scholars call for supporting students in navigating multiple science epistemologies (e.g., Barajas-López & Bang, 2018; McGinty, 2018), Rosa’s actions invite consideration of what

support STEM teachers may need to do the same. Third and finally, Rosa was enacting what Dyches and Boyd (2017) describe as the kind of discipline-specific knowledge needed to complement knowledge of social inequality or critical pedagogy generally, in envisioning teaching as a movement of justice.

While Rosa took an inquisitive stance toward various science practices without prompting, future discipline-specific professional learning could be structured for teachers to use their subject matter training in investigating heterogeneity. Such inquiry should also historicize the practices in relation to economic, political, and social contexts. For example, with Tzou and Bell (2010) case study, this could have meant discussing Traditional Chinese Medicine or Ayurveda as centuries old science practices with histories of resisting colonialism, the rise of allopathy, and indictments of quackery (Loudon, 2006; Wujastyk & Smith, 2013). More generally, it could mean exploring contemporary debates over WMS and the science of Indigenous and minoritized communities (e.g., Nicholas, 2019; Sneed, 2019). All in all, these are but a few examples of how to cast STEM disciplines in school as a canon within a much wider field of global possibilities; of how to surface racial hierarchies in STEM and the pernicious ways they bestow more or less legitimacy to particular knowledge, practices, and persons.

Epistemic authority

If cultureblind STEM draws attention to the ideological and racial meanings associated with the disciplines, then epistemic authority draws attention to the ideological and racial meanings associated with teaching/teachers (i.e., being an authority of the discipline). Until racial hierarchies in STEM are disrupted, epistemic authority will continue to follow whiteness and dominant masculinity (Harding, 2016; Leyva, 2017). This was most vividly represented by the two white male teachers, Brad and Scott: in the language Brad used to describe his neighbors or the “weird stuff” Latinx students share, in the way he and Scott dismissed Rosa for assigning garlic in the armpit as a science investigation, and in how perplexed they were by the idea that Vicks VapoRub could be used in ways different than theirs. This was also conveyed through eye gaze and gestures that culminated in their alignment while also distancing from Rosa. Moreover, despite Rosa attempting to gesture an alignment with him over their shared Pilipinx heritage twice during the focal exchange, he neither gestured, spoke, nor positioned in ways that met her expectations of support or agreement. Their reactions suggest the seminar failed to convey that epistemic authority is not a zero-sum game: recognizing the authority of students does not undermine the authority of teachers. As with Rosa, cultural heterogeneity in STEM is not a fork in the road (i.e., teacher as authority, student as authority) but rather, a widening of the road along which she, or her students, could lead.

Dismantling cultureblind STEM teaching opens doors to new relationships with students and their families. This rationale may be as important to some teachers as any other. Through the story of *ceviche*, for example, Rosa spoke with reverence about how “Pilipinos learned something about Hispanics,” and went on to describe that as “desirable things” in an era of science reforms. She ascribed epistemic authority to racially minoritized families: When asking about butter or mangosteen, she did not argue the unfamiliar practice *had* a (WMS) scientific basis; rather, she extended the families enough epistemic authority to pursue the possibility. By ascribing epistemic authority to persons unknown, Rosa was fracturing the exclusive association of scientificity with WMS or with those who ostensibly (racially, culturally) embodied it.

Hall (1985) argues that fractures in ideology come from an accretion of exchanges that destabilize what people take as known. As her peers repeatedly said, “Never heard of that,” Rosa challenged what they had “heard of” as the benchmark of whether others (including herself) know science. For example, when Brad and Scott described Vicks VapoRub on the chest as familiar and therefore, right, she conjectured it could also work by absorption through one’s back. She was fracturing their association (read: familiar) to create a new association by which rubbing menthol

anteriorly or posteriorly, are equally intelligible science practices. Similarly, by asking Brad if he talked to his neighbors about the butter, she implied there was something to learn from them. Indeed, across the exchanges, Rosa's agentic resistance to racial hierarchies (among sciences or science knowers) was an unrelenting effort at rearticulation: science with heterogeneity, racially minoritized people's practices with epistemic authority in science, and science teachers with becoming learners of yet-unknown science practices.

Rosa reminds us as designers, therefore, that whatever ideological shifts we thought possible over the course of a seminar, or whatever we imagined could be evidenced by lesson plans in just nine days, ideological change in STEM teaching, if it is to come, will take an ongoing commitment of many small efforts with and by teachers, over time.

The interplay of racial-ideological micro-contestations and microaggressions

The focal interaction extends prior research on racial-ideological micro-contestations by identifying the interplay of disagreements that carry implicit meanings of race and ideology with insults and invalidations directed at racially minoritized people.³ Notably, while these constructs forward attention to race, racial hierarchies in STEM are also always gendered (Harding, 2016; Leyva, 2017). As domains that uphold whiteness and dominant masculinity, therefore, our use of *racial* microaggressions and *racial-ideological* micro-contestations are more aptly, *race-gender* microaggressions and *race-gender* micro-contestations. The intersections of social difference are as numerous as the systems of oppression and as such, we also conjecture Rosa's Pilipina accented English, and readiness to identify as an immigrant, made her vulnerable (race-gender-language-nativist microaggressions). Rather than continue to hyphenate the microaggressions, however, what matters here is understanding their importance in ethically and responsibly designing professional learning at the intersection of race, disciplinarity, and teaching.

Within each exchange, Brad and Scott's dismissive tones, body positioning, and gestures, along with Abraham's silence, worked to challenge, dismiss, or otherwise repudiate Rosa's experiences and reflections on the case study. In rearticulating heterogeneity in science through stories of her life in the Philippines (garlic, Vicks VapoRub) or as a teacher of Latinx students (*ceviche*), the emergent micro-contestation was not just an abstract rejection of heterogeneity or the epistemic authority of minoritized people. Rather, it was a manifest and visceral challenge to Rosa as a Pilipina immigrant teacher. Ironically, Rosa was the only practicing biology teacher in the group (though Brad had a background in it also), a basis of knowledge and experience one might otherwise be credited in debates about health science, human biology, and teaching.

Highlighting the interplay of micro-contestations and microaggressions leads to important questions about how teachers of color might experience talk of disciplinarity, race, and teaching. If racial-ideological micro-contestations can be anticipated as likely (and desirable), then understanding the interplay of micro-contestations and microaggressions is necessary. Prior research suggests that facilitation of teachers' discomfort enhances learning (Remillard & Kaye, 2002). This case, however, warns of discomfort devolving into insult: We remain troubled that we had not anticipated Rosa's epistemic authority or personhood (as the only woman of color) would be disparaged. So, on one hand the interplay that emerged could mean greater vigilance in facilitation. On the other, Rosa's agentic resistance inverts the trope of racially minoritized women's vulnerability (Haddix, 2012) and shows how "unfacilitated" small groups can become facilitated from within. In that sense, how professional learning might safeguard the personal and professional identities of teachers from undue scrutiny or ridicule remains an open question.

³Within the group, Abraham is also racially minoritized and like Rosa, an immigrant from the Philippines (though educated in the U.S.). He did not share her views on the merits of engaging heterogeneity, which affirms that although teachers of color may have insider knowledge on issues of race and racism they are diverse in their interpretations of race, disciplinarity, and teaching (Kohli, 2009; Philip, Rocha, & Olivares-Pasillas, 2017).

Storied knowledge

By inviting talk of race, disciplinarity, and teaching in professional learning, we widen the door to teachers' storied knowledge (Carter, 1993) where teachers' individual histories of race are ushered in. Elsewhere, we have argued the importance of attending to teachers' stories as retrospective accounts that rationalize prospective plans to change (or not) their practices (Sengupta-Irving, Redman, & Enyedy, 2013). We find a heavy reliance on storied knowledge in the focal interaction to reaffirm those claims. Without re-analyzing the stories here, we recognize how the teachers used them to move between past, present, and future; and how they messaged implicit meanings of race, science, and the validity or value of heterogeneity in STEM. Indeed, we even looked to the stories as units of analysis in reckoning with the manifest content and latent meaning of teachers' talk.

In future designs, teacher educators and researchers should consider ways to slow the unproblematic take up of stories as directing teachers' future practices. After all, the danger in storytelling is that a single story of experience can be an incomplete and fragile basis from which to make pedagogical decisions. We suggest using stories as an object *of* and *for* analysis with teachers—what we have previously described as “re-storying practice” (see Sengupta-Irving et al., 2013). In re-storying practice, teachers' stories become opportunities to engage new ways of teaching and seeing students. In a related discussion of “(re)storying” land with teachers, Bang et al. (2014) describe how land can be (re)storied to show that settler colonialism in science is “foundationally implicated in teaching and learning” (p. 39). Taken together, re-storying/(re)storying are processes that mobilize storied knowledge as mirrors and windows that trouble the meanings of race and ideology associated with what teachers know (whether about a discipline, experience, or land), and in supporting them to reach for evermore expansive possibilities for their students and especially, for themselves.

Conclusion

Given the relentless demands on teachers, there are few opportunities for them to ask: “Whose science? Whose math?” The enduring absence of such questions, and the changes to STEM teaching they compel, are of dire consequence to racially minoritized children's experiences of STEM. Denying cultural heterogeneity in STEM marks an erasure of people past and present, an erasure of knowledge, and the erasure of opportunities to learn. It transforms STEM teaching into an experience of cultural, personal, and ideological combat for racially minoritized youth and, as we saw here, teachers. Professional development focused on race, disciplinarity, and teaching is thus critical to any effort at advancing minoritized students' opportunities for deep, rich, and rigorous disciplinary learning. The designers of such opportunities, in turn, have an ethical responsibility to safeguard teachers—to anticipate the disequilibrium that comes when others cannot or will not see them and the value of their experiences as fundamental to each other's learning.

ORCID

Tesha Sengupta-Irving  <http://orcid.org/0000-0001-6488-5846>

References

- Bang, M., Curley, L., Kessel, A., Marin, A., Suzukovich, E. S. III, & Strack, G. (2014). Muskrat theories, tobacco in the streets, and living Chicago as Indigenous land. *Environmental Education Research*, 20(1), 37–55. doi:10.1080/13504622.2013.865113
- Barajas-López, F., & Bang, M. (2018). Indigenous making and sharing: Claywork in an indigenous STEAM program. *Equity & Excellence in Education*, 51(1), 7–20. doi:10.1080/10665684.2018.1437847
- Bricker, L. A., & Bell, P. (2014). “What comes to mind when you think of science? The Perfumery!”: Documenting science-related cultural learning pathways across contexts and timescales. *Journal of Research in Science Teaching*, 51(3), 260–285. doi:10.1002/tea.21134

- Carter, K. (1993). The place of story in the study of teaching and teacher education. *Educational Researcher*, 22(1), 5–18. doi:10.3102/0013189X022001005
- Case, K. A., & Hemmings, A. (2005). Distancing strategies White women preservice teachers and antiracist curriculum. *Urban Education*, 40(6), 606–626. doi:10.1177/0042085905281396
- Cochran-Smith, M., Stern, R., Sánchez, J. G., Miller, A., Keefe, E. S., Fernández, M. B., & Baker, M., (2016). *Holding teacher preparation accountable: A review of claims and evidence*. Boulder, CO: National Education Policy Center.
- Derry, S. J., Pea, R. D., Barron, B., Engle, R. A., Erickson, F., Goldman, R., ... Sherin, B. L. (2010). Conducting video research in the learning sciences: Guidance on selection, analysis, technology, and ethics. *Journal of the Learning Sciences*, 19(1), 3–53. doi:10.1080/10508400903452884
- Dyches, J., & Boyd, A. (2017). Foregrounding equity in teacher education: Toward a model of social justice pedagogical and content knowledge. *Journal of Teacher Education*, 68(5), 476–490. doi:10.1177/0022487117705097
- Gay, G. (2010). *Culturally responsive teaching: Theory, research, and practice*. New York: Teachers College Press.
- Graneheim, U. H., Lindgren, B. M., & Lundman, B. (2017). Methodological challenges in qualitative content analysis: A discussion paper. *Nurse Education Today*, 56, 29–34. doi:10.1016/j.nedt.2017.06.002
- Gutstein, E. (2012). Connecting community, critical, and classical knowledge in teaching mathematics for social justice. In S. Mukhopadhyaya & W. M. Roth (Eds.), *Alternative forms of knowing (in) mathematics* (pp. 300–311). Rotterdam: Sense Publishers.
- Haddix, M. M. (2012). Talkin’ in the company of my sistas: The counter languages and deliberate silences of Black female students in teacher education. *Linguistics and Education*, 23(2), 169–181. doi:10.1016/j.linged.2012.01.003
- Hall, S. (1985). Signification, representation, ideology: Althusser and the post-structuralist debates. *Critical Studies in Mass Communication*, 2(2), 91–114. doi:10.1080/15295038509360070
- Harding, S. (2016). *Whose science? Whose knowledge?: Thinking from women’s lives*. Ithaca, NY: Cornell University Press.
- Harris, C. (1993). Whiteness as property. *Harvard Law Review*, 106(8), 1707–1791. doi:10.2307/1341787
- Karniski, C., Patterson, E. M., Krzyszczyk, E., Foroughirad, V., Stanton, M. A., & Mann, J. (2015). A comparison of survey and focal follow methods for estimating individual activity budgets of cetaceans. *Marine Mammal Science*, 31(3), 839–852. doi:10.1111/mms.12198
- Kohli, R. (2009). Critical race reflections: Valuing the experiences of teachers of color in teacher education. *Race Ethnicity and Education*, 12(2), 235–251. doi:10.1080/13613320902995491
- Leyva, L. A. (2017). Unpacking the male superiority myth and masculinization of mathematics at the intersections: A review of research on gender in mathematics education. *Journal for Research in Mathematics Education*, 48(4), 397–433.
- Loudon, I. (2006). A brief history of homeopathy. *Journal of the Royal Society of Medicine*, 99(12), 607–610. doi:10.1258/jrsm.99.12.607
- Martin, D. B. (2013). Race, racial projects, and mathematics education. *Journal for Research in Mathematics Education*, 44(1), 316–333. doi:10.5951/jresmetheduc.44.1.0316
- McGinty, M. C. (2018). *Teaching towards deep ecological understanding: Sociocultural influences and epistemic navigation in outdoor science education*. ProQuest LLC. 789 East Eisenhower Parkway, PO Box 1346, Ann Arbor, MI 48106.
- Medin, D. L., & Bang, M. (2014). *Who’s asking?: Native science, western science, and science education*. Cambridge, MA: Massachusetts Institute of Technology Press.
- Moschkovich, J. (2006). Using two languages when learning mathematics. *Educational Studies in Mathematics*, 64(2), 121–144. doi:10.1007/s10649-005-9005-1
- Mutegi, J. W. (2011). The inadequacies of “Science for All” and the necessity and nature of a socially transformative curriculum approach for African American science education. *Journal of Research in Science Teaching*, 48(3), 301–316. doi:10.1002/tea.20410
- Nasir, N. S., & Hand, V. (2008). From the court to the classroom: Opportunities for engagement, learning, and identity in basketball and classroom mathematics. *Journal of the Learning Sciences*, 17(2), 143–179. doi:10.1080/10508400801986108
- Nasir, N. S., Hand, V., & Taylor, E. V. (2008). Culture and mathematics in school: Boundaries between “cultural” and “domain” knowledge in the mathematics classroom and beyond. *Review of Research in Education*, 32(1), 187–240. doi:10.3102/0091732X07308962
- Nasir, N., Rosebery, A., Warren, B., & Lee, C. (2006). Learning as a cultural process: Achieving equity through diversity. *Cambridge Handbook of the Learning Sciences* (pp. 489–504). New York: Cambridge University Press.
- NGSS Lead States. (2013). *Next generation science standards: For states, by states*. Washington, DC: The National Academies Press.

- Nicholas, G. (2019, February 21). *When scientists ‘discover’ what Indigenous people have known for centuries*. Retrieved from <https://www.smithsonianmag.com/science-nature/why-science-takes-so-long-catch-up-traditional-knowledge-180968216/>.
- Omni, M., & Winant, H. (2014). *Racial formation in the United States*. New York, NY: Routledge.
- Philip, T. M. (2011). An “ideology in pieces” approach to studying change in teachers’ sensemaking about race, racism, and racial justice. *Cognition and Instruction*, 29(3), 297–329. doi:10.1080/07370008.2011.583369
- Philip, T. M., Olivares-Pasillas, M. C., & Rocha, J. (2016). Becoming racially literate about data and data-literate about race: Data visualizations in the classroom as a site of racial-ideological micro-contestations. *Cognition and Instruction*, 34(4), 361–388. doi:10.1080/07370008.2016.1210418
- Philip, T. M., Rocha, J., & Olivares-Pasillas, M. C. (2017). Supporting teachers of color as they negotiate classroom pedagogies of race: A study of a teacher’s struggle with ‘friendly-fire’ racism. *Teacher Education Quarterly*, 44(1), 297–329.
- Pollock, M., Deckman, S., Mira, M., & Shalaby, C. (2010). But what can I do?: Three necessary tensions in teaching teachers about race. *Journal of Teacher Education*, 61(3), 211–224. doi:10.1177/0022487109354089
- Powell, A. B., Francisco, J. M., & Maher, C. A. (2003). An analytical model for studying the development of learners’ mathematical ideas and reasoning using videotape data. *The Journal of Mathematical Behavior*, 22(4), 405–435. doi:10.1016/j.jmathb.2003.09.002
- Remillard, J. T., & Kaye, P. (2002). Supporting teachers’ professional learning by navigating openings in the curriculum. *Journal of Mathematics Teacher Education*, 5(1), 7–34. doi:10.1023/A:1013862918442
- Rosebery, A. S., Ogonowski, M., DiSchino, M., & Warren, B. (2010). “The coat traps all your body heat”: Heterogeneity as fundamental to learning. *Journal of the Learning Sciences*, 19(3), 322–357. doi:10.1080/10508406.2010.491752
- Sandelowski, M. (2011). Casing” the research case study. *Research in Nursing & Health*, 34(2), 153–159. doi:10.1002/nur.20421
- Sengupta-Irving, T., Redman, E., & Enyedy, N. (2013). Re-storying practice: Using stories about students to advance mathematics education reform. *Teaching and Teacher Education*, 31, 1–12. doi:10.1016/j.tate.2012.10.007
- Sneed, A. (2019, May 29). *What conservation efforts can learn from Indigenous communities*. Retrieved from <https://www.scientificamerican.com/article/what-conservation-efforts-can-learn-from-indigenous-communities/>.
- Solórzano, D., Ceja, M., & Yosso, T. (2000). Critical race theory, racial microaggressions, and campus racial climate: The experiences of African American college students. *The Journal of Negro Education*, 69, 60–63.
- Sorrel, T. (2013). *Scientism: Philosophy and the infatuation with science*. New York: Routledge.
- Stoll, L. C. (2014). Constructing the color-blind classroom: Teachers’ perspectives on race and schooling. *Race Ethnicity and Education*, 17(5), 688–705. doi:10.1080/13613324.2014.885425
- Sue, D. W., & Constantine, M. G. (2007). Racial microaggressions as instigators of difficult dialogues on race: Implications for student affairs educators and students. *College Student Affairs Journal*, 26(2), 136–143.
- Taylor, E. V. (2009). The purchasing practice of low-income students: The relationship to mathematical development. *The Journal of the Learning Sciences*, 18(3), 370–415. doi:10.1080/10508400903013462
- Taylor, E. V. (2012). Supporting children’s mathematical understanding: Professional development focused on out-of-school practices. *Journal of Mathematics Teacher Education*, 15(4), 271–291. doi:10.1007/s10857-011-9187-7
- Thompson, A. (1999). Colortalk: Whiteness and off white. *Educational Studies*, 30(2), 141–159. doi:10.1207/s15326993es3002_3
- Tzou, C., & Bell, P. (2010). Micros and Me: Leveraging home and community practices in formal science instruction. In K. Gomez, L. Lyons, & J. Radinsky (Eds.), *Proceedings of the 9th International Conference of the Learning Sciences* (pp. 1135–1143). Chicago, IL: International Society of the Learning Sciences.
- Warren, B., Ballenger, C., Ogonowski, M., Rosebery, A. S., & Hudicourt-Barnes, J. (2001). Rethinking diversity in learning science: The logic of everyday sense-making. *Journal of Research in Science Teaching*, 38(5), 529–552. doi:10.1002/tea.1017
- Wujastyk, D., & Smith, F. M. (Eds.). (2013). *Modern and global Ayurveda: Pluralism and paradigms*. New York: SUNY Press.
- Zotigh, D. (2019, November 26). Do American Indians celebrate Thanksgiving? *Smithsonian Magazine*. Retrieved from: <https://www.SMITHSONIANMAG.COM/BLOGS/NATIONAL-MUSEUM-american-indian/2019/11/27/do-american-indians-celebrate-thanksgiving/>.