Using Critical Case Studies to Cultivate Inservice Teachers' Critical Science Consciousness

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Abstract

Culturally relevant and responsive science instruction includes support of students' socio-political, or critical, consciousness. A lack of experience with marginalization, and limited attention to critical perspectives in science content and methods courses, however, may leave educators ill-equipped to address intersections of diversity, equity, and science instruction. Curriculum is needed that supports critical consciousness development among science teachers and their students. We describe an innovation, a critical inquiry case study, designed to address this essential facet of culturally relevant pedagogy. Design research methodology guided our development of an interrupted, historical case study employed as part of a four-day professional development workshop for secondary science teachers. In addition to provoking critical awareness and agency, the case study was designed to highlight ways that science itself may create or perpetuate inequities, or serve as a tool for liberation, a content-specific construct we call critical science consciousness. Implementation of the critical case study and participating teachers' interactions with case materials are described. In addition, we highlight learning goals developed to support critical science consciousness and provide insights into ways teachers exhibited growth in each area. Teachers report heightened understanding of the role science plays in perpetuating inequities, transformations in ways they think about systemic inequities that impact students and families, and growing awareness of the possibilities inherent in teaching science for liberation.

Introduction

> "Are there other examples besides pellagra? …What else happened because people didn't have the resources or power to heal or fix whatever was happening to them? … What else happened that they never taught us?" (Teacher participant, Critical Science Consciousness workshop)

Equipping teachers to engage all students in equitable and meaningful science education is a persistent challenge for science teacher educators (Atwater, Freeman, Butler, & Draper-Morris, 2010; Underwood & Mensah, 2018). Research indicates that when instruction and mentoring emphasize issues relevant to marginalized communities, student engagement and persistence increase (Campbell et al, 2015; Garibay, 2015; Thoman, Brown, Mason, Harmsen, & Smith, 2015). These findings underscore an essential component of culturally

relevant instruction; culturally relevant practitioners actively support students' development of socio-political, or critical, consciousness (Ladson-Billings, 1995). However, studies of science teachers learning to be culturally relevant practitioners reveal limited attention to critical perspectives (Brown, Boda, Lemmi, & Monroe, 2019; Johnson, 2011; Suriel & Atwater, 2012).

A lack of attention to facets of culturally relevant teaching that align with a critical approach (Freire, 2000; Giroux, 2011) is not unique to science teacher education. According to Ladson-Billings (2011), while educators understand the importance of high expectations for all learners and make attempts to foster cultural competence, they are often unable to support student critical consciousness because they "have not developed a socio-political consciousness of their own" (p. 41). Teacher candidates, the majority of whom are White, may only be prompted to consider topics of "diversity" and "equity" in a specific course reserved for this purpose during their preservice teacher education (Ladson-Billings, 2011, p. 42). According to Madkins and de Royston (2019), "teachers' consciousness must be robust enough to weave [culturally relevant teaching] into the daily fabric of their teaching; it must constitute their pedagogical approach rather than being an add‐on" (p. 8). Limited attention in science content and content-specific teacher preparation courses to ways that science, discrimination, and injustice intersect, combined with a lack of personal experience of marginalization, leaves future educators ill-equipped to incorporate critical aspects of culturally relevant instruction in science classrooms (Underwood & Mensah, 2018). Innovations in science teacher education that support critical consciousness and content-specific critical consciousness development are needed.

In this article, we describe an instructional resource, a critical case study, designed as part of a larger 4-day professional development for inservice secondary science educators. The main purpose of the professional development was to engage teachers in experiences that had the potential to promote critical consciousness. In the next section, we define critical consciousness and introduce critical *science* consciousness (CSC), a discipline-specific form of socio-political consciousness, that heavily informed our work. We then discuss the research methodology that guided the design, implementation and analysis of the professional development sessions (Design-based Research). Guided by our methodology, we designed a critical case study as one of the experiences that led to increased CSC. Thus, we describe literature supporting the use of case studies in teacher education and science education and present the specific case study used in this research. We conclude by summarizing findings related to teachers' critical consciousness and CSC development, and discuss the implications of those findings. We contend that critical case studies provide a research-based, yet novel, lens through which teachers can explore how science, race, and poverty intersect and, as a result, be equipped to recognize and address systemic inequities in classrooms, schools, and communities.

Critical Science Consciousness

To be critically consciousness is to possess an awareness of one's situated reality, to acknowledge systemic inequities, yet maintain a belief that oppression can be overcome; critical consciousness is hopeful, not fatalistic (Friere, 2000). Teachers who support critical consciousness development encourage students to use their knowledge "both to critique the world in which they live and, when necessary, to intervene in socially responsible ways in order to change it" (Giroux, 2011, p. 14). In an earlier study (Crabtree & Lim, in progress), we found that teacher participants were able to combine critical consciousness and new scientific knowledge to consider ways that science has created and perpetuated inequities. According to Erduran and Dagher (2014), the degree to which science is a social institution is an under-emphasized aspect of Nature of Science instruction. Acknowledging the political nature of science enables students to "develop a critical sense of scientific literacy without undermining the importance, value, or benefits of scientific knowledge and rationality" (Erduran & Dagher, 2014, p. 148).

We define *critical science consciousness* (CSC) as an understanding of the role that science has played in marginalizing groups, as well as an awareness of the potential for science to liberate. In designing a PD experience to support inservice science teachers' CSC, the following learning goals were created:

> **LG1.** Teachers will understand that science has been practiced in ways that are inequitable and unjust, e.g. who is acknowledged as a scientist, what questions scientists ask, and how investigations to answer those questions are conducted (Sheth, 2019).
>
> **LG2.** Teachers will develop an awareness that science has contributed to individual and systemic inequities in society, e.g. race as a biological construct (Donovan, 2014; 2016; Kendi, 2016; Morning, 2009;); focusing on individuals as opposed to systems and structures that oppress (Parsons, 2014; Tolbert & Bazzul, 2017).
>
> **LG3.** Teachers will recognize the potential for science to contribute to the liberation of individuals, groups, and society.

Teacher Development Design Research

Designing for increased CSC begs the creation of new professional development materials that build critical consciousness through the lens of scientific inquiry. As such, Design-based Research was used to guide the development of the professional development experience. Design Research has gained prominence in mathematics and science education and varies in its purposes and settings (Cobb, Confrey, deSessa, Lehrer, & Schauble, 2003; Stephan & Cobb, 2013). Although Design Research can be conducted at a range of levels, the process we describe here is Teacher Development Design Research (TD-DBR) (Simon, 2000) in which a PD experience is designed, implemented, analyzed and revised by a lead instructor who is a member of a research team. The main activity of researchers in this approach (TD-

DBR) is highly interventionist in that the instructor/researcher is proactively altering the PD experience in real time based upon how participants engage in the PD with the learning goals as the backdrop.

The TD-DBR project described in this article was conducted to test and revise a PD experience designed to cultivate inservice science teachers' critical consciousness in general, and CSC in particular. The design team included the first author, a former high school science teacher and doctoral candidate at the time of the study who served as the PD instructor, and the second author, a university mathematics educator, as well as two high school teachers (science and Special Education), one district science leader, two design research experts and a university faculty member/research biologist. The research question that guided the project was: *In what ways does the PD experience support and constrain the growth of inservice high school science teachers' a) critical consciousness and b) critical science consciousness?*

Case Studies and Science Teacher Education

One set of instructional materials that we designed to ground the initial work of the participants was a critical case study. The case method has been adapted for science education and science teacher preparation as a pedagogical strategy to engage students and preservice teachers in active, collaborative, inquiry-based learning (DeCoito & Fazio, 2017; Herreid, Schiller & Herreid, 2012). Case methodology offers a profound opportunity to increase theoretical understanding and promote a form of knowledge that moves beyond "how" to explicate "what and why" (Shulman, 1986, p. 13). Historical incidents, socio-scientific issues, and current controversies related to science can be investigated through well-designed cases (Allchin, 2000; DeCoito & Fazio, 2017). Case studies offer opportunities for students to explore the tentative, creative, and culturally situated aspects of the nature of science that are difficult for students and teachers to conceptualize; the interrupted case method is especially well suited for science education as its structure encourages students to wrestle with an authentic research problem in ways that mirror how scientists actually work (Herreid et al., 2012).

Cases should not merely report an event, they should be a "case of something… that can be explicated, interpreted, argued, dissected, and reassembled" (Shulman, 1986, p. 12). Although criticality is not an essential element of case pedagogy, we have found that the method's narrative form invites the use of critical perspectives to explore issues of power and agency. When developed using a critical lens, the story embedded in a case becomes a vehicle to illuminate persons or events excluded from dominant narratives. The use of storytelling as a counter-narrative, a tenet of critical race theory (Ladson-Billings & Tate, 1995), offers opportunities for voices that have been silenced by more powerful forces to be heard.

We draw from these emphases to create a new model for science teacher education, the Critical Case Study. Critical Case Studies incorporate historical or current incidents in science to support learning and provoke critical consciousness and CSC. Topics investigated using this approach have the potential to increase participants' awareness of ways in which power, opportunity, and resources are unequally distributed. Critical case studies highlight narratives of those who have been marginalized in and through science. As this example described reveals, critical case studies also provide opportunities for science teacher educators to model the incorporation of Next Generation Science Standards (NGSS) science practices, cross-cutting concepts, and disciplinary core ideas (NGSS Lead States, 2013) in creative ways (see Table 1).

Table 1

Alignment of Case Study with NGSS Three-Dimensional Learning

Case Study Elements	Science Practices	Cross-Cutting Concepts	Disciplinary Core Ideas
Introduction	Asking questions	Cause and Effect	ESS3.C: Human impacts on earth's systems
Part 1	Asking questions	Patterns	LS1.B Growth and development of organisms
Part 2	Asking questions	Patterns	LS1.C: Organization for matter and energy flow in organisms
Part 3	Constructing explanations	Cause and Effect	PS3.D: Energy in chemical processes and everyday life
Part 4	Obtaining, evaluating, and communicating information	Cause and Effect	LS1.B: Growth and development of organisms
Part 5	Using Mathematics Analyzing data	Cause and Effect	ETS2: Links among engineering, technology, science, and society
Part 6	Asking questions Evidence-based argumentation	Systems and system models Stability and change	LS2.C: Ecosystem dynamics, functioning and resilience
Part 7	Developing and using models	Energy and matter: Flows, cycles and conservation	LS1C: Organization for matter and energy flow in organisms
Part 8	Using mathematics Analyzing and interpreting data	Patterns Cause and effect	ETS2.A: Interdependence of science, engineering and technology

In addition to case methodology, the case described below incorporates a critical pedagogy of place (Gruenewald, 2003). The educators who attended the PD live and teach in a region of the Southeastern United States dominated by the textile industry throughout the 20th Century. Although most of the mills are now idle, their specter looms large over classrooms, schools, and communities. Incorporating elements of historical, interrupted case studies and critical, place-based pedagogy, "Mill Mothers' Lament: The Scourge of the South," explores the history of an epidemic that has disappeared from science textbooks, revealing the impact of poverty and race in the pre-World War II "New" South (Etheridge, 1972, p. 152).

Overview of the Workshop

A critical case study was incorporated within a PD workshop attended by seven high school science teachers who consented to be part of the TD- DBR study. Teacher participants were recruited through an email sent by the district curriculum specialist to all secondary science educators. This method of random sampling resulted in a group of participants who exhibited

diversity in their length of teaching experience, science content expertise, instructional level of courses taught, school size, and school demographics, however, all participants identified as White. Workshop sessions were conducted by the first author on four consecutive days in July, 2019. Data collected during the TD- DBR study included pre- and post-workshop interviews with six of the participants, audio-recordings of workshop sessions, field notes, small-group responses to critical case study questions, and reflective writings by teacher participants. Participants engaged in activities related to the critical case study during the first two days of the workshop. During the preceding week, the teachers had participated in a district-sponsored PD in the same setting. Accordingly, they exhibited a level of comfort with each other and in the setting. Prior to introducing the case, the instructor guided the group to establish norms and engage in a reflective team building exercise.

To launch the critical case study (available at http://bit.ly/millmotherslament), and in keeping with the place-based focus of the workshop, participants read a brief biographical sketch of a local White woman, Ella May, a mother, textile worker, songwriter, and leader in attempts to unionize Southern textile mills (Horton, 2015). Participants worked in small groups to construct a timeline of Ella May's life, tracing her family's movements from subsistence farming to logging, sharecropping, and eventually, textile work. Ella May's murder, carried out by a White mob as she was riding in a truck transporting Black potential strikers to a rally, made international headlines. Only one teacher, however, was familiar with the event. As they learned that four of Ms. Mays' nine children died before the age of two, participants cited a desire to earn a *living* wage as a powerful motivator for the young mother's involvement in the strike. Records reveal that Ella May's children died of whooping cough and pellagra (Horton, 2015). One teacher stated, "My students would relate to her story. Many of them are working to help their family." Unlike whooping cough, participants had never heard of pellagra which provoked a desire to investigate further.

Mill Mothers' Lament: The scourge of the South

The critical case study described below was created using Google Forms and is available at http://bit.ly/millmotherslament. As an interrupted case study, participants were provided with access to each of the eight parts in sequence. Working in small groups of three or four, participants read, discussed insights, and engaged in science practices to answer questions embedded in the case study. For example, in Part 5, teachers transferred data from historical public health surveys into electronic spreadsheets for analysis. As participants engaged in the activities, PD leaders moved from group to group to listen for their thinking, observations which allowed the instructor to conduct a large group debrief session around the teachers' ideas. For each part of the case, following 15-20 minutes of collaboration, the instructor encouraged teachers to discuss their findings with the larger group before having access to the next part of the case study. To maintain a sense of mystery and allow participants to experience ways in which science knowledge evolves (Herreid et al., 2012), they were asked to not access the internet during the case study.

Part 1: A Sudden Epidemic

Part One introduced pellagra, a deadly disease first reported in the United States in the early 1900's characterized by a severe rash and symptoms including dementia (Etheridge, 1972). The fact that the disease most often occurred in low-income households offered opportunities for teachers to think about systemic inequities that impact groups, as opposed to individuals (Learning Goal 2). During small group discussions, teachers expressed surprise that they had never heard of pellagra. A prompt within the case materials asked participants to record what intrigued them about the disease; participants indicated they were intrigued that the disease had a greater impact on "the poor more than the wealthy." An additional question in the case study prompted participants to think about lines of inquiry they would pursue if they were in the position of Dr. Goldberger, a Public Health scientist dispatched to investigate the epidemic.

Part 2: A Long Train Ride

Riding along with Dr. Goldberger from Baltimore to Augusta, GA, participants read varied hypotheses regarding the cause of pellagra promoted in 1914. Common in Southern Europe among agricultural workers, peasants, and beggars, explanations for pellagra ranged from spoiled corn to bacterial infection (Rajakumar, 2000). Privately-funded groups surveying mill villages reported inconclusive evidence regarding possible links among diet, sanitary conditions, and pellagra (Bollett, 1992). The Public Health Service conducted experiments on animal models which were inconclusive. A question in the case study materials prompted teachers to consider why researchers investigating the same disease might reach different conclusions. Participants' responses that "different backgrounds and specialties" as well as "money and race biases" might impact conclusions indicated an awareness that scientific investigations can be influenced by the identity of those conducting research (Learning Goal 1). Drawing a parallel between pellagra and the HIV/AIDS epidemic one teacher stated, "It's just like HIV – who it affects, impacts who cares. Money equals power" (Learning Goal 2).

Part 3: Hypotheses and Investigations

As Dr. Goldberger traveled throughout the Southern United States, he observed the living conditions and noted that persons experiencing poverty consumed a diet of cornbread, molasses, and fatback. Questions embedded in the case study materials prompted participants to discuss inferences Dr. Goldberger might have made from his observations and ways lack of knowledge of Southern culture might have allowed him to see what others didn't see. These questions prompted the teachers to consider again how bias might impact scientific investigations (Learning Goal 1). One small group concluded that while familiarity may be beneficial, it can also blind investigators to the "big picture."

Part Four: Orphanages, Sanitarium, Prison Farms, and Filth Parties

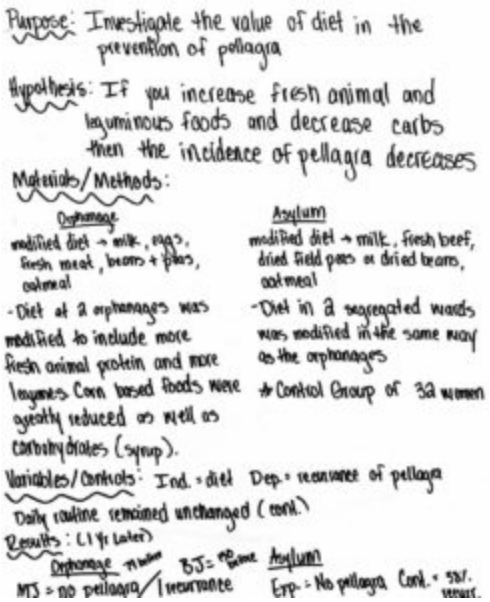
Dr. Goldberger and a team of investigators conducted experiments to determine the cause of pellagra in orphanages, sanitariums, prisons, and laboratories. Using primary sources, (Goldberger, 1916; Goldberger, Waring, & Willets, 1915; Goldberger & Wheeler, 1920), teachers worked in small groups to determine the hypotheses, methods, materials, variables, results, and conclusions reached in their assigned experiment. The investigations included studies in which the variety of food provided to children in an orphanage and residents of a sanitarium was increased; in a separate study, however, the diet of prison inmates was restricted. These contrasting situations were included in the case study to provoke discussions among participants about ways scientific investigations may cause harm to vulnerable populations (Learning Goal 1). As the small groups worked, an older teacher who, as a child, lived near the town in which his assigned experiment was conducted exclaimed:

> "They are treating the [Black] women differently! Even in the experimental group the Black women are not doing as well. It's right there in the data! [The sanitarium] is segregated and they're treating them differently. I know this area and I guarantee this place was segregated and the Black women were not getting the same treatment."

After analyzing the experiments, participants displayed their findings on posters and presented them at an "Annual Conference on Pellagra" (Figure 1). During a discussion of the group's collective findings, several teachers challenged the ethics of the experiment in which food was withheld from incarcerated persons. "Is that right to do, even if you have been found guilty of a crime?" one teacher asked. "Would they be allowed to do that today?"

Figure 1 (Click on image to enlarge)

Poster created by Teacher Participants (Critical Case Study – Part Four)



Part Five: Pellagra and the Economy

In addition to conducting empirical investigations, Dr. Goldberger and a team of epidemiologists surveyed mill villages in South Carolina to explore correlations between the salary of the mill workers, food consumption, and pellagra (Goldberger, Wheeler, & Sydenstricker, 1920a; 1920b). This portion of the case study incorporated technology as participants transferred original data into spreadsheets and created graphs that exposed the extent to which the incidence of pellagra correlated with gender and income levels (Figure 2). This exercise was designed to reveal the power of data generated by scientific investigations to illuminate systemic inequities and potentially provoke change (Learning Goal 3). Graphs created by the participants emerged as important images informing small and large group discussions about gendered roles, income inequities, and food insecurity in the present as well as the past.

Figure 2 (Click on image to enlarge)

Graph created by Teacher Participants (Critical Case Study – Part Five)

Although surveys conducted in mill villages provided evidence of a relationship between pellagra and family income, careful reading revealed a glaring omission. “With the exception of a few negro families which were not considered, all were white, and with hardly a single exception, of Anglo-Saxon stock, born in this country of American-born parents,” (Goldberger, Wheeler, & Sydenstricker, 1920b, p. 2678). This sampling methodology illustrates how questions and methods in science investigations may reflect bias (Learning Goal 1) and perpetuate systemic inequities (Learning Goal 2). As teachers read this excerpt emphasized in the case materials, they expressed surprise; during small group discussions several participants drew parallels between the exclusion of Black families in these surveys and gender exclusion in pharmaceutical research.

Part Six: A Premature Celebration

Fewer cases of pellagra occurred as cotton prices rose in 1920. In 1921, however, a steep decline in cotton prices led to a significant number of new cases. In a graphic example of the potential for science to contribution to the liberation of marginalized groups (Learning Goal 3), Dr. Goldberger’s documentation of this new phase of the epidemic sounded an alarm that reached the White House. President Harding’s appeals to Congress and the Red Cross to provide relief, however, were met with loud denials by Southern leaders (Bollett, 1992).

Questions embedded in the case study prompted participants to examine the impact of monoculture on the region and to discuss whether pellagra was a disease of ignorance, economy, or both. Some teachers focused on a lack of knowledge and poor dietary practices among persons who experienced pellagra, stating “if they knew what it was though… I am sure they could’ve re-evaluated their thinking.” Others challenged their colleagues to consider what this case reveals about financial barriers to healthy eating, “What do you do? There’s no other food.” Participants also connected inequities that created the pellagra epidemic to food insecurity today:

> “Yeah, that [situation still] exists today. …When I go home I [can] cook a meal for my family. But if I’m poor, I may go to a second job because I need more money…. So, I can’t make food even though I know I need to feed my children healthy things. … There’s still a barrier even though you know that it’s bad for you. There are still economic barriers that keep people feeling like they [can] never do the right thing.”

Part Seven: The Pellagra Preventing Factor

Combining a break-through announced in 1937 with current models of cellular respiration, teachers evaluated how a lack of niacin, a critical component of NAD, produced the symptoms of pellagra in this section of the case. Bolstered by the need for a healthy workforce during World War II, government regulators mandated the fortification of wheat flour with niacin in the early 1940’s (Etheridge, 1972). Outbreaks of pellagra subsided, revealing once again the liberatory potential of scientific advancements coupled with new technologies (Learning Goal 3). Lingering questions remained, however, regarding why knowledge of this epidemic has disappeared from classrooms and textbooks.

Part Eight: New Questions About an “Old” Disease

In Part 8, teachers analyzed new findings that reveal extensive racial and gender disproportionality in deaths from pellagra (Chacko, 2005; Marks 2003); at the height of the epidemic, more black women died from pellagra than any other group. While analyzing this data, one participant concluded, “Basically, the black females were members of two groups that are discriminated or treated [as] lesser,” revealing that critical scientific inquiry might support teachers’ understanding of concepts including intersectionality (Crenshaw, 1990).During this section of the case study, teachers were prompted to return to the sampling methodology described in Part 5 (Goldberger, Wheeler, & Sydenstricker,1920b) and consider ways that “research practices determine what is seen and not seen, analyzed, or considered” (Marks, 2003, p. 55). One group of teachers summarized their discussion with the following statement: “what is studied” is what “is worth studying in the eyes of those doing or paying for the research.”

Emerging Critical Science Consciousness

Case study materials employed during the PD experience provoked teachers to consider ways that science relates to issues of social justice and equity. Participants also made multiple connections between their curriculum and topics addressed in the case study. One teacher plans to use the case study to help students understand that “deforestation led to the decrease in subsistence farming, which made them all move to the mill cities and started the whole thing…so they can see why it’s so important to have a sustainable model and what can happen when you don’t.”

In addition to discussions that occurred during the implementation of the case study, further evidence of teacher growth emerged in post-workshop interviews. Three learning goals relative to critical science consciousness development guided the design of the instructional materials and analysis of the interview data. Learning Goal 1 addressed teachers’ awareness that science can be practiced in ways that are inequitable. Evidence of learning included increased awareness by teachers of the potential for bias to influence scientists’ methods and conclusions. In addition, participants described the lack of concern regarding the impact of pellagra on persons of color as evidence of their limited value to those investigating the epidemic. The potential for science to contribute to broader societal inequities was the focus of Learning Goal 2. Connections made by participants between ways discrimination in science may reinforce health disparities revealed growth in this area.

Learning Goal 3 addressed the importance of teachers recognizing that science can be a tool for liberation. An interesting expansion of this objective emerged during post-workshop interviews as participants described the important role inquiry played in their learning during the workshop. One participant stated, “I just enjoyed working with the data and …trying to find an explanation for this trend.” Another said, “Anytime we get to look at data and discuss it with our groups and try to draw conclusions… it’s really very engaging, very memorable. You’re practicing the skills, honing the skills, using science.” In a similar fashion he described a classroom in which he would be motivated to stay in the teaching profession as one in which, “students are coming up with solutions …coming up with new conceptions about the world and then using those in their lives.” As these statements reveal, the opportunity to engage in inquiry can be liberating for teachers as well as students. Using critical inquiry in Professional Development provides a model of teaching science for liberation for practicing teachers.

Analysis reveals that studying a historical epidemic both supported and constrained teachers’ development of critical consciousness related to racial discrimination. In a post-workshop interview, one participant described the treatment of persons of color as having been “glossed over” when he was younger, acknowledging that “the people in charge did not want the truth out because then they would have to admit there is a discriminatory factor, there is a racial factor. There [are] truths that they did not want known.” Another teacher stated, “I definitely reached the conclusion that a long time ago there were a lot of injustices relating to things like race and skin color.” When asked if these issues still exist today, the participant stated, “um, it’s possible. Certainly not to the degree it did back then.” This

response reveals a challenge presented by addressing issues of race and class discrimination using *historical* case studies. While the instructional materials prompted one teacher to re-evaluate what had been ignored in the past, the historical nature of the case study allowed the other teacher to persist in his belief that inequities do not occur to a significant degree in the present.

Conclusions and Implications

For teacher educators seeking to incorporate a critical framework in teacher preparation and professional development, the "dilemma lies in how to get teachers – who have been educated and inducted into patterns of tradition and hierarchy that reproduce inequality – to teach in critical, emancipatory ways" (Ladson-Billings, 2000, p. 151). Based on our experiences with practicing teachers, we suggest the use of critical case studies to support the development of teacher socio-political consciousness. Other topics that science teacher educators may consider exploring include incidents of environmental injustice, distribution of "free" cigarettes that led to nicotine addiction among members of the military, and the role of pharmaceutical companies in the opioid epidemic. The case study summarized in this article prompted participants to reconsider deficit-based conceptualizations of communities experiencing poverty and the compounding impact of racial discrimination. We also find that critical case studies can be designed to support the development of CSC, a deeper understanding of ways that science has contributed to inequities yet can also be a tool for liberation. By incorporating critical inquiry, science teacher educators can support teachers and promote a more socially just and culturally relevant science education.

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