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**WHITE SHAME, WHITE AMBIVALENCE, AND LEARNING TO BE A WHITE ANTI-
RACIST AMBITIOUS SCIENCE TEACHER**

A Dissertation in

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by

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ABSTRACT

Science education has a white supremacy problem. With all the research pertaining to advancing social justice and achieving equity in science education, few studies explicitly explore how science education resists and embraces white supremacy (Le & Matias, 2019; Ridgeway, 2019). Given this reality, I used design-based research to create a learning environment for secondary science interns to help them learn about whiteness, white supremacy, and Ambitious Science Teaching using an amalgamation of critical whiteness pedagogy and practice-based teacher education. For over two years, I collected data of the nearly five-year design to understand how White science interns learned to be anti-racist educators and how combining critical whiteness pedagogy and practice-based teacher education supported science interns in adopting anti-racist practices.

This study draws upon critical whiteness studies and practice-based teacher education to tell the story of one White science intern's learning during the 2020-2021 iteration of the design. The narrative below draws upon Reverend Thandeka's (1999) theorizing about white shame, Ralph Ellison's (1995) unpacking of white ambivalence, and sociocultural thinking about how teachers learn. The story reveals the role white shame and white ambivalence played in the White science intern's and their peers' learning about their White identity and anti-racist science teaching. In the narrative, I also demonstrate how critical whiteness pedagogy and practice-based teacher education work together to create a learning environment that provides White science interns opportunities to take on more nuanced and dynamic White identities as they practice and try-out "being" White anti-racists and White anti-racist science teachers.

This study's findings indicate the need to create learning environments for teachers that have opportunities for teachers to practice "being" anti-racist. In particular, this study shows the constant presence of white shame and white ambivalence throughout White teachers' learning

about white supremacy, whiteness, White identity, and science teaching. These findings point toward the need to create opportunities for White people to take on complex and dynamic identities, design learning environments where White people grapple with shame and ambivalence, and the potential behind critical whiteness practice-based teacher education to contribute towards helping interns learn anti-racist teaching.

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Chapter 1

White Beginnings

I was going to a science education conference I had only heard stories about. Each story was better than the next. The relationships built at this conference sounded more like friendships than that of colleagues. The community at this conference sounded like a family. Little did I know, the conference would put me at a crossroad. One that would either see me finish my graduate studies or have me returning to my former life before graduate school at Penn State.

As I flew into the city where the conference was held, I was on a flight with scholars who I looked up to. They didn't know me, but I was excited to meet them. If it was "normal" I probably would have asked for their autographs. I may have hyped up the conference too much in my head. However, I was excited to join what I thought would be my new community. My new academic family of sorts.

There was a social the first night. I met new people. I was making new friends. The conference felt like the family I had hoped it would be. Everyone I met was friendly and warm. It was the first time I experienced a conference with no obvious hierarchy. Sure, I was enamored with the senior scholars I had read in classes, but they spoke to me like I was an old friend. One of them even made a few jokes at my expense. As I spoke to more and more people, I was excited to share work I was nervous about sharing because of how it might challenge the status quo. This group seemed like the right group to share my initial thinking with.

My presentation was the next morning. I got to the room early and it was empty. People filled the room shortly after. Eventually, the room was so full, people had to drag in chairs from outside. When it was my turn to present, I opened by telling my first memory about race. I will not recount the story here, but know it is filled with racism. I went on to talk about how the story was

simultaneously straightforward and complex depending on the lens used to understand it. I described how science education needed to prepare interns, especially White interns, to grapple with whiteness and white supremacy by iteratively telling stories about their racialized lives. I argued our field needs critical whiteness studies to help us grapple with whiteness and white supremacy inherent in our field and discipline. I then described my worries. I was worried I centered whiteness in harmful ways. I was worried I didn't center the experiences of people of Color enough. I was concerned my thinking wasn't "sciency" enough. I was worried I was missing something. If I am honest, I thought the responses to the questions would be, yes, no, yes, and yes. If I am honest, I just hoped the community would get I was trying to do something different and help me figure it out. I was told this was the community to be vulnerable, raw, and push boundaries with.

To say I was wrong, is an understatement. After I presented, it was like the gates of hell opened up. I got the responses I expected, but each "question" was leading and more of a comment designed to explain how wrong I was rather than help me think more deeply. I was told scholars I cited would disagree with my ideas. Some folks wanted to know what my presentation had to do with science education because, "I don't see any science." Others listed articles and authors I should read. One White woman, looking at me with cold eyes and a furrowed brow sternly told me, "I think you need to read Robin DiAngelo's work. You need to reconsider what you think social justice work is for White people because this isn't it." Lots of people nodded and murmured agreement with this comment.

As I got peppered with comments about how my work was racist and misguided, I cycled through what felt like infinite emotions. I was angry, confused, hot, depressed, frustrated, calm, knowing, content, and disturbed, among others. I wanted to actively resist. I wanted to tell them they misunderstood what I said and wrote. I wanted to tell them they were wrong and it was them who were being fragile. All I suggested was White people talk and explore our White identities in

more complicated ways and science education use critical whiteness studies to understand whiteness in our field more fully.

There seemed to be two sides to the arguments made against my proposals. One side, who I identified as the “left,” did not think White people should talk about race in the ways I was suggesting. They had a very specific idea about how White people should interact with race. We should be quiet, read, listen, and confess our white privilege. The White woman who chastised me is an example of this. Pointing out my citation of a White man, Tim Lensmire, in my presentation, a Black scholar argued Dr. Lensmire would disagree with my work. Weeks earlier, Tim saw my work and agreed with it. The other side, who I thought of as the “right,” wanted more science and thought my work wasn’t grounded in science education enough. This disqualified my work out right for them. For example, one White person, wanting to help me, said, “I can’t believe you thought what you presented was ok.” This White person said my presentation had little to do with science and I should stick to focusing on access for people of Color because, “science isn’t necessarily the problem.” Ironically, two sides who are often opposed, joined forces to argue against my presentation. They also did not critique the perspectives of the “other” side being shared.

Although I was frustrated and wanted to flee to my hotel room, I stayed after my presentation. I did get some amazing feedback. One Black man suggested I look at the work of Dr. Nolan Cabrera. This was extremely helpful because I had not engaged much with Dr. Cabrera’s work. Another woman of Color said I probably shouldn’t write about race for a while. While this was a harsh critique, they followed up by saying, “I think there are other ways to frame what you want to say. I am not sure what those are, but once you figure it out, I think you have something here.” I thanked both of them for their time and thoughtfulness. I am still grateful for their feedback.

Throughout the rest of the conference, I felt like an outcast. I felt folks did not want to speak with me, especially the White people. For example, one White woman asked me about my presentation during a meal. I had sat down before anyone else had joined the table. They asked me what I was thinking about doing differently. I said I needed to find a new way to share my ideas because the group clearly didn't get my message. The White woman sternly told me, "I thought they told you to drop your study and do something different. They said the theory you used was wrong and not founded." I responded gently by saying I shared my work weeks early with the people whose theory I used in the presentation and they approved of it. The White woman found an excuse to leave our conversation and sat at a new table. Even my advisor seemed to feel my position as outsider. At one point, Scott stopped me in the hall and asked how my presentation went. I said it was, "rough, but I will be ok." I didn't know what else to say. I wanted to blow up and say all the people were jerks and misrepresented what I was trying to do. I wanted to say this community was not the "critical but kind" family described to me, but I didn't. These folks were Scott's friends and he was one of them. Scott told me he had heard my presentation was rocky and assured me all would be well. After that we didn't speak much. Scott was busy reconnecting with old friends and new friends who were in my presentation and, in my opinion, wanted little to do with me. I was so mad at him for this. Yet, I couldn't blame him. I didn't tell him what I felt and he had other things on his mind. Plus, I am not sure he even knew what to say and was figuring out how to best advise me. We would later talk more extensively about my experience; Scott is the one who encouraged me to open my dissertation with this narrative. I forgive him. I actually forgave him almost immediately after the conference because I knew he cared about me and trusted my scholarship, and more importantly, believed in me fully and unconditionally. Still, I felt outcast by everyone during that moment in time.

Not everyone disliked my presentation. At dinner one evening, on the last night of the conference, I was with graduate students and teachers at the conference. One of them, a White

woman, wanted to talk more about my presentation. A graduate student of Color agreed. They all told me they thought my work was interesting and valuable. A Black graduate student told me something along the lines of, "I get why folks reacted the way they did. You were implicitly, if not explicitly, critiquing all of them in one way or another." All of the people at the table felt they couldn't talk about my presentation positively because of how others had reacted. They felt they would get chastised for saying my ideas had value. Reading between the lines, they didn't want to get outcast too. I think this because when one person, who had chastised my work, joined us, the conversation about my presentation stopped immediately.

The experience at this conference almost broke me. I got back to State College and had serious conversations with friends and family about dropping out of graduate school. I felt misrepresented. I felt naïve. I thought the community was right and I needed to go read and listen. I needed to let others do the work I wanted to do because I felt I got something wrong. The experience made me not want to present or talk about my work. I chose not to attend some conferences and nearly threw up before presenting other talks. The experience I underwent made me want to go back to teaching or leave education all together. I spent weeks with insomnia thinking through the experience. I wanted to run away to a forest in the Pacific Northwest or a beach in the Caribbean and never return. I thought bar tending or fishing sounded like careers I would prefer instead.

The thing that kept me around? The thing that helped me survive that period? It was the conversation the last night of the conference. The conversation where other individuals said they didn't feel they could support me because of how others reacted. I was fascinated by their reaction to my presentation. I also wanted to understand my own reaction. I knew I couldn't run away. I am not someone who backs down. I believed in my work, even if I wanted to throw up each time I spoke about it. If I left, I knew I would be letting myself and others down. So, I stayed and am grateful I did.

I am not under any pretenses the narrative I shared above doesn't have a lot to think about. I wrote the narrative over and over again. I wanted to focus on parts that are most important to me while still conveying the whole experience. I will not dissect or analyze the narrative now because the reason I share it at this point is to set the stage for what is to come. I will revisit this narrative at the conclusion of this dissertation to demonstrate the possibilities of science education adopting critical whiteness as a way to (re)imagine what is possible.

The first reason I shared the narrative to open this project is my experience at the conference is the reason I completed the dissertation I did. The experience at the conference showed me I needed to figure out how to talk about White anti-racism, White science interns' anti-racist learning, and white supremacy in science education in new ways. I needed to be clear and uncompromising. The resistance I encountered was a signal to me. It was a sign I had something to say; the resistance and quiet support indicated, to me, what I had to say might be a different enough to contribute something to the field of science education.

The second reason I shared the narrative is because the experience I had encapsulates the critiques of my work that have become, at this point, all too common. The worries I mentioned to the audience at the conference are questions I get asked frequently. In fact, most of the critics of my work at the conference leveraged the questions I was worried about. Therefore, rather than let the questions linger, I will address them directly at the outset. I am choosing to do this to make my stances clear. I am doing this because I do not believe this project fits into the status quo. By addressing the common concerns now, I can be clearer about my thinking and intentions. It will also allow me to situate my dissertation properly among the socio-political reality that we currently exist in as a society.

Our current political reality

This project took place during a period of history where the United States' politics are particularly partisan. This does not mean the United States has not had partisan politics before now or we will experience a point in history where politics are not partisan. Nothing happening now is unique, and yet, it *feels* different on some level. For example, not in my lifetime have I witnessed the level of outrage, especially in the White community, at the murder of unarmed Black people at the hands of White people and (White) police officers. The murders of George Floyd, Breonna Taylor, and Ahmaud Arbery during the summer of 2020 sparked something I had not witnessed before in the White communities I live in, around, and with. I have not experienced a pandemic before now. I also did not realize the level of misinformation in the world, and perhaps, until the advent of social media, understood how quickly it could spread. Yes, none of the phenomena I describe are new. Since Africans were kidnapped and enslaved by slave traders, the Black diaspora and allies have worked to end the violence and oppression created by white supremacy, colonialism, and imperialism. COVID-19 is not the first pandemic. We only need to look at HIV/AIDS in recent memory to understand the pain and suffering caused by failed responses to harmful viruses. Beyond this, misinformation has always existed and it has always had mechanisms to spread quickly. Still, something feels new about this moment in time, or at least it does to me.

I am an education scholar. I am not an expert in history, technology, sociology, etc. I will not try to explain why or how this moment feels or is actually different from the past. I will leave that to pundits and real experts. However, what I do notice, based on the responses to my work is there are largely, in my opinion, two sides to conversations about race and how to create a more racially just society. I characterize the two sides along our traditional political spectrum of “liberal” and “conservative.” Notice, I did not say, Democrat or Republican. I don't think those

labels work. If I had a nickel for the amount of people who have told me they affiliate with one political party or another then espouse some variation of, “I am socially liberal and fiscally conservative” or “I am ok with gay marriage, but I have a problem with abortion (or insert another social debate here)” I would be extremely wealthy. Yet, largely, people fall on one side or another when it comes to most social issues. We are trapped in a binary of being “liberal” or “conservative” on most issues. For example, you are either for or against abortion, the death penalty, gun regulation, affirmative action, vaccine mandates, mask mandates, green energy, and on and on and on. I have seen little room for space in between each position in our current discourse. As a result, both the “liberal” and “conservative” positions come with their own responses, in my experience, to my work. This is my attempt at responding to those positions in order to make my own clear because, spoiler alert, I don’t necessarily ascribe to either position. Instead, I am searching for a new lane in the conversation.

Where is the science?

“What does this have to do with science?” is the big, if not sole, critique I place within the “conservative” camp. This critique does not address the central claims I attempt to make, that race, and therefore, white supremacy, is a central organizing feature of society and is embedded in all elements of our society, science included. Truthfully, my argument is not a new one, critical race theorists (see Derrick Bell, Kimberlé Crenshaw, Richard Delgado, Cheryl Harris, Mari Matsuda, Gloria Ladson-Billings, and numerous others) have made this same argument for decades about society, the law, and education more generally. By critiquing my work for not explicitly talking about science, is to argue my work has no value in science education *unless* it has enough science within it or I speak about science in particular ways. The stance that science education research must only and exclusively be “about” science ignores how race, whiteness,

and white supremacy matter within our field. Stances demanding science education research be exclusively “about” science or cross a magical threshold for the amount of science within a study is race evasive and maintains status quo in my opinion. Status quo, in this case, is white supremacist.

Any research happening in a science or science education context should be introduced to the science education community. The reason for this is studies revealing inequities within science education or examine oppressive structures, like white supremacy, are seeking to understand science learning spaces. Science and science learning contexts are not exempt from white supremacy. Therefore, to decide research belongs elsewhere because it is not “sciency” enough is only an attempt at maintaining status quo and willfully ignoring how white supremacy operates within our field. This dissertation is for science education *because* it is about science teacher education, and I don’t believe I need any other justification than that.

Centering the experiences of people of Color

One of the major critiques I got from the people I would position in the “liberal” camp is I did not center the experiences or thinking of people of Color sufficiently. This was represented by the numerous scholars of Color I was told to read and cite. It was also demonstrated by people who told me I should not talk about White identity beyond white privilege, white fragility, and White people being racist. The fact that I was searching for new ways to understand White racialization and ways to support people, but especially White people, in being anti-racist was inappropriate to folks who thought I should more fully cite, center, and use scholarship and ideas from people of Color.

I don’t necessarily take issue with this critique. In my presentation at the conference I described above, I certainly could have cited more scholars of Color, I could *always* cite more

scholars of Color. Therefore, I think this critique is an attempt by “liberal” individuals to win an argument by using a point that could always be used. In short, while a completely valid and important critique, it acts as a red herring in this case.

I will admit, to refer to the centering of experiences of people of Color as a red herring is taboo. However, in a study about the stories of White people, the learning of White people, the racialization of White people, the point is to center White people, whiteness, and white supremacy in order to dismantle systems of racialized oppression. Inherently the work is not about people of Color. With this said, I can center the ideas and thinking of people of Color. In this dissertation, as was true of my presentation, I leverage critical whiteness studies, a field, as I will describe later, explicitly grounded in the thinking of African American intellectuals and other people of Color (Jupp, Berry, & Lensmire, 2016; Jupp & Lensmire, 2016). By drawing upon an intellectual tradition founded by African American intellectuals, I am citing and centering the thinking of people of Color, particularly Black people in my case, in all the work I do.

I do not think people who critiqued me at the conference (and those since then) for not citing or reading particular scholarship were actually critiquing me for not citing scholarship from people of Color. I think this because they were more upset I was attempting to buck the trend of White people passively participating in anti-racist action. For example, what most people on the “liberal” side want from White people, in my experience, is for White people to, and I say this bluntly, sit down, shut up, and confess our privilege. As I will discuss later, this is a form of white privilege pedagogy and can result in resistance on the part of White people and usually provides a permission structure to not engage in meaningful anti-racist action (Lensmire et al., 2013; Levine-Rasky, 2000a). This dissertation is an attempt at finding new ways to engage White people in anti-racist learning and action. I want White people to take an active role and stance in racialized conversations and contexts. This means White people will not have read everything, will not always cite everything, will make mistakes, and the “liberal” camp needs to be ok with it.

Learning happens when individuals participate in community (Goodwin, 1994; Gutiérrez & Rogoff, 2003; Lave & Wenger, 1991; Rogoff, Paradise, Arauz, Correa-Chávez, & Angelillo, 2003), therefore, we need to opportunities for White people to participate actively rather than passively. By suggesting I read more or cite different people (i.e. people of Color), while potentially a completely valid argument and request, it can also act to reposition me, a White person, as needing to listen, admit my faults, and do nothing active for racial justice besides read more.

If White people can actively participate in racialized conversations, this means we will hear more White voices. I realize the risk in that statement. White narratives have been historically centered and dominant, and the movements of the “liberal” camp to decenter White peoples’ narratives are important. Still, we need to find a space where it is not a zero-sum game. The goal is not to “win” an argument or singular battle by forcing White people into submission and silence. The goal is to create a heterogeneous, dynamic future which has not yet been realized, and, *at a minimum*, find ways for people of Color to have the same rights as White people currently enjoy (Leonardo, 2004). Reaching this imagined future requires new forms of participation on the side of White people, in my opinion, because so far, listening hasn’t produced the change I think “liberal” people espouse to strive for. The work of imagining and creating new forms of participation for White people that go beyond listening and confessing is what this dissertation is about.

Centering whiteness

The most frequent critique of my work is that it centers whiteness. This was a worry of mine when I presented at the conference. It was also the biggest critique of people at the conference. I would position this critique as being on the “liberal” side of the race conversation

because most people who I would position in the “conservative” camp either want to center whiteness or more accurately, White identity. The “conservative” side usually does not believe talking about race, and therefore, whiteness, is particularly useful for any reason too. With this said, while I used to worry about centering whiteness, my response to this concern now is, simply, yes, my work does center whiteness.

My work centers whiteness and white supremacy because in order to understand either phenomena and critique them, I think one must actually talk about, analyze, and interrogate whiteness and white supremacy. If this means I am “centering” whiteness, then I can live with the accusation. I am centering whiteness, “not to *center* or *cater* to whiteness!” (Johnson, 2017, p. 483). Instead, I am centering whiteness and white supremacy to, “work against whiteness and racial oppression and work and teach for full humanity and liberation” (Johnson, 2017, p. 483). Centering whiteness in critique is a way to dismantle white supremacy, “in a way that fairly redistributes the racial burden of race” (Matias & Grosland, 2016, p. 2).

Centering whiteness or White people in a critical way is not a new idea. Drawing from a documented exchange in Lipsitz’s (1995) essay about the possessive investment in whiteness, Tanner (2019) writes about an exchange between a French reporter and Richard Wright. Richard Wright was asked about, “the Negro problem” in the United States after World War II. Richard Wright responded by saying, “There isn’t a Negro Problem, only a white problem.” Agreeing with Richard Wright, Tanner (2019) and I agree, “Race is a *white problem*” (p. 182). Richard Wright was not the only individual to argue race is a White problem. In a speech on October 11, 1963, at University of California, Berkeley, Malcolm X argued that racial separatism was the best way to solve the problems facing Black people in the United States (BlackPast, 2013). In their speech, Malcolm X outlined the numerous ways White people created the problems facing the Black community, arguing that, “The real criminal is the white liberal.” While not as direct as Richard Wright, Malcolm X is arguing race is not a problem created by Black people. In fact,

Malcolm X is saying Black people are not the “problem,” but it is White people who create, perpetuate, and are the problem as it concerns racial discrimination and oppression in the United States and abroad. Building on the theme of race being a White people problem, James Baldwin (1962) wrote,

White people in this country will have quite enough to do in learning how to accept and love themselves and each other, and when they have achieved this – which will not be tomorrow and may very well be never- the Negro problem will no longer exist, for it will no longer be needed (p. 22).

In this quote, Baldwin is pointing out that “the Negro problem” was manufactured by White people because we stopped respecting and rejoicing, “in the force of life” (Baldwin, 1962, p. 43) and now,

In order to survive as human, moving, moral weight in the world, America and all the Western nations will be forced to reexamine themselves and release themselves from many things that are now taken to be sacred, and to discard nearly all the assumptions that have been used to justify their lives and their anguish and their crimes so long (p. 44-45).

In short, Baldwin (1962) is arguing White people need to center, in an effort to understand, whiteness and white supremacy, to become human again and dismantle racial oppression. This is why I choose to center whiteness. I want to understand it, critique it, and begin the work of dismantling it in order to create a new reality and White identity because race *is a White problem*.

This dissertation

This project seeks to understand how White preservice science teachers learn to *be* anti-racist. When I say “anti-racist,” I am referring to a way of “being” (Casey & McManimon, 2020;

Ladson-Billings, 2006, p. 46) or “becoming” (Kumashiro, 2000) that purposefully and authentically resists white supremacy and all other systems of oppression. You cannot be anti-racist and be sexist, ableist, homophobic, or embrace any other form of bigotry (Kendi, 2019). There is not one way to be anti-racist. Being anti-racist is dynamic, varied, and a constant struggle. Being anti-racist is filled with tensions and trauma. Anti-racism, like racism, is also learned.

In this dissertation, I describe, in detail, the learning of a White, cis-gendered, heterosexual, able-bodied, middle-class man, Boaz, during the 2020-2021 academic year of a five-year (re)design of The Pennsylvania State University’s secondary science program. This study centers how the secondary science program was designed to focus more explicitly on white supremacy in science, schools, and society. The process of shifting the program was not easy. It was complicated and messy. However, as Tanner (2014) said, “Messiness is different than sloppiness” (p. 6). It is in the mess, in my opinion, that magic happens. It is in the mess where we can learn how anti-racism plays out in everyday life (Aquino, 2016) and complicate simplistic notions of what constitutes anti-racism for White people. So, while some researchers would argue this dissertation is “contaminated” because of how it embraces anomalies, contradictions, and the non-traditional, as Farrant (2014) states,

Research contamination can be seen in this light: challenging the notion of “pure” research, muddying processes, and findings, making researchers who discuss their work in ways that could be conceived of as “contaminated,” representative of something bad, wrong: weak rather than strong (p. 465).

Therefore, this dissertation embraces contamination and/or messiness to provide insight into practice and theory through the story of Boaz and his peers.

Moving forward what I will do is highlight how messy the project was. In other words, I will demonstrate the complexities involved in developing a learning environment for secondary

science interns to interrogate white supremacy. I will show how wickedly chaotic and lively it is for White people to grapple with their White identities and with whiteness. To do this, I follow in the footsteps of other scholars like Tim Lensmire, Jim Jupp, Sam Tanner, Cheryl Matias, Reverend Thandeka, James Baldwin, Toni Morrison, Ralph Ellison, Zeus Leonardo, and others who all show how messy and complex race is, even, if not especially, for White people. For example, Lensmire (2017b) shows the contradictions in White peoples' racialization. One on hand, showing how White people want the world to be more racially just while doing things that hinder that progress. Tanner (2018c), describes a project whereby he constantly questioned himself and let students do potentially problematic things in order to support them in understanding their White identity and whiteness more thoroughly. Matias (2016) shows how the emotionality of White people is fraught with illogicalities and paradoxes. James Baldwin (1962), Toni Morrison (1993), Ralph Ellison (1995), and other notable Black scholars provide deep insights into the White psyche and share robust commentaries on white supremacy through complicated stories and analyses. Each of the individuals I mention here do not provide straightforward, linear descriptions of the world, of whiteness, and of white supremacy. They are also not thoughtless, weak, jumbled, or sloppy. Instead, they are complex, dynamic, powerful, robust, and, yes, messy. They seek to show the world with nuance rather than simplicity. Like Mason (2016) and Britzman (2003), I want to present a narrative of a research project using narratives that display the complicated, conflicting, and messy process that unfolds when learning to teach and "become" anti-racist for White people.

Key Definitions

I now want to take time to define and highlight key words I will use throughout my dissertation. I am choosing to articulate the meaning of these words because they are words that

are often taken for granted and usually ill-defined. For example, I use equity, social justice, and anti-racism within this paper. Often, these words are used interchangeably, when they mean, for me and for others, different things. I will do my best to keep my definitions and use of the words consistent, but I want to define the words to make it clear what I mean when I use them.

White supremacy

White supremacy is a historically grounded, power-laden social construct created for and by elite White people with the sole purpose of oppressing peoples of Color and controlling other, non-elite White people. White supremacy contains eight characteristics. The characteristics are, white supremacy being deeply systemic, particularly masterful, highly adaptive, incomparably persistent, intergenerationally oppressive, promoting caricature and erasure, tricky and illusory, and it hurting and killing people (J.M. Staples, personal communication, May 2021). In this way, white supremacy is perpetuated by people, institutions, and systems interpersonally, socioculturally, structurally, and globally in both explicit and implicit ways.

Whiteness

Whiteness is the discourses, practices, and ideologies that perpetuate, extend, and create white supremacy. Described by Pauli Badenhorst (2018), whiteness is like a Slinky™. Whiteness has six qualities that support it operating among, “*regular people*, often of multiple races, sometimes through regimes of coercion, yet more often through covert, unconscious, and unspoken habitus-based social practices of complicity” (Badenhorst, 2018, p. 51). The six qualities of whiteness are that it is flexible and contextual, contradictory and chaotic, stable and stationary, centers itself, entangled in other systems and histories of oppression, and is malleable.

For the utmost clarity, whiteness is not an identity or culture, therefore, it can be engaged in by anyone, regardless of race (Leonardo, 2002, 2004).

Black/Latine/Asian/Indigenous/White/etc.

These words signify different racial groups. Note each word is capitalized to recognize the shared histories and cultures. For example, I use the word “Black” to encompass the diverse diaspora of African descent. Additionally, I recognize the controversy behind capitalizing “White.” There are many sides to the conversation. I chose to capitalize White because I believe it is important to highlight our shared history, as White people, within and around white supremacy. I also think it is important to denote that we are a specific group of people and *not* the norm, although whiteness works to make White people “normal” in our white supremacist society. As a quick note, I do not capitalize “whiteness,” “white supremacy,” “white privilege,” and similar words because I believe they are processes that unfold differently for different people, including White people, and are context dependent. Therefore, while I could make broad, sweeping generalizations, I do not believe there is as strongly a shared history and experience with these processes as there is when using the label “White” to describe a group of historically joined peoples and identities. Additionally, Black, Latine, Indigenous, Asian, and all other racialized individuals have relationships with these processes, making the experience of the processes specific and contextual given that anyone, regardless of race, can participate in whiteness and white supremacy, albeit in different ways and for different reasons (Leonardo, 2002, 2004). Lastly, I realize the inaccuracies involved in grouping heterogeneous groups of people together into vague categories created by white supremacy. However, while race is not biological, it is real, matters in peoples’ lives, and through racialization. creates similar and different identities, ways of knowing, being, etc.

Equity

I draw my thinking about equity from the work of Daniel Morales-Doyle (2019). Equity for Morales-Doyle (2019) and, consequently, myself, contains three elements. The elements are, historical underpinnings, politics, and being clear about morality (Morales-Doyle, 2019). This means to be equitable, one must grapple with the historic factors in how people, ideas, etc. are positioned differently in various contexts, act in ways that contest oppressive status quos, and consider the consequences of our actions for humanity and the Earth broadly. In sum, equity in education is about providing learning opportunities to students that equip them, “to survive in the world as it is while we inspire them to imagine and fight for a world in which they and others would thrive” (Morales-Doyle, 2019, p. 489).

Social justice

Social justice is similar to equity. Social justice requires engagement with equity, and equity cannot be achieved without social justice. The difference, in my opinion, between social justice and equity is social justice is an uncompromising attempt to alter the foundational underpinnings of society to transform identities, institutions, and systems. Social justice is an explicitly activist stance. Therefore, social justice is the *how* of achieving the *what* of equity. Social justice is fundamentally about *freedom* (Love, 2019).

Anti-racism

Anti-racism is the act of challenging, resisting, and dismantling white supremacy. Kendi (2019) describes anti-racism as supporting policies and espousing ideas that advance racial equity. To be more specific, anti-racism is about seeking to understand, “the everyday

experiences of dark people living, enduring, and resisting White supremacy and White rage” (Love, 2019, p. 54) as well as understanding white supremacy’s consequences for White people as we act against it. Anti-racism is a race specific form of social justice, but to be clear, one cannot be anti-racist and not support other social justice efforts that work toward equity of all kinds.

Chapter Overview

Chapter one lays the foundation for this study. Throughout the remainder of the chapter, I will position myself historically and contemporarily within the study by engaging in racialized storytelling, a method of storytelling that works to situate me as a social actor and create an opportunity for self-actualization (Johnson, 2017). Afterwards, I will connect my racialized stories to a rationale for the design of the project overall.

I use racialized storytelling throughout the dissertation. This dissertation is, in and of itself, one big story to me. I opened the dissertation with a story and I will close it by revisiting the same story. The reason I use racialized storytelling now and overall, is to create a, “contested space that illustrates our stories do not solely belong to the self – in short, our racialized stories are not just our stories” (Johnson, 2017, p. 482). Storytelling is the soul work needed to achieve liberation and human freedom, storytelling helps us confront memories that are unhealthy and morally unethical to repress, and it is a mechanism by which we can illustrate how the past shapes the present and how the past and present structure the possibilities of the future” (Johnson, 2017, pp. 479–481).

As a White man, I use racialized storytelling to (re)enter our racialized past in order to understand the present and imagine what could be. Race according to Gordon (1997) is something that haunts us, and White people are the ghosts that haunting (Johnson, 2017). By

using racialized storytelling, I hope it leads to self-actualization for myself and White people collectively. This may sound selfish, but citing Dillon (2012), Johnson (2017), argues, White people are “possessed” by the “spirit of slavery” or a desire exceeding conscious control and thought, meddling in the present as it, “compels movement, motivates ideology, and drives the organization of life and death” (Dillon, 2012, p. 115). Racialized storytelling is a way to unveil the possession and navigate the messy terrain of the past, present, and future to achieve, “being to (re)imagine myself(ves) and the world in which I live” because racialized storytelling is, at its core, a method of thought (Johnson, 2017, p. 499).

I will now describe seminal moments of my racialized life leading up to my engagement in my dissertation study. I want to elucidate, “Why I am here,” a question I have been asked on numerous occasions throughout my life. I also engage in racialized storytelling because I am shaped by my racialized experiences. The racialized stories represent my worldview and thus further explicate the stance I take towards and in this project (Chadderton, 2012; Foste, 2020). In other words, I need to show you, the reader, “where” I live, “in order to imagine living elsewhere” and I need to, “imagine living elsewhere before we can live there” (Gordon, 1997, p. 4).

When I learned I was White

I remember the first time I realized I was White. The memory isn't very pleasant. It contains racism, but that is the least remarkable thing about it in my opinion. What is most interesting about this memory is how tricky it is to tell. The story is straightforward, but when one pauses, it is anything but. It is complicated, nuanced, and difficult for me to write and think about (as it may be for others too). Therefore, it serves, constantly, for me as the bedrock of why I wake

up every day thinking about whiteness, white supremacy in science, and how to provide learning environments to help White people be anti-racist. With that said, here is a story.

Growing up, I rarely slept over at my grandmother's house. My grandmother lives in Shelocta, Pennsylvania, an hour away from where I lived in Allison Park, Pennsylvania. She lives on the same plot of land, in the town of Elderton she grew up on. Near the same plot of land her mother lived on until the land was turned into the Keystone Lake in 1945. She lives on the land my ancestors, descendants from the MacGregor clan in Scotland, decided to settle on. This made going to Grandma's exciting. I loved hearing the stories that happened on the land around her house, I still do. Seeing the place my father shot his first (and last) deer. Hearing about the dairy cows, meat cattle, chickens, and vegetables raised on the land. Knowing that my uncles would ride bikes all around the area, Grandma was once nicknamed "Speed Ball" even though she is more of a turtle now than a hare, and Aunt Mary literally jumped out of the second floor of the school building on her last day of 8th grade because she was completely done with school, carried an exotic, tantalizing energy of an era and world I would never know. So, when I found out I would get to spend the night with Grandma I was over the moon.

That day, we went to Shireman's, the local florist where Grandma worked for decades. I roamed the green houses with my cousin Timmy and my little brother Matt. I can still smell the damp, earthy, floral aromas that filled the air everywhere we went. We picked flowers and sprayed the big hoses. Later, I sat and watched Grandma transform green foam blocks and empty vases into works of art. When we left, we dropped Timmy off at home and drove to Wal-Mart. At Wal-Mart, Grandma let Matt and I pick out a toy (I probably chose a Star Wars action figure) and some junk food my parents would never let us have. After dinner, we got to eat it all!

As I was unwrapping a treat (probably a Zebra Cake or Honey Bun), I walked into the living room. The lights were off and the TV was lighting the room with a flicker of blue. Matt was laughing hysterically. Aunt Mary was too. I walked in and sat down on the blanket and pillow

covered floor where I would be sleeping that night. Aunt Mary and Matt were watching professional wrestling. On the screen was a White man and a Black man wrestling. I remember the White man having blonde hair, but I don't remember their name. The Black man was Booker T. Not being a wrestling fan, I don't remember many wrestlers' names, but I remember Booker T because of what soon transpired.

*The White wrestler was winning, and my Aunt Mary began to cheer on the White wrestler. She yelled things like, "Beat that n****r" and "Look at that little n****r run!" The laughing continued. Soon after, Matt joined in and began to copy Aunt Mary. Then Grandma walked in. She smiled and chuckled along with Aunt Mary. At this moment, I remember being confused. I have no idea where I learned it or how I knew, but the things being said were "bad." I didn't know why, I just knew. Yet, Grandma would have said something if what was being said was bad, I thought. Grandma wouldn't let Matt say them too. I felt nervous and unsure. Eventually, wanting to fit in, I said something about Booker T and uttered THE word I knew I shouldn't say. Aunt Mary, Grandma, and Matt all howled with laughter. It felt good to get affirmed for my comment, but I was still nervous and confused. As quickly as the match had started, it was over, and everything went back to eating snacks, listening to country music, and asking questions about what Dad was like as a kid.*

The next day, my parents picked me up. They asked what we did. I immediately felt an intense wave of shame and trepidation wash over me. I said very little, but Matt, he didn't know any better. He told my parents everything. Without missing a beat, Mom whipped around in her seat and Dad hit the brakes, pulling the car over. Once the car was pulled over, we both got told we were "NEVER" supposed to use "THAT" word "EVER AGAIN!" We were then told Aunt Mary was wrong and people don't think that way anymore, or at least good people don't. They then asked if we understood. Both of us said yes and we continued on.

As a child, I knew my parents were right, but I also had so many questions. What is wrong with THAT word? What does Aunt Mary think? Why if people don't think that way, does Aunt Mary? Why did Grandma not stop us? Why were my parents so mad? What would happen if I did screw up again? I didn't know much and had a lot of questions, but what I did know was everything that transpired was because Booker T looked different from me. He looked different from the other wrestler. He looked different than anyone I knew. He looked like the people we drove past going to Kennywood or the people who lived in the city where it was "dangerous." It was because he is Black and I am White.

This story is filled with emotions for me. Joy. Guilt. Love. Confusion. Clarity. Shame. They are all intertwined. They are inseparable. While it is clear I had previously learned something about race given my initial feelings when encountering Aunt Mary using the n-word or the shame I felt upon my parents asking about the visit, this is the first conscious memory I have of learning that race mattered. The difference between Black and White people mattered; this would later get more complicated when including all other racial identifiers.

As I got older, I learned more about race and got answers to all, or at least most, of my questions, but this memory stuck in my mind's eye, and until fairly recently remained there. I never shared it because I feared what it would make others think about me, but more importantly Aunt Mary, Grandma, and Matt. I feared them being labeled racist, but more than that, I feared losing them. By sharing this story, I felt I was pointing out character flaws, speaking towards something deep within them that wasn't their true selves. I felt I would be pointing out the same flaws within myself. I also felt by sharing, by "confessing" this story, I was taking a moral high ground above them. A position I did not, and still believe, I do not hold, but knew, I would get whether I wanted it or not. Grandma, Aunt Mary, and Matt are not bad people, they are not immoral people. They are kind and generous. In fact, all three of them have said and done things I consider to be anti-racist, and yet, we are all capable of engaging in the racist act I described

above. This leaves me with the question of, “How can we complicate notions of anti-racism and create opportunities for White identity to be more dynamic and complex in relation to whiteness and white supremacy?”

Being “anti-racist”

I worked as a facilitator at Dialogue Inc. During my time training as a facilitator, I learned how to lead conversations about “contentious” topics like race, gender, and climate change. I am now an expert in a wide range of facilitation techniques. I was and am a great facilitator.

During my time at Dialogue Inc., I was mentored, and eventually became close friends with two Black men. They were mentors, and they were my first true friends of Color, who I will affectionately refer to using the initials, K.G. and L.W. I hung on their every word, hell, I still do, even on social media. They are brilliant and embodied everything I thought a facilitator and anti-racist should.

We were very candid about race. They taught me dance moves and introduced me, in a serious way, to hip hop. They mentioned articles, movies, authors, and words I secretly went home to consume or learn about. We joked about how White I was, and, for the first time, I didn’t feel ashamed to be White.

As my friendships with K.G. and L.W. deepened, I strove to belong to a community that was different from the one I grew up in. My old community was almost entirely White, my new community was incredibly diverse. In the new, more diverse community, I had become very well versed in how to confess and acknowledge my white privilege. I got very good at telling stories that divulged the “secrets” of the racist communities I felt I belonged to and the racist things I

had experienced. It was, at times, a maniacal, self-flagellating performance. I did all of this in order to signal my belonging.

As I became a member of Dialogue Inc., I started sharing new insights on white privilege and voicing support for people of Color in the presence of my White friends and family, and I slowly got pushed out of some of my White community. For example, my mother would listen to me, but sometimes our conversations would end abruptly after I realized I upset or offended her. I was told by some of my White friends I was “ruining their fun” or “always making everything so serious.” As a result, I needed K.G. and L.W. and the rest of my newly formed community or I feared I would not have anyone.

*Eventually K.G., L.W., and I spent almost every day together. I remember speaking about what K.G. thought was an impending race war after George Zimmerman was acquitted of his murder of Trayvon Martin. We had similar conversations after the murder of Michael Brown. We spoke about the sides we would take. K.G. told me I would be a secret weapon. I would be able to infiltrate White enemy lines. Each new experience, each new conversation I had with them always made me nervous, but K.G. previously told me that, “If you’re going to hang with us, you need to learn.” So, I would suck it up, say nothing, and do what I was told because I loved them (and still do). I wanted to belong. Eventually, they began to encourage me to take on and include me in discourses I felt were only for them. Specifically, L.W. began to refer to me as a “street n***a” and K.G. who would often refer to L.W. and him as “ain’t shit n***as,” began to refer to me in this way. I felt uneasy each time (I had learned early on that White people should not use or even be around the n-word), but I also believed this was a sign I belonged. Ultimately, they began to encourage and prompt me into using similar language. I would, only when prompted, use the n-word in reference to myself as a “street n***a” or us (L.W., K.G., and I) being “ain’t shit n***as.” As far as I knew, I was the only White person who was “allowed” to engage with them in this way. Beyond this, there was an unspoken competition among the White facilitators to be*

“the best” White person as indicated by the acceptance of the people of Color at Dialogue Inc. The discourses I was included in sent a signal, to me and other White folks, that I was one of the “best” White people.

At this point in my White anti-racist journey, I felt like I belonged and was recognized by people within Dialogue Inc. and on campus broadly as a White anti-racist. This was evidenced by being out at bars or in class and being stopped to talk about race because “you work at Dialogue Inc., right?” or “I heard/had you in a dialogue.” I was considered one of the White people to look up to at Dialogue Inc. I was positioned as someone who “got it.” I was even told by a mentor I was consistently “ranked” as the top facilitator one semester. I was also given leadership roles. I believed, and was told, I was no longer White, but something else. I knew I wasn’t Black, yet in many respects, believed I was beyond the rest of the White people I knew. Besides, even if I did see myself as White, I knew I wouldn’t be welcome in my White community anymore, or at least I wouldn’t be welcomed in the same way.

My relationships with K.G. and L.W. were complicated. They were authentic and robust. That is all a good thing. Our relationships were not one sided, but they could be lopsided depending on the context. I had learned “rules.” These rules told me how to interact with K.G. and L.W. around race. I learned to agree with what they said and spent most of the time making fun of other White people, acknowledging my privilege, giving them insight into the White community, and learning about their Black identities and cultures. On the surface, I was confident and composed when talking about race. On the inside, I was too, if not a bit arrogant, even though I still got nervous and unsure. Regardless, I did not have a voice around race. I played my role as a “good” White person. At points I was referred to as an ally, later a co-conspirator, but I spent my time parroting others’ opinions, positioning myself as “better” than “other” White people, and not understanding history and power as forces that mattered in K.G.’s, L.W.’s, and my own racialization and therefore, our relationships.

My White identity during my early friendships with K.G. and L.W. was driven by fear and a desire to not be seen as White. By that I mean, I feared being thought of as a racist because that was all I understood White identity to be. This fear of being a racist actually led me to engage in something I believe is racist, saying the n-word. Sure, K.G. and L.W. *encouraged* me to use the word, when prompted, with them. Yes, I have spoken since about my usage of the n-word in this context and, some folks, Black people included, have argued it was “ok,” “appropriate,” and even “necessary” for me to use the word like I did. Others, obviously, disagree. Regardless of one’s opinion on the use of the n-word, specifically by White people, is my use of it was not thought out. I allowed myself to be dictated to by K.G. and L.W., not by my own sense of self and my own understanding of history and power as it relates to the n-word and our collective racialization. If I had a greater sense of self, I know I would not have used the n-word because I have encountered similar dynamics since my interactions with K.G. and L.W. and declined to engage in using the n-word. Therefore, the narrative leaves me wondering, “How can white people learn to be active agents in our own racialization and engage with race as an interpersonal, sociocultural, structural, and global phenomena in authentic ways that are justice-oriented?”

My science teaching

I taught at a public school in Brownsville, Brooklyn for “overage and undercredited” students. This meant I taught students who were mostly 19-21 years old. It also meant my primary job was to help students accrue credits and pass the New York State Regents exams. I was a teacher equivalent to a trauma surgeon. Working against a clock, with students who experienced any number of traumas at the hands of the educational system (and many others), and the name of the game was “survival.” I taught a student population that was entirely Black and Latine. As a teacher, I was often measured by how well my students did on tests, how obedient they were,

and whether I modeled the “right” ways to do things like annotate a text. I was considered to be a good teacher if I conformed to what the school wanted because their way “worked.” I can’t remember the number of times I heard the principal say, we needed to, “get on the bus.”

During my first year of teaching, I had a student proclaim to me that, “mice have no bones.” I was a science teacher, so I would often get into conversation about how students understood the natural world around them. I heard many ideas I would consider odd and even more ideas folks would refer to as “misconceptions” or “noncanonical.” What was striking about the comment about mice was we were learning about evolution. We learned about different kinds of organisms, and based on our discussions, mice had to have bones.

I was not a teacher who told kids they were wrong, so I asked them, “why do you say that?” They responded by telling me mice can fit into spaces too small for their bodies. They claimed to have seen a mouse squeeze underneath a door once. I pressed them and asked, well could a mouse fit into ANY space? The student said “yes.” After some back and forth, I realized I would not change the student’s mind with words. They and many of their peers were convinced that mice didn’t have bones.

Later, I procured cadavers of mice. We dissected them. I showed them mice did have bones. The students were still not convinced. I was perplexed. I thought I was a failure as a science teacher if my students left class and thought mice did not have bones. Students were convinced the white “sticks” they saw could not be bones because bones don’t get smaller and are supposed to hold the body in place. Therefore, for the students, mice could not have bones AND fit through tiny holes. I resigned myself to letting them believe mice had no bones.

When I gave the students their final paper for the unit about the relationship between dinosaurs and birds. Most students displayed a sufficient understanding of evolution and concepts we spoke about throughout the unit. Then it dawned on me. Why did I care about whether students thought mice had bones or not? The idea really didn’t matter. Their explanation

worked. In fact, I thought it was possible to potentially justify mice not having bones. We think mice have bones because other people said they do. Who decided mice have bones and the white sticks I thought were bones were actually bones? Sure, chemically they are the same thing as every other white stick we call a bone, but bones do, in a way, act differently in mice. At that moment, I decided to not worry about the small details and let my students, as long as they could justify their stance meaningfully, think what they wanted.

The following year, I was being observed by the superintendent and a number of other teachers from different schools. I was leading a Socratic seminar focused on the question of whether we should invest more money in birth control for people with testicles (aka: male birth control) to end a unit about the reproductive system. If the topic wasn't "radical" enough, in the middle of the conversation, one student proclaimed, "I have the solution! We all seem to be at an impasse." The student noticed the room was divided, mostly along gender lines. So, they proposed their solution, "Instead of worrying about birth control, maybe we should invest more money in abortions!"

The room erupted. Some students shouted positions that were anti-abortion. Some thought it was a genius middle ground. The teachers and superintendent watching started to talk with each other. I stood quietly in the corner smiling. Eventually, the student facilitators got control of the room and engaged the student's proposal. The class spoke about ethics. They took a moment, because abortion wasn't the conversation they prepared for, to look into costs and other details on their phones. To be clear, phones were not allowed in class due to school policy. Again, I just stood, watched, listened, and gave my input discretely on sticky notes I passed out to students. I thought the conversation was awesome.

After, I debriefed with the teachers, the superintendent, and my principal. They all had concerns. They said the information the students discussed wasn't always correct. They were worried my seventeen- to twenty-one-year-old students spoke about sex and abortion. They were

not happy the students used evidence from their personal lives and the Internet from unvetted sources. They said the students got “off topic.” They mentioned I was quiet the whole time and did, “nothing other than walk around with sticky notes.” When I responded, I said the class was exactly what they claimed to want, “student centered.” I also pointed out how the students were engaged in using, evaluating, and interpreting evidence in relation to birth control and the reproductive system, the objective of the day. I also said when the students were talking about birth control and abortion, the students were referring appropriately and accurately to the content we discussed during the unit about the reproductive system. I told the group I trusted the students to have meaningful conversations using science ideas. I wasn’t concerned with all the tiny details they spoke about that had little to do with the big ideas I was teaching during the unit. Plus, I mentioned, “the sticky notes were how I was able to support the conversation. I wasn’t going to let ‘anything go.’ I gave them live feedback, ideas, and questions without stopping their conversation.”

The next day, I brought in donuts. This was my policy after being observed. Students were excited and wanted to know what everyone thought. I told them about the debrief. Some of them laughed, some dapped me up, others sat thinking. One particularly sharp student wondered why I didn’t worry about them getting “right” answers all the time. I told the student if I learned one thing from teaching it was each student thinks differently, each person is dynamic, and if I worry about controlling situations and what students think, I was framing the world in one way. I told them I was used to just listening to people. I had done things I wasn’t proud of because I just thought people who I believed knew more than me were always right. I wanted to be a teacher that ensured certain ideas, the big ideas, students understood, but how students choose to use the ideas were up to them. Whether they believed the ideas was up to them. The student was frustrated by the response, but they knew they wouldn’t change my mind.

Right from the get go, when I reflect on this narrative, I am struck by the subtle ways I notice whiteness-at-work (Yoon, 2012). I see whiteness as playing a controlling role. It is white supremacy, in my opinion, that made me feel concerned students thought mice had no bones, and it is white supremacy that had the superintendent, teachers, and principal worried. Although I did not recognize the dynamics playing out as whiteness at the time, the major difference between my relationships with K.G. and L.W. in the previous narrative and the students in this narrative, is I slowed down, I took time to think, and I engaged in reflection rather than reaction. I did not immediately react to my students initially by trying to prove them wrong. After they gave me the gift of resistance, something I don't think I would have received without having a relationship of trust with them, I did rethink my stance on the "mice don't have bones" issue.

The moment changed how I thought about my science teaching, it changed how I thought about the Black and Latine students I served, and it changed how I saw myself as a White person who taught science to Black and Latine students. The major shift was that I took a stance. Rather than see my Black and Latine students as people I needed to solely get to pass tests and accrue credits, I saw them as the dynamic, heterogeneous, brilliant students they had always been. I chose to position them as knowers and experts above all else. Like with K.G. and L.W., I listened to them intently, taking in their lessons. However, unlike my relationships with K.G. and L.W., I actively took a stance rather than following directions. It helped that my job was to teach students, giving me a position of authority, but I created nuance where I had previously only held binary stances. I realized I could support students in learning the "right" science while also not needing them to be "right" all the time. "Right" was contextual and, to be honest, flexible. Now I would call this "progressive discourse" (Bereiter, 1994). The goal was not for students to have all the canonical science knowledge, but for students to progress their ideas in meaningful ways that "worked" for them. As a community we got to determine what worked. I knew what students needed for the test and the world beyond, they knew what they needed to navigate their lives in a

way that was meaningful for them. As their White science teacher, it was my job to make sure they succeeded beyond my classroom, but it was also *not* my job to tell them how, when, and why to use the specifics of the knowledge they were learning. With this said, I am left thinking about science teaching, wondering, “How is learning to be a science teacher racialized?” I also am curious about, “How can we support science teachers in adopting science teaching practices that balance the multiple needs of students, schools, teachers, and society in a way that transforms what is possible when teaching and learning science?”

Why are you here?

I have been asked a version of “Why are you here?” three times at three important junctures of my life. Each time I was asked, I reacted differently, but I said essentially the same thing. The first people who asked me this were former students. They are the reason I came to graduate school to begin with. The second time was my first day of classes at Penn State. Dr. Jeanine Staples asked me this question after I introduced myself in her Black Feminisms course. The third time I was asked this question was by my committee, specifically by Dr. Samuel Tanner, during my dissertation proposal defense. Each time the words I used were some version of, “I don’t know. I just can’t imagine being anywhere else.”

The first time I was asked “Why are you here?” I was teaching science to students labeled “overage and undercredited.” Essentially, the students I served were students who had something happen in their life that made high school take longer. They were, without mincing words, failed by the United States education system. The students who asked me this question were sitting in my room during lunch. All of them identified as Black. On this particular day, I had gotten a little cranky with some students over something I can’t remember now. However, being in that class, one of the students asked me, “Why are you teaching us?” They put a lot of

emphasis on the US. The others quickly jumped on board as they wondered why I decided to teach "THEM". I remember one student saying, "You went to PENN STATE, you could do ANYTHING you want!" I chuckled and said, "If only that were true." Then I paused. The question confused me, but I quickly came to the conclusion they said what they said for two reasons. First, they cared about me and thought I was deserving of anything I wanted, but more than that, they did not think they deserved to have a high-quality education. This is not to say I was giving them the best education in the world (I wasn't), but their comments indicated they did not believe I actually wanted to be their teacher. I thought about saying, "This is what I always wanted to do" or "This is the best job in the world," but I knew that would be lying. I promised my students I would never lie to them. So, I told the truth. I said, "I don't really know. I like what I do and this school felt right for me the second I arrived." It was not a satisfying answer for them, and for me, but it was the truth. We all sat in understanding silence after. I like to think they believed me, knew I was being truthful, and that was enough, even if it was an unsatisfying response.

The second time I was asked "Why are you here?" I was literally asked that question. I was the only White person, the only man, the only White man, in a class about Black feminism. The course was taught by Dr. Jeanine Staples. My peers were two Black women. To say it was a small class would be an understatement. After Dr. Staples introduced herself, she had us introduce ourselves. We gave the obligatory graduate student introductions. We said our names, hometown, our department/program, and our research interests. My peers went first. Then, on my turn, I said a version of, "My name is JD McCausland, I am in Curriculum and Instruction emphasizing in science education, I grew up in Pittsburgh but lived in New York City before this, and I am interested in helping teachers learn Ambitious Science Teaching." When I was done, I remember Dr. Staples was surprised I was in science education and then asked if I was in the right class. I was taken aback. I was a little shocked. I was also confused. The question felt like a

test. Maybe it was, but my guess now is Dr. Staples was genuinely curious and was excited to have me in the class. After what felt like too long, I said, "I don't know. The class looked interesting and I wanted to sign up, so I did." Again, I told the truth, but it wasn't satisfying. Thankfully, Dr. Staples came to the rescue and mentioned some of the projects were specifically designed to support identity development of Black women, so we would need to adapt them for me if I decided to stick around. Dr. Staples took me at my word and gave me a chance to enter her class community and learn not only about Black feminism, the identities of Black women, but my own White identity too.

The third time I was asked "Why are you here?" was during my dissertation proposal defense. I had a particularly trying fall. Folks pushed back on my work. I felt ostracized at a conference that I thought would give me a lot of insight and help me find community. So, naturally, the committee, specifically Dr. Sam Tanner asked me, "Are you sure you want to do this?" It wasn't exactly, "Why are you here?" but that is how I interpreted the question. I remember sitting for a while. I felt a crash of emotion come over me. I remembered my students. I remembered all of our conversations. I thought about my Grandma, Aunt Mary, Matt. I thought of my friends. I remembered the laughs with K.G. and L.W. It all sat on my shoulders. Then I said, "Yes. I don't know what else I would do. It is all I can imagine doing" as I choked back tears. I went on to talk about how my dissertation would be for the students I served at the end of the day. I spoke about how deeply I cared for the project I proposed even as my voice shook. In the end, I just looked up and my committee stared back at me with encouragement. The looks I received from my committee indicated they thought my ideas were worthwhile, it was ok I didn't have everything figured out yet (not that I ever would), and I had something valuable to contribute.

For 28 years, I have lived in a body that is White, cis-gendered, heteronormative, able-bodied, well-educated, English-speaking, upper-middle class and a man. For 10 years, I have

spoken about racism, white supremacy, and White identity. I have received a lot of praise over that time. Being who I am and being willing to articulate or admit when I cannot articulate thoughts about inequality and structural -isms, I have been labeled as “woke,” “down,” or “one of the good ones.” It has and does give me access to places, people, and ideas other White people do not get access to. Initially, this made me feel good and like I was doing “the work.” I said and did all the “right” things. In my arrogance, I often screwed up. I still screw up. I did/do and said/say things that were/are racist. Each time, I felt/feel immense amounts of shame. People would say I experienced white fragility (DiAngelo, 2011), but this doesn’t fully describe what I felt, what I feel, when I screw(ed) up or speak about race generally. For me, notions of white privilege and fragility, while true on many levels, often flatten what it means to experience the world as a White person and how we learn to be White. In fact, I might go a step further and say white privilege/fragility frameworks limit or completely prevent anti-racist action and, consequently, might support white supremacy because they present a monolithic idea of what it means to be and learn to be White (Lensmire et al., 2013). My goal is to explain and understand White identity more deeply, articulate how whiteness works, and find ways to prepare people, primarily teachers, to think about white supremacy deeply and engage in anti-racist teaching.

The responses to my answers to the question of “Why are you here?” demonstrate what happens when White people are given an opportunity to be our authentic selves. With the students, they accepted my response as truthful (which it was) and let my response sit, unchallenged, even if I knew they wanted to challenge it. Dr. Staples trusted me to participate in class as a full member. Dr. Staples did not hold me to any lower standard, trusted me to engage in the same practices she demanded of my two Black women peers, but ensured the assignments I completed were geared towards my own identity rather than writing and thinking about an identity I did not embody. Dr. Tanner and my committee believed my response. They all let it be enough and trusted me to do the work of theorizing and engaging in a project around whiteness

and white supremacy. The question was not intended to get me to switch projects, just to take a stance, at the moment, in regards to my eventual dissertation. These reactions may seem like the reactions of most humans. Maybe they are. However, the reactions shaped my pedagogy far beyond it as it relates to other White people, or just conversations about “contentious” issues all together. I choose to believe people. I choose to give *everyone* a chance and see the best in them. I choose to trust people to mean what they say and for their ideas to arise with the best of intentions. When the impact is unsatisfying, I choose to ask questions, to let the ideas sit in silence, and to trust people will come to the “right” conclusion. I want to give space for people to be confused, unsure, and just exist. Which makes me wonder, “What does it look like to trust White people to theorize and think about white supremacy without *giving* them the canonical knowledge traditionally presented in courses about anti-racism?” and “What are the consequences of enacting a pedagogy that trusts in the best parts of White identity when working with White people around race, white supremacy, and anti-racism?”

A final thought on my story... for now

These are only a few of the stories throughout my life that have demonstrated to me that White identity and whiteness are complicated. To start, the histories surrounding the stories I shared are vast and complicated. For example, the first story begins with my ancestors journeying from Scotland and Ireland. My ancestors fled Scotland in the early 1700s and others fled the Irish Potato Famine in 1845. The Scottish ancestors settled what was then land lived on, by, and with Indigenous peoples, specifically the Shawnee and Osage, who now reside in present day Oklahoma, and other Ohio Valley tribes. I came to exist because my ancestors participated in genocide while fleeing war and persecution themselves. My living in the United States is also the result of a fungus, and interestingly, my ancestors were not initially considered White people, but

would become White people over time (Ignatiev, 2009). While this is an oversimplified version of my family's history, it demonstrates the complexities within the histories. Fleeing harm, my ancestors committed a great atrocity. Fleeing starvation, my ancestors sought out opportunity, only to find they were treated as less than human, but they would eventually find a way into whiteness. All this is said without getting into the histories involved in the other stories I presented. This tells me whiteness and white supremacy are complicated.

Being White is complicated. Growing up in my White middle-class suburban community, I was taught to look down on country people or "White trash," "Rednecks," and "Hill-billies" (later I would learn that to be a "good" White person, I needed to make fun of most other White people). While some of these words accurately describe my family, I love them deeply. The sense of wonder, joy, and love I feel with my father's side of the family is profound. I may not see them every day, but I am one of them. Still, we have distance between us. I have friends of Color. I care for students of Color. I advocate for ideas that have labeled me as a "do gooder." Therefore, while they love me, that love has its boundaries. On the flip side, on my mother's side of the family, race is never discussed. I feel/felt weird bringing it up most of my life. When it was unavoidable, I found myself doing verbal gymnastics to explain what I did as a teacher who served Black and Latine students in New York City. Again, I love my family, and yet, because of the work I did, the work I am doing, I still feel distance between me and my White family. So, in short, all of it is complicated.

I can spend pages unpacking why, how, and what I did in each of the stories. Why I felt what I felt. How I learned what I learned, and what I learned from the moment, in the immediate aftermath, as well as later in life as I reflect. I could try to explain all of this using a white privilege framework that would treat the actions and reactions throughout my narratives in a good versus bad binary, but I think that explanation would be flat and only capture a fraction or zero of what is actually interesting about each narrative. Throughout each narrative, there are learned

responses. The learned responses run deep and are more complicated than being fragile in conversations about race, for example. To drive this point home, I have called Aunt Mary racist to her face and she was not phased. In fact, she retorted with, “At least I’m willing to say what I think.” This statement gave me pause. It was her calling me out for my arrogance, my perceived “wokeness,” and the limits of my knowledge. Therefore, this is me, “saying what I think,” as I try to figure out how White people learn to be White people, understand whiteness in nuanced ways, and unpack the relationship between science, science education, and white supremacy.

Where this is going: Science education and whiteness

In my own learning about race, I received explicit and implicit messages about what it meant to be White in the United States. This learning did not stop when I entered science. While we identified the stages of mitosis and meiosis, balanced chemical equations, or explained why a car increased its speed going down a ramp, we also spoke about race. It was not obviously connected to content directly, especially in high school, but the specter of race was present. In an AP Chemistry course, my friends and I (all White) would ridicule the singular person of Color (also a friend) in the room for being “erratic” and “bad” at chemistry. While there is some truth to the erratic comment as this student broke many beakers, test tubes, and more, it is interesting we positioned them as not being a science person. This phenomenon, where students of Color are positioned as incapable or unscientific, exists all across the United States (Allen & Eisenhart, 2017; Calabrese Barton & Yang, 2000; Carlone, Scott, & Lowder, 2014; Na’ilah Suad Nasir & Vakil, 2017).

As the student population continues to diversify, the teacher population does not often reflect the diversity of the students they serve. In fact, most teachers, including science teachers are White (NCES, 2020). When factoring the racist histories of the discipline science teachers

teach (Marks, 2017; Roberts, 2011; Saini, 2019; Watkins, 2001), there are many potential barriers for students of Color who want to enter science. Some scholars believe the history and reality of science education has produced a culture of power that actively marginalizes students of Color for numerous reasons (Calabrese Barton & Yang, 2000). Recognizing this, scholars in science education have attempted to remedy the culture of power in science education by highlighting how students of Color are marginalized in classrooms (Calabrese Barton & Yang, 2000; Carlone, Johnson, & Scott, 2015; Carlone et al., 2014; Carlone, Webb, Archer, & Taylor, 2015), designing environments to support students of Color in science (Birmingham et al., 2017; Calabrese Barton & Tan, 2019; Thompson, 2014), or preparing teachers to teach science in equitable ways (B. Brown, 2019; B. Brown, Boda, Lemmi, & Monroe, 2018; Jaber, Southerland, & Dake, 2018; Kavanagh et al., 2020; Rosebery, Warren, & Tucker-Raymond, 2016), among others. While this work is powerful and affecting how students of Color experience science, Sheth (2019) argues racism is foundational to science education.

I believe that Sheth (2019) is correct, racism is foundational to science education, but I believe it is white supremacy the science education community needs to focus on. We need to focus on white supremacy because racism is the *symptom* not the *disease* (Le & Matias, 2019). White supremacy is a historically grounded system of ideologies, discourses, practices, and material realities perpetuated by institutions and people to oppress people, often peoples of Color, by (elite) White people to defend and sustain a system of wealth and power (Casey & McManimon, 2020; Leonardo, 2002). Racism is a consequence of white supremacy because the micro, macro, and systemic aggressions that characterize racism broadly are ways White people maintain and sustain white supremacy. For example, citing the racial achievement gaps, Le & Matias (2019) argue the racism causing the “gaps” (e.g. unqualified teachers in schools serving BIPOC children, lack of access to NGSS-aligned curriculum, not honoring or acknowledging student epistemic agency, etc.) would not be an issue if whiteness did not exist. Beyond the

“achievement gap,” science education focused on “Western” or “Eurocentric” science has been accused of being assimilationist (Sammel, 2009). In other words, students can be “forced” to learn a particular version of science without meaningful engagement with other ways of knowing that often are highly aligned with how science exists contemporarily. As students are indoctrinated into one, dogmatic form of science, racist practices rooted in white supremacy can be used to police the boundaries of that science (McCausland, 2020) creating science as white property (Harris, 1993; Mensah & Jackson, 2018), or a science that is owned and controlled by White people. By focusing on racism alone, the science education community is engaging in a practice I believe is akin to putting band-aids on cancer. White supremacy is the cancer in science education, and we cannot *heal* until we address the disease within the DNA of our field.

Goals of this project

This study describes my attempt to begin to address white supremacy in science education by working towards answering the following questions, a) how do White science interns learn to be anti-racist educators? and b) how does combining critical whiteness pedagogy and practice-based teacher education support science interns in adopting anti-racist practices? What I will present is a story of the 2020-2021 iteration of a design-based research project around Penn State’s secondary science program. The goal of the project was to support interns in enacting a justice-oriented form of Ambitious Science Teaching (Windschitl, Thompson, & Braaten, 2018; Windschitl, Thompson, Braaten, & Stroupe, 2012) by using practice-based teacher education (S. McDonald, Bateman, & McCausland, 2020) and critical whiteness pedagogy (Matias & Mackey, 2016; Tanner, 2017, 2018a, 2018b). The story I will share centers on one White man, Boaz, and his year-long journey as he grappled with his White identity and science

teaching. Like the stories above, Boaz's story is complex. Through my writing I will attempt to unravel and communicate this complexity.

Overview of what is to come

In Chapter Two, I will discuss the literature guiding this study. I will discuss my perspective on teacher education and detail the current movement in practice-based teacher education. I will also outline critical whiteness studies as a field. Specifically, I will articulate second-wave critical whiteness studies and the role African American thinkers Ralph Ellison (1995) and Reverend Thandeka (1999) play in my understanding of whiteness and white supremacy.

Chapter Three will cover my use of design-based research for this project. I will describe the design-based research project as a whole and outline its five-year history. This description will revolve primarily around a conjecture map (Sandoval, 2014) I created to articulate the 2020-2021 design of the secondary science program. Following this, I will describe my data collection methods and analysis.

Chapter Four will be the findings of the study. Chapter 4 is the story of Boaz's learning. Although Boaz is the focus of this study, I include salient instances with other participants. As much as Boaz was an interesting case, similar trends can be seen within other participants. I also include myself within the story because although this is a story about Boaz's learning, it also is a story about my pedagogy, a central aspect of the learning environment.

Chapter Five is where I engage in discussion around the findings and outline the potential of using what I will call critical whiteness practice-based teacher education. I will also discuss potential future research. While it sounds like I will try to simplify ideas and concepts, I hope to do the opposite. White supremacy is not simple or straightforward. Therefore, solutions to white

supremacy, if we can call them that, should not be either or we risk only fixing symptoms and not the disease.

Chapter 2

Bringing Critical Whiteness Studies to Science (Teacher) Education

Science's social history and present

Humans are curious. There is ample evidence from archaeology, anthropology, and history to suggest this. From early use of tools, trade routes, domestication of plants and animals, engineering feats still considered to be wonders of the world, and beyond, humans have learned how to manipulate, exploit, and live in harmony with nature. This desire to, at its core, understand nature continues to drive science today. While early humans did not have science as we now know it, they did have sophisticated understandings of how the world worked (Watson-Verran & Turnbull, 1995).

Today, science is practiced on every continent by humans of all identities. This makes characterizing science particularly challenging because science does not belong to one person, culture, or society. In fact, science is a product of society and therefore, contains the values, beliefs, and ways of acting and being that exist within any given group, culture, or civilization (G. Kelly, Carlsen, & Cunningham, 1993). Society influences science and vice versa (Harding, 1994, 1998; Longino, 1990). Debunking the notion that science is objective, Knorr Cetina (1995) demonstrated how decisions made in local laboratory contexts are social. Decisions by individual scientists are not influenced by any strict "method." The fluidity between sociocultural influences on science and every-day actions of individual laboratory communities leaves room for the presence of many sciences, yet throughout much of the globe, one particular description of science is dominant.

Science as we think of it today has its origins in Egypt and Mesopotamia (Lindberg, 1992) and evolved during the European Scientific Revolution (Godfrey-Smith, 2009; Principe, 2011). As described by Pickstone (2000), science has transformed from being interested in nature from a philosophical and religious point of view to seeking an understanding of nature through empiricism. This form of science is sometimes referred to as Western science, Western Modern science, or Eurocentric sciences to represent its origins (Aikenhead & Ogawa, 2007; Cajete, 2000; Kawagley, Norris-Tull, & Norris-Tull, 1995). Regardless of the name one uses, the aforementioned science has particular presuppositions that includes nature being knowable and controllable, acquiring knowledge to gain knowledge, and until about the 1960s, although this thinking still exists, a positivist worldview (Aikenhead & Ogawa, 2007).

Eurocentric sciences are just one way to explain nature, and other sciences have contributed to the way we understand nature, contributed to Eurocentric sciences, and are fully formed ways of knowing and doing science in their own right (Aikenhead & Ogawa, 2007; Bang & Marin, 2015; Corsiglia & Snively, 2001; Snively & Corsiglia, 1998; Watson-Verran & Turnbull, 1995). With this said, through colonization, European countries supplanted Native sciences with Eurocentric sciences or Eurocentric sciences have assimilated knowledge produced by Native sciences into their epistemology (Sammel, 2009). Therefore, while there is a plurality of sciences, science is often used to refer only to Eurocentric sciences, which makes up the canon for science education. From this point forward, unless I denote it specifically, Eurocentric sciences is what I mean when I refer to science for the remainder of this paper.

Science has roots in European history. This history is riddled with coloniality and white supremacy. Given white supremacy produces a racial hierarchy through actions and discourses perpetuated by people, institutions, and other structures, it should be no surprise science and whiteness have worked together to marginalize individuals not deemed White (Takaki, 1990; Watkins, 2001). Roberts (2011) details the historic relationship between white supremacy and

science by highlighting how science was used to justify the presence of race and a racial hierarchy, placing White people, intentionally, in a superior position. For example, taxonomists like Carl Linnaeus organized humans into four groups, “White, Black, Red, and Yellow” (Watkins, 2001, p. 27). These labels represented the four major categories of race often operationalized today. Today we often use White, Black, Indigenous, and Asian to organize humans racially. Additionally, deviating from the positivist worldview claimed by science at the time, Linnaeus spent time in their descriptions of the races they outlined describing ideal physical features for each race and their personalities (Roberts, 2011). This resulted in a hierarchy with White people on top.

Since the entrance of race into the scientific discourse, there have been many scientific revolutions (Kuhn, 2012). For example, Darwin’s theory of evolution and Mendel’s discovery about heredity were influential in science. We still teach these ideas today in science classrooms. Unfortunately, scientists used these theories to rationalize numerous racialized oppressions like settler colonialism and chattel slavery (Gould, 1996; Saini, 2019; Takaki, 1990). However, one notable revolution, the Human Genome Project, debunked the presence of a biological race. This should have caused science to lose its language around race, but, as Roberts (2011) demonstrated, with each scientific revolution, scientists found new ways to recreate race with theories related to geography, populations, ethnicity, and more. Additionally, practices around ownership and the pursuit of knowledge for knowledge’s sake have been used to justify unethical behaviors by scientists in their work (Marks, 2017; Saini, 2019), for example the taking of DNA from Indigenous peoples (Reardon & TallBear, 2012). These acts only reify the connection between white supremacy and science. Given the deep connections between science and white supremacy, it is impossible to separate the histories.

In a racialized society, like the one we currently inhabit, it makes sense scientists would ask and attempt to answer questions about race. It also makes sense the theory produced would

support the dominant value system, in the case of our society, that is often white supremacy. Since what is considered “true” in science is determined by the community and, more broadly, society (Kuhn, 2012), if a society is imbued with white supremacy, science can be racist and does embrace white supremacy. Look no farther than the continued fascination with race by scientists today when it comes to drugs designed for specific races and more (Roberts, 2011; Saini, 2019). If race does not exist biologically according to the Human Genome Project, then why do scientists still engage in research revolving around race or something similar? It may sound like science is always racist. I am not saying that. What I am saying is science can embrace white supremacy because historically, “Science provided the legitimization for Whiteness to take root” (Sammel, 2009, p. 652) making the two, “mutually constitutive” (p. 651) unless we choose to untangle them.

Science can be presented in ways that mask how it is really made (Wong & Hodson, 2009), having dire consequences for how science is understood and experienced by everyone (including scientists). Without a project specifically designed to reveal how science can be racialized, we will continue to perpetuate white supremacy in and around science. For example, Asian women in STEM fields can and do experience numerous microaggressions including their confidence being framed as aggression and experiencing sexual harassment that is gendered and racialized (Castro & Collins, 2021). What these findings show is science is made in misogynistic and white supremacist spaces, and this undoubtedly impacts the science being done in those spaces.

Science and science education

Traditionally in science education, science is presented in its “final form” or as a list of facts to be memorized as truth (Duschl, 1990; National Research Council, 2007). In an effort to

move away from presenting science in this way, the *Framework for K-12 Science Education* provides a vision for science education where students build on and revise their ideas, limits traditional content to a set of core ideas, and focuses more on practices of science (National Research Council, 2012). The authors of the *Framework*, as a whole, argue in science, “the theories, models, instruments, and methods for collecting and displaying data, as well as the norms for building arguments from evidence, are developed collectively in a vast network of scientists working together over extended periods” (National Research Council, 2012, p. 27). In other words, science is a social enterprise, and science has norms one must adhere to if they are to succeed in the community. Science education, through the *Framework*, along with its manifestation in the Next Generation Science Standards (NGSS; NGSS Lead States, 2013), has broadly defined what science is for teachers and students in terms of practices, crosscutting concepts, and disciplinary core ideas.

The practices, crosscutting concepts, and disciplinary core ideas form the canonical science taught in K-12 classrooms. Unless a student can demonstrate their use and knowledge of the three-dimensional learning proposed by the NGSS, they are not considered, at least according to the NGSS, to have met the standards of a science student. It is this canonical science, as articulated by the NGSS, that makes up part of the culture of power in science which can and does marginalize students who do not fit the norm (Calabrese Barton & Yang, 2000). Certainly, each community has a set of beliefs and values people are enculturated into, so in this, science education is not unique. What makes the NGSS unique is that the cannon outlined by the NGSS concerns content, in form of disciplinary core ideas, and the practices by which students engage in and learn science, are outlined. This is different from previous standards that only outlined content, not practices. Therefore, the NGSS is potentially more canonical than previous standards. Again, this is not a bad thing. However, it is important to recognize how science education

defines science because it has consequences for who is and is not considered to have met the standards and is positioned as a science person based on the criteria set forth by the NGSS.

To engage students in crosscutting concepts and the practices of science, “eight major themes and grade level understandings about the nature of science” are included in the NGSS (NGSS Lead States, 2013, p. 98). The tenets of nature of science are designed to be coherent, widely agreed upon in scientific communities, and important for students and teachers to understand how to participate in the scientific enterprise (Norm Lederman, Abd-El-Khalick, Bell, & Schwartz, 2002; National Research Council, 2007). However, defining tenets about the nature of science, and consequently, defining science, are incomplete because they do not reflect issues of equity or present a vision of multiple sciences (Bianchini & Solomon, 2003; Rudolph, 2000; Stanley & Brickhouse, 1994).

Historically, many of the critiques of defining science through tenets surround how the tenets can present science as a universalist epistemology (Stanley & Brickhouse, 1994) and how they can neglect the impact of local communities on science (Knorr Cetina, 1995; Rudolph, 2000). In other words, tenets fail to fully recognize variations in science and how social constructs like race impact science. Arguing for a more complex view of nature of science, Allchin (2011) states, “one needs to also understand the nature of uncertainty and possible sources of error. In particular, cultural biases tend to go unnoticed” (p. 522). Through this argument, Allchin (2011) is advocating for a contextualized view of science to push back against science being framed as universalist. Once this contextualization occurs, the nature of science can change depending on the disciplinary context (Irzik & Nola, 2011) and the discourse present in individual labs (Knorr Cetina, 1995), for example. This work supports the position that scientists are influenced by the communities they belong to, and by failing to recognize the influence of context on science, science education runs the risk of over-simplifying science and not fully addressing equity in all dimensions of our work.

Science education and equity

Both the *Framework* and NGSS dedicate time to arguing science education must encourage educators to leverage student language and experiences, make diversity visible, treat science as culture, and include marginalized students' interests within reforms. While these efforts are an improvement on past reforms that largely ignored equity all together, research still notes the marginalization of students of Color in science (Allen & Eisenhart, 2017; Carlone et al., 2014; Martin & Fisher-Ari, 2021; Nasir & Vakil, 2017; Sheth, 2019). This leads to problems of access and recognition for students of Color in science broadly, two issues many studies attempt to rectify (for examples see, Aikenhead, 1997; Atwater, 2012; Bang & Medin, 2010; Banner, 2016; B. A. Brown, 2006; Davis & Schaeffer, 2019; Warren, Ballenger, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001). To address equity, Rodriguez (2015) argues for adding a fourth dimension into the NGSS to address engagement, equity, and diversity (p. 1043). In other words, Rodriguez (2015) is arguing to make equity explicit and central to science education.

Making race and equity visible is important in science education, but unless science education addresses its culture of power in historicized and politicized ways, many efforts will struggle to take root (Philip & Azevedo, 2017). For example, in their work, Calabrese Barton and Yang (2000) found a student, Miguel, who felt they needed to adopt a specific, "set of values, beliefs, and ways of acting and being" (p. 873) to succeed. By doing so, Miguel felt they would be leaving their culture behind. Additionally, Rolin (2018) argues that science values a combative style of communication and competitiveness, privileging people who embrace masculinity. Brown (2006, 2019) also demonstrates how scientific discourse is a barrier to students. Many facets of science education are embedded with this culture of power, and it largely works to sort students in ways that have negative outcomes for many historically marginalized youths, including students of Color.

In order to combat the culture of power in science education, scholars recommend asset-based pedagogies such as culturally relevant pedagogy (Ladson-Billings, 1995, 2006), culturally responsive teaching (Gay, 2002; Villegas & Lucas, 2002), culturally sustaining pedagogy (Alim & Paris, 2017; Paris, 2012; Paris & Alim, 2014), and funds of knowledge approaches (Calabrese Barton & Tan, 2009; Llopart & Esteban-Guitart, 2016; Moll, Amanti, Neff, & Gonzalez, 1992), among others. Each of these approaches to teaching advocates for similar ideals. Mainly they view students, their ideas, and their communities as assets rather than barriers to learning. Although these models can transform how science is taught and learned, none of the pedagogical models are science specific. Therefore, they may change how science is taught in some ways and not in others. For example, Calabrese Barton and Tan (2010) had students engaged in a phenomenon directly involving their community. This created an opportunity to advocate for their community in documentaries the students created, and as the authors argue, produce and critique science (Barton & Tan, 2010). This is powerful and important work because students need to be able to critique science if they are to understand it and engage with it on their terms. Still, even this innovative learning environment only addressed the presentation of science and language used to explain how science mattered in their communities. These changes, in my opinion, are not enough if science is to become truly anti-racist. In another study, students were engaged in a unit using the guiding question of, “How does water support life?” (N. R. Davis & Schaeffer, 2019, p. 373). Through this unit students were able to learn science *and*, “understand water justice as a sociopolitical (and in some cases raced) and ethical issue” (N. R. Davis & Schaeffer, 2019, p. 384). In this study, students leveraged science in a way to understand important social justice issues, a key component to any culturally relevant learning environment (Ladson-Billings, 2006), but the students did not critique science. Certainly, science is helpful and we cannot accomplish every goal that might be included in an anti-racist or equitable learning environment, therefore, these studies and others (e.g. Kayumova & Tippins, 2021; Morales-

Doyle, 2017; Nguyen, Gasman, Washington Lockett, & Peña, 2021; Shea & Sandoval, 2020; White, Miles, & Frantell, 2021), provide valuable examples for what is possible in science education.

Learning as racialized

In a step towards producing an anti-racist science education, Sheth (2019) argues racism might be foundational to science teaching and learning, even teaching intended to be grounded in equity. These foundations of racism largely form what Mensah and Jackson (2018) refer to as “science as white property” or the ways science marginalizes students of Color to create a racial hierarchy within science. Both of these studies indicate there is a need within science education to do more than create alternative learning spaces centered on equity and social justice. By only focusing on access and representation, the people in science may change, but student learning, at all levels of science education, may still inhibit their epistemic agency (Manz, 2015; Emily Miller, Manz, Russ, Stroupe, & Berland, 2018; Stroupe, 2014), or their ability to build knowledge and be positioned as knowers. This will inevitably result in a particular type of student being successful in science, limiting the change possible because there is more to the culture of power in science education than who gets access and representation. In fact, by focusing on equality, access, inclusion, and recognition have thus far, “failed to yield systemic, long-lasting institutional and social change” (A. J. Rodriguez & Morrison, 2019, p. 268). Instead, Rodriguez and Morrison (2019) argue people, researchers specifically, need to engage in activism or do something to shift the actual power structures creating the injustices of unequal access.

Roberts (2011) and Sammel (2009) demonstrate, white supremacy is linked to, and is therefore a part of, science and science education. This connection has largely gone unexamined by science education (Le & Matias, 2019; Ridgeway, 2019). Although their work does not draw

extensively on science education literature, Le and Matias (2019) do make it clear that science supplants practices of other people and sciences, a form of epistemic oppression (Dotson, 2012). This process happens in unapparent ways, but nonetheless, result in the oppression of students of Color (Le & Matias, 2019; McCausland, 2020). For example, Mutegi (2011) describes how the slogan “Science for All” holds widespread appeal, but nonetheless fails to adequately address the needs of African American students because it may serve to reinforce assimilation into a worldview constructed by individuals who oppressed African American people, would not result in changing the colonized status of African American people, treats Eurocentric sciences as good for everyone, and fails to recognize race as playing a role in science and science education. In this way, as Ridgway (2019) suggests, drawing from the work around whiteness in math education (Battey & Leyva, 2016; D. B. Martin, 2013), science is a racial project and we as a science education community must consider how whiteness operates in our science learning spaces.

The work by Sheth (2019) and Mensah and Jackson (2018) show how learning science is racialized (Bell, Tzou, Bricker, & Baines, 2013; Nasir, Snyder, Shah, & Ross, 2013). For Nasir et al. (2013), learning is racialized because of three connected processes,

(a) racial storylines are pervasive in our societal discourse; (b) racial storylines are a critical aspect of life in schools, and they serve the purpose of socializing student racially and academically; and (c) as these racial storylines are invoked, certain identities are made available, imposed, or closed down, and influence the engagement and learning in school settings (p. 286).

These storylines result in limiting or expanding the possible learning pathways a student can experience overtime (P. Bell et al., 2013). Racialized pathways, in my opinion, are the consequence of whiteness and actively shape the who, when, what, how, and why in the teaching and learning of science (and all other domains too). For example, Bullock (2017) shows how race played a significant role in White people claiming STEM education as property when repurposing

a “failed” Black school in Memphis, Tennessee. Mensah (2019) also shows how the experiences and learning of a Black woman science teacher, Michele, were shaped by race, specifically believing science was “not for people of Color” because of past experiences. Mensah (2019) then shows the power of having a Black woman professor who is able to provide Michele what she needed as a Black woman science teacher. Thirdly, other studies (e.g. Carlone, Johnson, et al., 2015; Carlone et al., 2014; Carlone, Webb, et al., 2015) show how science learning is racialized based on actions taken by teachers. These studies reflect how racialized pathways are also intersectional, or include narratives that combine students’ gendered and racialized identities (K. Crenshaw, 1995). An example of the intersectional nature of racialized pathways is Carlone et al.’s (2014) work showing how Aaliyah, a Black girl, was positioned as a good science student in elementary school, but in middle school, the White man who taught her, silenced her through racialized and gendered comments. On the flip side, Amy, a White girl, was positioned as a near perfect performer in part because of her “answer-seeking” demeanor that positioned her as “submissive” within the classroom, a position often given to White women (Frankenberg, 1993). With all this said, whiteness must be seriously considered and understood in science education beyond just something that acts as a barrier to getting students of Color access to science education, but as an interpersonal and systemic process shaping the learning of science for all students in different, but consequential ways.

Critical whiteness studies: An introduction

Research on whiteness is largely absent from literature in science education (Le & Matias, 2019; Ridgeway, 2019). Currently, most efforts to combat whiteness in science education are attempts to, “treat the *symptom*, not the *problem*” (Le & Matias, 2019, p. 10). By only solving symptoms and not the underlying disease, science education continues to fail and dehumanize

students, especially students of Color. Yes, any work attempting to make science education more equitable does push back against whiteness, however, by not addressing whiteness directly, whiteness is able to adapt based on new contexts and situations (McManimon, Casey, & Berchini, 2018; Picower, 2009; Yoon, 2012). Therefore, I believe science education must borrow ideas from critical whiteness studies (CWS) in order to address the white supremacy that is inherent to science education and create new possible racialized learning pathways (Nasir et al., 2013) in science education.

CWS focuses broadly on understanding the, “hegemonic racial structurings of social and material realities operating in the present moment that perpetuate racialized inequalities and injustices” (Jupp et al., 2016, p. 4). However, decades before CWS appeared, African American intellectuals (e.g., Morrison, Baldwin, Ellison, Du Bois, Douglass, X, and more) provided deep and robust understandings of race in the United States. Regrettably, scholars of Color are not often given credit and are omitted from studies concerning whiteness. Yet, these scholars were influential in moving the conversation about race from biological to social and historical grounds (Jupp et al., 2016; Jupp, Leckie, Cabrera, & Utt, 2019). While second wave CWS is built on the foundation laid by these scholars, CWS can be understood as a derivative of critical race theory (Jupp et al., 2016, 2019). Although Jupp et al. (2016) note “striking differences” (p. 7) between critical race theory and CWS, scholars in both traditions hold similar perspectives that race is an essential organizing factor in the United States (Derrick Bell, 1987; Berry, 2015; Harris, 1993; Ladson-Billings & Tate, 1995; Leonardo, 2004).

In CWS, especially second wave CWS, whiteness is understood to be a discourse and ideology rather than one culture or identity (Leonardo, 2002). Whiteness is the numerous practices, ideologies, and discourses that perpetuate white supremacy, the historically grounded system that consists of these discourses, practices, and ideologies which are perpetuated by people and institutions to uphold the racial hierarchy we live in today. This means that anyone,

not just White people, can embrace whiteness and perpetuate white supremacy, but the participation of White people and people of Color in white supremacy is fundamentally different (Leonardo, 2002; Matias & Mackey, 2016). Taking a view of whiteness as a discourse and ideology explains why some people choose, perhaps unknowingly, to engage in whiteness, while others do not. This does not mean whiteness and white supremacy will “go away,” if one decides to “not participate” because, as Haviland (2008) states, whiteness is, “powerful yet power-evasive” (p. 41), “employs numerous techniques to maintain its power” (p. 42), and “is not monolithic” (p. 42). This is especially true in a discipline forged with white supremacy. However, by taking a nuanced stance on whiteness and white supremacy, it can be designed against in productive ways that are malleable enough to address whiteness when it appears in learning environments.

Critical whiteness studies: The beginning

As previously mentioned, CWS emerged from an African American intellectual tradition (Jupp et al., 2016, 2019). While many of the Black scholars who engaged in dissecting and revealing what Richard Wright referred to as, “a white problem,” (cited in Tanner, 2019 from Lipsitz, 1995), or helping society understand the ways whiteness operates and White people develop our identities, they often get little to no credit for their contributions. For example, in a review of White teacher identity studies, a subfield of CWS, there were few examples of work that drew upon African American intellectual traditions (Jupp et al., 2019). Additionally, in the recently published *Encyclopedia of Critical Whiteness Studies in Education* (Casey, 2021), only seven chapters of the encyclopedia’s 96 chapters deal directly with specific scholars of Color, especially those from the Black community’s contributions to CWS. This is not a critique of the encyclopedia because many of the authors of the chapters cited important scholars of Color,

including the African American scholars who form the foundation of CWS, but it does point out that, as Jupp et al. (2019) advocate, “engagement in the African American historical archive is important for the continued development of the field” (p. 9).

With this said, CWS entered more popular academic consciousness as a part of the emergence of critical race theory. Critical race theory was created by Black legal scholars, most notably Derrick Bell (1987). Additionally, Black legal scholars like Alan Freeman, Richard Delgado, Kimberlé Crenshaw, Cheryl Harris, and many more built a scholarly movement from ideas born out of European philosophers like Gramsci and Foucault but also early Black thinkers like Sojourner Truth, W.E.B Du Bois, the Black Power and Chicano Movements, and others (Delgado & Stefancic, 2017). What critical race theory contributes to our thinking is racism is ordinary, the idea of interest convergence, the social construction of race, the idea of storytelling and counter-storytelling, and how White people have been the recipients of civil rights legislation. In this way, both CWS and critical race theory contain activist elements and are designed to support people in articulating how race matters in society.

Given the interconnected ways CWS and critical race theory emerged, there are similarities between both scholarly traditions, but there are also significant differences. The similarities include using storytelling as a method, being interdisciplinary, analyzing whiteness as a power-laden discourse, being used in scholarly activism, and complicating White identity (Jupp et al., 2019; Matias, Viesca, Garrison-Wade, Tandon, & Galindo, 2014). It was critical race theory’s articulation of whiteness serving as an, “institutional and historical identity-property of White-skinned people that emphasized legal status and guarantees that racialized others did not enjoy” (p. 7) that helped lay the foundation for CWS along with work in labor history, cultural and literacy studies, feminist theory, and gender studies (Jupp et al., 2016).

Diverging slightly from critical race theory, I believe CWS, based on a critique of critical race theory positing critical race theory lacks a racial theory (Cabrera, 2018), is more heavily

grounded in theory that helps explain the mechanisms behind the realities critical race scholars describe (Matias et al., 2014). For example, Cabrera (2018) argues critical race theory is excellent at describing what is, but is limited in explaining how the phenomena are structured. To solve this, Cabrera (2018) suggests the introduction of hegemonic whiteness as a racial theory because, “Cultural and discursive practices (hegemonic Whiteness) serve to naturalize unequal social relations along the color line” (p. 223). Additionally, Matias and colleagues (2014) describe how hegemonic whiteness is the underlying mechanism for racism. CWS grapples with whiteness more than critical race theory. They also reveal critical race theory was useful when analyzing the effects of racism, but CWS was needed to understand how the White preservice teachers in their study were acting and thinking (Matias et al., 2014). In this way, CWS is able to capture not only what occurs in contexts but how and potentially why certain racialized phenomena are happening.

Both CWS and critical race theory entered education in the 1990s. Ladson-Billings and Tate (1995) introduced critical race theory to education arguing it would help education scholars understand the role race plays in educational spaces. Around the same time, Sleeter (1992, 1993) introduced CWS to education by providing descriptions of White teachers’ race-evasive identities. Since then, race has become an increasingly discussed and researched issue in education, and CWS has had two distinct “waves” (Jupp et al., 2016; Jupp & Lensmire, 2016). The “waves” of CWS are the first and second waves.

First wave critical whiteness studies

According to Jupp, Berry, and Lensmire (2016), there are two waves of CWS. Historically, first wave CWS was made up of many areas of study, but Peggy McIntosh’s (2008) essay, *White privilege: Unpacking the invisible knapsack*, has become a mainstay in many classes about social justice. Consequently, the idea of privilege, specifically around White people, sits at

the core of first wave CWS. For McIntosh (2008), it is our inability, as White people, to understand and “see” our privilege that produces the significant inequalities in our society.

For education, Jupp et al. (2016) identify Sleeter’s (1992) research as one of the original texts signaling entrance of CWS into education. Analyzing interviews with teachers in a 2-year professional development around multicultural education, Sleeter (1992) discussed how White teachers ignored institutional racism, placed blame on individual characteristics for students’ lack of success, and maintained overall positions that failed to fully acknowledge the racialized identities of their students. While Sleeter (1992) focused primarily on race-evasive ideologies, or positions taken up by White people to avoid acknowledging or dissecting the role of race in our society, another critical aspect of first wave CWS, they also embed aspects of white privilege. Both themes are highlighted by Sleeter’s (1992) discussion of White teachers as having worldviews that “support White privilege” (p. 20) and concluding the article by arguing teacher educators must find ways to help White teachers “re-think their beliefs about race” and “acknowledging both the validity and limitations of their own life experience” (p. 30).

Since Sleeter’s (1992) study, other scholars have confirmed their findings by examining and articulating the specific rhetorical maneuvers and ideologies White people and teachers engage in when discussing race and/or whiteness (Bonilla-Silva, 2002; Haviland, 2008; Picower, 2009). This means, for the most part, first wave CWS can be characterized by the focus on white privilege and race evasiveness on the part of White teachers. In their review of race-evasive White teacher identity studies, Jupp et al. (2019) highlight the contributions of work on race-evasiveness by categorizing them into five groups: a) racialized silence and invisibility, b) resistance and active reconstruction of white privilege, c) whiteness in institutional contexts, d) fertile paradoxes, and e) reflexive whiteness pedagogies. The first two categories specifically focus on first wave ideas. The other three categories highlight the direction of CWS more recently, a direction referred to as second wave CWS.

Second wave critical whiteness studies

Where the first wave of CWS, in education, can be understood as examining how White teachers denied and resisted race and white privilege in their practice and lives, the second wave of CWS is characterized by building on that foundation through focusing on race-candid identities of White people and describing the pedagogies and curricula forming contexts of White teacher identity by explicitly using the foundation laid by African American scholars (Jupp & Lensmire, 2016). Through this refined lens, second wave CWS brought a framing of whiteness more concerned with understanding how whiteness operates in specific contexts, how context affects White people, understanding the intricacies of whiteness including double binds and affect, as well as removing the assumption of a static connection between White people and whiteness (Berchini, 2017; Jupp et al., 2016; Jupp & Lensmire, 2016; Levine-Rasky, 2000a, 2000b; McCarthy, 2003). With this said, first wave CWS did not disappear. Instead, first wave CWS transformed from attempts to categorize every way White people have privilege and engage in race evasion to embracing notions of complexity in White identity as well as adopting more reflexive approaches to teaching and research (Jupp et al., 2016, 2019; McCarthy, 2003; Tanner, 2018b).

Exemplifying second wave CWS are the efforts of many scholars to push beyond notions of white privilege popularized by McIntosh (2008). Although McIntosh's (2008) work was important, many believe focusing on white privilege is too simplistic (Jupp & Lensmire, 2016; Lensmire, 2017b; Lensmire et al., 2013; Leonardo, 2002, 2004; Leonardo & Zembylas, 2013; Miller & Tanner, 2019; Tanner, 2017, 2018b, 2018a). One of the main critiques of McIntosh's (2008) essay is the belief that the focus on white privilege renders anti-racist action, on the part of White people, to confessing our privilege (Lensmire et al., 2013). Building on this critique, scholars also believe white privilege can stop anti-racist action because it treats White people as

monolithic, makes privilege an individual problem rather than a systemic one, treats whiteness as static in context, and it takes the focus away from the costs of white supremacy (Crowley & Smith, 2020; Lensmire et al., 2013; E. T. Miller & Tanner, 2019).

Researchers in second wave CWS consider, “what whiteness means for White people, ways that whiteness continues to matter, and how white supremacy informs institutional and social practices” (Tanner, 2016, p. 9). Within this scholarship, work has been aimed at obtaining a, “greater sense of White and people-of-color’s identity nuances and complexities as a necessary part of teaching and learning about race, whiteness, and white identity” (Jupp et al., 2016, p. 12). As a result, scholars have articulated race-evasion in the silence of White people (Mazzei, 2008), practices of whiteness (Bonilla-Silva, 2002; Leonardo & Zembylas, 2013; McManimon et al., 2018; Picower, 2009), more complex theorizing around White identity (Lensmire, 2008, 2010; 2014, 2017a, 2017b), and pedagogies designed to go beyond white privilege (Matias & Mackey, 2016; Miller & Tanner, 2019; Tanner, 2017, 2018b, 2018a).

White shame

Reverend Thandeka’s (1999) theorizing around white shame is an example of seminal second wave CWS work. When explaining white shame, Thandeka (1999) speaks about white racial abuse during a White child’s upbringing in order to form a White identity. By white racial abuse they mean the ways White authority figures (parents, teachers, police officers, etc.) explicitly and implicitly police White children when they enter nonwhite zones. The nonwhite zones can be both physical and psychological. They represent places White caretakers do not want their children to reside. For example, nonwhite zones are places (physical and psychological) where a White person feels positively about persons of Color or is an actual location where people of Color reside. The act of interacting with nonwhite zones and the

subsequent policing by White authority figures dictates how, “the child learns what feelings to embrace and which to reject to earn affection of caretakers” (p. 25). Describing the phenomenon, Thandeka (1999) describes the feelings of Don Wallace, whose learned fear of the police is demonstrated by their feeling of “walking-on-eggshells” (p. 23) when they moved back and forth between their girlfriend’s home located in a predominately Black and Brown neighborhood (nonwhite zone) and his home located in a predominantly White neighborhood (white zone). It is the feeling of white shame, which can be exhibited in a multitude of emotions, that Thandeka (1999) argues, forms the inner core selves as White; a place where being Other is toxic and avoided at all costs for fear of losing community and the benefits of whiteness.

White shame presents as, “an emotional display of a hidden civil war” (p. 12), occurring throughout the life of White people. This civil war takes place both within the mind of White people and between White people. For example, early on, it is White authority figures who vigilantly police the boundaries of white and nonwhite zones by telling White children implicitly and explicitly when they enter nonwhite zones. Miller and Tanner (2019) describe this by detailing how Derek, a White boy, was removed from their anti-racism class by their White parents when Derek’s White parents perceived Derek as entering a nonwhite zone when Derek drew a picture of a Black Abraham Lincoln. This is an example of how White people police one another. In another example, showing the inner civil war of White people, Lensmire (2017a) shares how a White woman, Delores, was nervous about and therefore did not participate in Civil Rights protests (which she agreed with) for fear of losing her White community if she was caught or even seen downtown near the protests.

Due to the white racial abuse of White authority figures, White people set aside all aspects of ourselves not deemed “White.” This is an attempt to be White enough to belong in our White communities (Thandeka, 1999). For example, Crowley (2019) presents a story about how a White student was bullied for liking hip-hop by other White people. This bullying resulted in

them changing their behavior and music interests to fit in. Hip-hop was considered to be a nonwhite zone. For liking hip-hop, the White student was policed, and in order to remain in their White community gave up hip-hop for other music deemed to be “White.”

What is notable about Thandeka’s (1999) theorizing is whiteness does not provide White people with privilege exclusively. In fact, their descriptions provide an account of the cost of whiteness for White people; our sense of self is constantly trying to maintain whiteness. It also highlights how White people play an active role, every day, in the reification of whiteness even if we do not know about it or directly interact with people of Color, but at the same time, by recognizing that whiteness is separate from White people, provides an optimistic vision, in my opinion, of a potential future. Through white shame, Thandeka (1999) provides a detailed and nuanced explanation for how whiteness operates within our society, specifically with and among White people and White communities, to actively oppress people who are not deemed White while preventing White people from living our lives with integrity.

White ambivalence

White ambivalence was described by Ralph Ellison (1995) and is another example of how African American intellectual thinking has been taken up in second wave CWS. Ambivalence generally can be characterized as a person’s contradictory emotions or desires towards something. For Ellison (1995), White people have a tension between what we believe and want for our society and what the reality is. Describing this, Lensmire (2011) says of Ellison’s ideas about white ambivalence, “at the core of white racial identities is a dilemma, a conflict, ambivalence - a belief in, a desire for, equality in America, poised against the evidence, all around us, of massive inequality” (p. 102). In order to resolve this dilemma, White people engage in scapegoating rituals born out of stereotypes that rationalize white supremacy. These

scapegoating rituals take the form of, literally and metaphorically, lynching Black people (and other people of Color) to feel comfortable in our White identity. Rather than being the result of fear of people of Color due to harmful stereotypes of people of Color, for example, the hypersexuality of Black men (Frankenberg, 1993), Ellison (1995) argues stereotypes provide comfort for White people in our own identities. This point is important because it is the stereotypes of people of Color that create White identities. We need the stereotypes to keep living in an unjust world because it is the stereotypes justifying white supremacy.

In describing the ambivalence of White identities, Lensmire (2010) describes the experience of Delores, a White teacher who grew up in rural Wisconsin. Delores chose not to participate in Civil Rights demonstrations. For Delores, there was a conundrum, a dilemma, in believing each person has inherent dignity and the fear of the violence that could result from changing the world that does not honor the dignity Delores believed in. Delores feared for her safety and being removed from her community (Thandeka, 1999). In sum, Delores' identity was, "riddled with shame and ambivalence - a white racial identity defined by wanting to reach out beyond the white community coupled with a fear of this wanting" (Lensmire, 2008, p. 315).

Paired with Thandeka's (1999) theorizing around white shame, Ellison's (1995) descriptions of white ambivalence and scapegoating work to articulate the need for White people to belong. Lensmire (2017a) highlights this connection when describing the pain they felt when their mother, in a particularly heated conversation, tells Lensmire (2017a) to leave the United States if he doesn't like it. Lensmire's (2017a) mother threatened to abandon them for not being White enough. While this is an example, again, of the white racial abuse that takes place in White communities, resulting in white shame (Thandeka, 1999), Lensmire (2017a) shows how the need to belong connects to scapegoating rituals for "anti-racist" White people too. Describing how a younger White woman scapegoats an older White woman for not being critical enough during a conference, Lensmire (2017a) says the younger White woman's actions should be read, "not only

in terms of her desire for a particular identity, but as the expression of a desire to belong” (p. 11). In other words, the younger White woman scapegoated the older White woman in order to feel good about their White identity by positioning themselves as “better” than the older White woman. I surmise the younger White woman used the stereotype of older White women being more racist than younger White women as a way to scapegoat the older White women and establish their identity as a White anti-racist woman.

Second wave critical whiteness studies and education

There have been many calls by critical whiteness scholars to address whiteness in educational settings. Recently, Tanner (2019) made a call for English education to begin to take whiteness seriously. Martin (2013), in math education, and Le and Matias (2019) and Ridgeway (2019), in science education also argued that whiteness should be examined. However, locating whiteness in education is difficult. In their auto-ethnographic work, Berry (2015) details their encounters with whiteness during their journey through education. Tracing the roots of the education system in Canada back through time beginning with the emergence of Western rationality, Berry (2015) outlines how, “Whiteness lies invisibly dormant in the processes of modern education as a set of neutral, taken-for-granted, hegemonic practices.” In other words, education is designed to support the cultural practices of White people by keeping whiteness invisible. In order to mask itself, whiteness hides in race-evasive rhetoric (Bonilla-Silva, 2002; Haviland, 2008), the policing of White children (Lensmire, 2017b; Thandeka, 1999), and everyday practices of schools (Berry, 2015; Tanner, 2018c, 2018b, 2018a). While this list is not comprehensive, it demonstrates that whiteness is everywhere. However, according to Leonardo (2002), “These structural features filter into micro-interactions between students and teachers” (p. 31).

In teacher education, Lensmire and Snaza (2010) suggest, “teacher educators and researchers to explore and theorize how *White ambivalence both endangers and enables* a multicultural and antiracist teacher education” (p. 420). I take their suggestion seriously because new pedagogies and curriculum are needed to transform education. In order to support White people specifically in becoming more critically conscious, many educators enact “white privilege pedagogy” (Lensmire et al., 2013; Levine-Rasky, 2000a). White privilege pedagogy is a teaching practice that relies heavily on the confessions of White people and individualism (Crowley & Smith, 2020). This type of pedagogy is better than the superficial curriculum and teaching described by Justin Grinage (2020) whereby Eric, a White facilitator, removed the word “white” from talking about privilege in order to, “underscore the colorblind language of diversity” (p. 18). However, both forms of teacher education, especially for White people, serve to provide the idea of anti-racist action while doing little to transform education more broadly. This maintains white supremacy as status quo.

Critical whiteness pedagogy

Second wave CWS has made the work around whiteness more robust and complex, however few studies have addressed how to engage people in learning about whiteness. There is general agreement among second wave CWS scholars that McIntosh’s (2008) essay on white privilege is largely unhelpful outside of listing privileges many white people experience. Describing white privilege pedagogy, Lensmire et al. (2013), argued white privilege pedagogy limits the possibilities for White people to engage in anti-racist work by relegating our participation to confessionals. In turn, the confessions can create resistance and act as the beginning and end of anti-racist work for white people. Levine-Rasky (2000a) stated white privilege pedagogy is more concerned with the who of whiteness rather than how whiteness plays

out in social contexts. White privilege pedagogy believes by revealing White identity, whiteness will disappear and transformation can begin. In other words, by acknowledging white privilege, White people will be different. This is a static and flat viewpoint of whiteness that often results in missing the complicated nature of whiteness, does not permit an exploration of systemic aspects of whiteness, produces guilt and fear, and can generate backlash (Levine-Rasky, 2000a). All of this is largely unproductive for social change.

Much of the work with White teachers revolves around deficit notions of White people. For example, describing a “pedagogy of whiteness for *angry* white students” (emphasis added; Kincheloe & Steinberg, 2000), the authors describe several tenets for their pedagogy. The tenets are, admittedly banal, and even fairly progressive. They include not using race as an essentialist identity category for White people, appreciating the plight of the White working class, having White people answer the question “who are we,” not being surprised by resistance, and having White people listen and learn from people of Color to create change (Kincheloe & Steinberg, 2000). However, they assume resistance on the part of White people and state it is important to give White people knowledge about whiteness and white privilege. White people have a lot to learn, but this framing discounts what White people do know about race, white supremacy, and our own White identities. Another study aligns with this belief. Yeung et al. (2013) describe using dialogue to help White students learn about whiteness. While they found White students did learn something and overall enjoyed the experience, some participants describe not sharing ideas for fear of being seen as racist and wishing they had gotten to talk about different topics more (Yeung et al., 2013). This indicates that White participants were picking up messaging and had their own thoughts about race that were ignored by the dialogue facilitators. Nichols (2010) outlines what they perceive to be the goals of critical whiteness pedagogy. These goals include teaching White people about whiteness, understanding white privilege, building a literacy of whiteness that includes discourses of racializing power, and to help White people build a positive,

anti-racist identity. Again, these are not inappropriate goals, however, each one is couched in White people not knowing or, in general, probably being resistant or ignorant of white supremacy and race. When not thoughtfully engaged, white privilege pedagogy or pedagogies of whiteness position White people as the villains only and may be contributing to the failure of anti-racist agendas (Berchini, 2017). Therefore, the question is how to engage people, especially White people, in understanding whiteness and their own racialized identity in nuanced and complex ways. To answer this question, I believe we need to position White people as knowers, capable, willing, and interested in justice. In opposition to white privilege pedagogy, critical whiteness pedagogy is potentially an avenue to go down.

As a whole, critical whiteness pedagogy (CWP) adheres to second wave CWS, and while there are not many examples of this kind of teaching, the few studies available do provide some guidelines to enacting this work. First, these scholars acknowledge the presence of white privilege, but take a nuanced perspective on it. CWP scholars recognize that whiteness and White people are not monolithic. In addition, they do not view students, no matter the age or level of education, especially White students, in a deficit way in conversations about race (Lensmire et al., 2013; Matias & Mackey, 2016; Miller & Tanner, 2019; Tanner, 2017, 2018c, 2018b). Instead, they create space for students, including White students, to grapple with their racial identity. By providing space for people to grapple with their racialized identities, educators using CWP create chances for multiple racialized pathways, particularly for White students, that go beyond the “good” and “bad” binary (Philip & Benin, 2014).

CWP often takes the form of radically open dialogue. In the case of Tanner (2018c), they allowed a White student to share what was a racist narrative in order to not police (Thandeka, 1999) how their student was making sense of race. On the flip side, Tanner (2018c) had critical conversations with White students whereby they made sense about whiteness and White identity *together*. Key to Tanner’s (2018c) implementation of their pedagogy was the idea of play and

improvisation. In their circumstance, students created stage production based off of their learning (Tanner, 2018c), but students were also given the opportunity to complete other projects as well. Confusion was encouraged, and it was engaged through journals, discussions, and other activities (Tanner, 2018c). This highlights the need for CWP to create space for critical and deep reflection in ways that attend to students' emotionality when discussing race, especially for White students. This, in my opinion, holds true for teachers as well.

Shim (2019) demonstrates the importance of reflection for both interns and anti-racist educators in their work with three White men who engaged in anti-racism work. Shim (2019) also shows how various emotions and affects serve as tools to mask, and simultaneously indicate the presence of, white supremacy. Matias and Mackey (2016) support this type of work by having White teachers, through painful and honest reflection, move past their white fragility (DiAngelo, 2011), take ownership of their feelings, and move towards a point of self-advocacy and self-agency. Key to every implementation of CWP however, is the presence of an educator committed to helping interns and guiding them through complex conversations about race and whiteness (Lynch, 2018).

The role of the educator is incredibly important in critical whiteness pedagogy. For example, Berchini (2017) is clear that CWP should have students connect context with power (Levine-Rasky, 2000) and that White people should not learn at the expense of people of Color. Describing hearing the stories of three Muslim American women, Berchini (2017) explains how she needed to hear about the Muslim American women's oppression in order to learn about their own white privilege. The pedagogy was, in essence, extractive and not actually anti-racist. Describing how identified anti-racist teacher educators thought about their practice, Moore (2021) highlighted the importance of modeling vulnerability, shifting agency to students, building community, and posing questions. In this way, Moore (2021) showed anti-racist teacher educators place value on showing how they still struggled, building space for critique of self and others,

genuinely caring for students, using student lived experiences and ideas in class actively, and asking questions that prompt students to think more deeply rather than making comments.

Arguing being White carries power and powerlessness, Marx and Pennington (2003) describe their critical whiteness pedagogy as working to help White people move past defensiveness and create a space to put feelings out honestly and authentically. They note they assumed talking about white supremacy would bring about the guilt and bafflement Rodriguez (1998) “assured” was necessary on the journey to a White anti-racist identity (Marx & Pennington, 2003, p. 93), and therefore, tolerated the racist and biased things shared in initial conversations because most of the White students working with them had not spoken *critically* about race before. For clarity, this does not mean the students had not spoken about race before. What Marx and Pennington (2003) found was most of their students left wanting to learn more, it is important for White people to tell stories, and engage in “white talk” (McIntyre, 1997) at times to get on the same page and create a shared language (Marx & Pennington, 2003). In the end, Marx and Pennington (2003) state that their pedagogy was, “both frightening and liberating. It was also very personal” (p. 98), everyone in their studies agreed, “talking about race, about their White race, is a good thing” (p. 99), and in some cases, White students were empowered by taking responsibility for their racism. This leads me to believe that CWP is not comfortable for anyone and there is no one way to implement it except to have students engage, authentically, as a community, with white supremacy.

The one common thread throughout all the literature on CWP is students are engaged in conversation. Some of these conversations can take place in inter-race groups or intra-race groups. Intra-race groups are also referred to as race caucuses. Although there are mixed findings from race caucuses (Varghese, Daniels, & Park, 2019), they could provide an avenue for White people to deal with our own whiteness without subjecting people of Color to new trauma, renewed frustrations with their White peers, and combat the whiteness inherent in many teacher

education programs (Amos, 2010; Fylkesnes, 2018). For example, while I think the dialogues implemented by Yeung et al. (2013) had faults, they did show the potential usefulness of dialogue spaces as a tool in CWP.

Most of the work in CWP has taken place with White people (students, teachers, etc.), and I believe science must embrace CWP for students of Color as well because of the relationship between science and whiteness (Le & Matias, 2019; Mensah & Jackson, 2018; Roberts, 2011; Sammel, 2009). This is especially true given that teachers of Color can struggle enacting some of the practices needed for equity, especially if they are not addressed during their teacher education (I. Jackson & Knight-Manuel, 2019). Additionally, while not framed as such, a pseudo-CWP in science is described by Mensah and Jackson's (2018) engagement around "science as white property" or the practices that make science inaccessible to students of Color. I say "pseudo" because while the authors articulate the presence of whiteness, they engage students in thinking about racism, not necessarily whiteness itself. Regardless, through this articulation, they supported teachers of Color in reclaiming science for themselves through activities that allowed teachers of Color to openly discuss race and the relationship between racism and science. This demonstrates addressing whiteness is even beneficial for students of Color. In some ways, Mensah and Jackson (2018) had their students critique and alter "cherished curriculum knowledge" (Jupp, 2017, p. 17). By critiquing traditional knowledge, which was previously framed as something by White people, that they, people of Color, can "join" or "add to," Jackson and Mensah's (2018) students rearticulated what science was for them. By engaging all teachers in understanding and critiquing "science as white property" and "cherished curriculum knowledge," curriculum and pedagogical models could be altered.

Given the few studies using CWP, understanding how to turn CWS into practice in education is not well defined. This is especially true in science education where whiteness has largely been unexamined. Therefore, questions still remain regarding how CWP is implemented

generally, within science specifically, and around how to prepare teachers, especially interns in adopting CWP in their own classrooms. Given the recent “practice turn” in teacher education, part of this process will be the articulation of practices for both teacher educators and teachers. By clearly describing practices of CWP, teacher educators can help interns implement ideas found within CWS and address the potential, and probable, variability that exists across curriculum and pedagogy about CWS in teacher education programs.

The “practice turn” in teacher education

The “practice turn” focuses on developing teachers’ ability to enact “core” and/or “high-leverage” practices (Ball & Cohen, 1999; Ball & Forzani, 2009; Grossman, Hammerness, & McDonald, 2009; Windschitl et al., 2012). The goal of finding and describing these practices is to create a set of learnable teaching moves that lead to student learning as compared to other practices (Ball, Sleep, Boerst, & Bass, 2009). As a whole, these practices are designed to occur at high-frequency, able to be enacted by teachers across contexts, able to be mastered by teachers, allow teachers to learn more about students and teaching, preserve the complexity of teaching, and are research-based with the potential to support student learning (Grossman, Hammerness, et al., 2009).

In science education, ambitious science teaching (AST) was created as a set of core practices to improve science teaching and learning (Windschitl et al., 2018, 2012). Consisting of four practices (1 planning practice and 3 pedagogical practices), grounded in model-based inquiry (Windschitl & Thompson, 2006; Windschitl, Thompson, & Braaten, 2008), AST is designed to support teachers in helping their students explain natural phenomena (Windschitl et al., 2018). Working together, these practices are designed to help teachers plan for engagement with big

science ideas, elicit students' ideas, support ongoing changes in thinking, and draw together evidence-based explanations (Windschitl et al., 2018).

By planning for engagement with big science ideas, teachers anchor all learning in a phenomenon students will produce an explanation of, a key attribute of model-based inquiry (Windschitl et al., 2008). It can be difficult for teachers, even with curriculum, to identify big ideas or anchoring events (Thompson, Windschitl, & Braaten, 2013). Kang (2017) demonstrated that interns who planned with big science ideas provided students opportunities to reason with science ideas, use data and observations to construct explanations, and/or develop arguments based on evidence more than interns who did "traditional" planning. Although this practice happens before teaching begins, teachers should be choosing phenomena that are relevant to their students and weave the "big ideas" throughout the unit, including periphery ideas, if the ideas are helpful to explaining the anchoring event and corresponding question associated with it as they write a gapless explanation (Windschitl et al., 2018). The gapless explanation should drive what is "covered" in the unit and is crucial in designing consequential learning experiences for students within the other AST practices.

Following the planning practice, teachers should elicit their students' ideas about the phenomenon in question. Eliciting provides an opportunity for teachers to access students' funds of knowledge (Llopart & Esteban-Guitart, 2016; Moll et al., 1992) and recognize the heterogeneous ways students make sense of the phenomenon (Bang & Marin, 2015; Bang, Medin, & Atran, 2007; Bang, Warren, Rosebery, & Medin, 2013; Rosebery, Ogonowski, DiSchino, & Warren, 2010). While eliciting traditionally takes place after the introduction of a phenomenon and when students create initial models, eliciting should occur throughout a unit as students make sense of new data, observations, and ideas. Additionally, after teachers engage in the process of eliciting, they can revise their phenomenon for future units and alter their plans for the second practice, supporting ongoing changes in thinking.

Supporting ongoing changes in thinking is designed to, “help students collect and use evidence from activities to better explain the anchoring phenomenon” (Stroupe, 2017, p. 461). This practice requires students to observe new experiences that help students explain the phenomenon. Not only does supporting require students to alter their thinking, it engages them in science practices that include, “special skills, tools, and routines that may not be familiar” (Windschitl et al., 2018, p. 155). Oftentimes, teachers will use multiple cycles of “introducing new ideas,” “engaging students in activity and sense-making,” and “collective thinking,” the practices that make up this core practice (Windschitl et al., 2018, p. 153). Within this practice, teachers need to pay particular attention to how they are defining science, the amount and type of student agency being provided, and the space created for productive discourse around all ideas because this practice determines how students will develop their final explanations. To be clear, this practice is intended to be a form of “interactive direct instruction” because students need the freedom to make sense of evidence and experiences being provided to them, but this practice is not intended to be an “anything will work” approach to learning. It is a way for teachers to have students make sense of the natural world in a way that is guided and supported by the teacher.

The final pedagogical practice in AST is called, drawing together evidence-based explanations. This practice supports teachers in helping students connect all the collected evidence into an explanation, and it can be executed at any point during a unit. For example, at the midpoint of a unit, a teacher may want students to revise their initial models. This can act as a formative assessment and help teachers understand where to go next. It also supports teachers in developing robust and flexible summative assessments. Windschitl et al. (2018) recommend co-constructing a check-list with students that includes the concepts students must know. The goal of this practice is to get the best explanations from the students as possible, so if this means allowing them to draw, work in pairs, or reminding them of the essential question for the phenomenon, a teacher will provide the support necessary. However, it is important for teachers to understand the

implications of what they believe the final explanation should be for their students because this process will render some ideas invisible and inconsequential that *could* be tightly held beliefs with validity in other sciences.

Strengths of Ambitious Science Teaching

The practices of AST are meant to help describe what teachers do. However, the practices are not prescriptive. For example, Windschitl et al. (2012) found while the core practices gave language to the interns that allowed them to communicate across their field placement contexts, it was not the practices by themselves that mediated interns' practice. Instead, the conversations around and the creation of face-to-face tools aligned to AST were more influential in impacting the interns' teaching practice (Windschitl et al., 2012). This indicates AST can and should be enacted flexibly, as needed by teachers in specific contexts, and AST provides a way to speak about what teachers do in order to create community and problem-solve.

Wanting to understand how AST impacts novice teachers, Thompson, Windschitl and Braaten (2013), sought to, "understand how and why beginning educators attempt to appropriate ambitious classroom practices during their internship years and first year of professional work" (p. 576). Ultimately, they found teachers can adopt AST, borrow practices from AST, and appropriate the language of AST without using the practices (Thompson et al., 2013). These patterns indicate practice-based teacher education can reconcile tensions of putting theory into practice for new teachers (Kennedy, 1999) even if the tensions are not reconciled with complete fidelity to AST. Teachers who adopted AST, while not having a concrete vision of teaching, did have a way to articulate what they were doing in their classroom and used practices connected to AST. This demonstrates how clearly described AST practices and how the practices are flexible enough to be used separately and in ways that differ from the strict definitions of each practice.

Building on these findings, Braaten (2019) investigated how learning opportunities in field experiences supported interns' adoption of AST. Their findings showed teachers do adopt the three pedagogical practices during their field placement. In another study, Kang (2017) found teachers who plan with a focus on "big ideas" are more likely to plan "intellectually challenging tasks" (p. 60). Findings from Stroupe (2016) support this notion as novice teachers who engaged in "generative cycles" either adapted or "threw away" their schools' materials and used student ideas to shape their classroom. Agreeing with Stroupe's (2016) findings, Thompson, Hagenah, Kang, Stroupe, and Braaten (2016) found discussions were constructed to avoid pushing students to correct answers, instead pressing for science explanations connected to previously learned ideas. This point is important because, "high levels of explanatory rigor did not emerge in classrooms where teachers and students were unresponsive to publicly voiced ideas or puzzlements" (Thompson et al., 2016, p. 9). By bringing ideas into a public forum, the responsiveness of AST makes talk a central aspect of AST learning environments, producing science as a public practice (Stroupe, 2017). Each of these findings, in their own way, contribute to a research base highlighting the ability to support teachers in enacting ambitious pedagogy, dampening the problem of enactment in teacher education.

Kang and Windschitl (2018) compared first-year teachers who went through a practice-based teacher education program focused on AST and teachers who did not. Their findings suggested teacher educated about core practices created more opportunities to learn for their students, were more likely to frame lessons with the NGSS, had five times more responsive discourse, and their lessons contained similar elements (Kang & Windschitl, 2018). These findings suggest, "they [teachers] developed a shared curricular vision – a shared image of science teaching – that was consistent with the images represented through the core practices from the program" (Kang & Windschitl, 2018, p. 36). Yet, Kang and Windschitl (2018) do note there was extremely high variance among, "the quality of student learning opportunities in the

core practices group (CPG) compared to the comparison group (CG)” (p. 23) and 74% of lessons from the core practice group were framed in conventional ways. This was true for 90% of the comparison group. These findings echo many of the same sentiments of the previous studies because they show how core practices, like AST, support interns and novice teachers in using more ambitious forms of practice, but there are still significant barriers facing novice teachers *always* enacting ambitious forms of practice.

Core practices and social justice

As more effort has been placed in developing practice-based teacher education, there are scholars who believe core practices decenter social justice (Daniels & Varghese, 2019; Kennedy, 2016; Philip, 2019; Philip et al., 2019). In the case of AST, it is grounded in model-based inquiry (Windschitl et al, 2012), but model-based inquiry is not grounded in ideas about power or identity. In fact, it is a foundation that takes a particular stance on science that may act to marginalize other sciences and work as a form of science as white property (Mensah & Jackson, 2018; Sammel, 2009). Additionally, AST practices are notably race-evasive. They do not directly or specifically mention race, raising questions like, “Whose thinking is being supported?” (Shah, 2020, p. 15), placing a greater burden, “on teachers’ in-the-moment discretion to ensure that Black students’ or Indigenous students’ thinking, specifically, is supported” (p. 15). This means when adopting AST as a pedagogical model, teachers will also adopt its vision of science and not learn a stance about power in science classrooms or necessarily have teaching practices to lean on that explicitly address race and white supremacy.

Recognizing the critiques, proponents of AST have worked to address the concerns of critics around equity. Focusing on equity in AST, Kang and Windschitl (2018) claim, “Equity is foundational in these [AST] core practices” (p. 8). In their book, Windschitl et al. (2018) also

outline the features of equity in AST in a section titled “The Central Role of Equity in Ambitious Science Teaching.” These features lean heavily on notions of access and ideas that sound more like beliefs rather than practices. Early in their book, the authors state, “As instruction unfolds, teachers honor students’ sense-making repertoires” (Windschitl et al., 2018, p. 11). While I wholeheartedly believe in this statement, the practice is not articulated as clearly as the other disciplinary practices of AST. Finally, Braaten and Sheth (2017) display the tensions one teacher had in implementing AST equitably, leading them to note the lack of focus core practices, like AST, have around critical consciousness. This led them to ask if AST was an “equity pedagogy” (Braaten & Sheth, 2017). This lack of articulation and specificity around equity and race is part of the critique some scholars make about the practice-based movement.

In a response to the “practice turn,” Zeichner (2012) warned whatever falls outside the scope of core practices will be, “defined as not essential and will be marginalized and eliminated” (p. 376). For AST, this might be true because Kang and Zinger (2019) found AST contributed to altering disciplinary teaching for interns, but AST was “limited” in its ability to disrupt teachers’ internalized scripts about inequities (p. 24). Again, Braaten and Sheth (2017) also found AST did not always support equitable teaching for a teacher who desired to teach equitably. These findings support the claim of Philip, Souto-Manning, Horn, Carter-Andrews, Stillman, and Varghese (2018) that by,

reducing the role of teachers to performing core practices to raise student achievement on standardized measures, reform efforts that center core practices in the name of equity obscure the historical legacies and contemporary processes of social reproduction (p. 3).

Furthermore, these authors argue core practices run the risk of being a form of trickle-down teaching, too prescriptive, and embrace an ideology arguing students can succeed if given the same teaching (Philip et al., 2018). In many ways, critics believe core practices remove

responsiveness from teaching and there is an urgent need for centering social justice in the core practice movement (Kennedy, 2016; Richmond, Bartell, Floden, & Petchauer, 2017).

Continuing the argument for centering equity more, Sheth (2019) dissects intended responsive teaching and unveils how the teaching is actually race-evasive. Specifically, Sheth (2019) critiques AST for being, “colorblind by not critically addressing racism embedded in science and science teaching” (p.5). Not arguing against core practices, Sheth (2019) recommends the introduction of a “foundational practice” that demands engaging with racism within science and science teaching to support teachers in recognizing and addressing inequities in science learning and teaching (p. 19). They summarize this practice as “grappling with racism” which is summarized by “desiring,” “knowing,” and “doing” (Sheth, 2019). Like model-based inquiry, Sheth (2019) intends for this practice to inform other core practices, potentially forming a foundation on which the equitable in ambitious and equitable science teaching can be built.

What is interesting about Sheth’s (2019) argument is not that the practice-based movement is negative. Instead, they are arguing for core practices that directly address and support teachers in achieving social justice in their teaching. In fact, while Philip et al. (2018) criticize practice-based teacher education, Philip’s (2019) notion of principled improvisation, whereby every action a teacher takes is orientated towards justice and teachers engage in the work of, “continuously re-solving fundamentally unsolvable problems” (p. 5) is not far from a core practice. By articulating something a teacher *does* and providing space for teachers to engage in the practice of principled improvisation, Philip (2019) is engaging in practice-based teacher education in my opinion. Rather than center a discipline however, they center issues related to power and identity. Beyond this notion, there are other teacher educators working to find core practices that could center equity more exclusively, even in science (Haverly, Calabrese Barton, Schwarz, & Braaten, 2018; Jaber et al., 2018; Rosebery et al., 2016).

Realizing the critiques of core practices, some scholars and advocates of AST have responded to their critics in an effort to clarify, refine, and extend thinking around how AST advances justice-oriented goals. Clarifying and refining how core practices should be implemented, Windschitl, Thompson, Braaten, and Stroupe (2020) argue AST should and is responsive to students (Gay, 2000). In particular, they describe core practices as a form of “disciplined improvisation” whereby teachers implement the AST practices broadly, but can, “address students’ needs by extending, adapting, or even discarding elements” (Windschitl et al, 2020, p. 34) of AST. These authors also push back on critics by arguing the tenets and practices of AST are meant to be contextualized and challenge the culture of “doing school” which has historically marginalized students of Color. Extending AST, scholars have articulated critical and cultural ambitious science teaching (C2AST). These scholars argue C2AST is a culturally and linguistically sustaining approach to AST (Thompson, Mawyer, Johnson, Scipio, & Luehmann, 2020, 2021). These authors recognize the importance of power in addition to issues of access in science teaching saying,

The AST vision is that science learning contexts can be places where students experience science in ways that have relevance and power in their own worlds and cultures, especially for students from groups who have been historically marginalized. This commitment translates to a need for teachers to be learners of students’ local cultures and identities, and to be brokers of science as they support learners in understanding how humans have constructed science and the power and status issues related to who determines what, how, and why science is accomplished (Thompson et al., 2020, p. 45).

C2AST contains four principles intended to provide a foundation on which to enact the four practices of AST. The first principle is recognizing our own and other’s worlds and developing critical consciousness. For this principle, Thompson and colleagues (2021) suggest learning about one’s own positionality and biases through finding critical colleagues and

engaging in self-reflection. The second principle is learning about and prioritizing students' communities and culture. To engage in this principle, teachers must know what is valuable to students, their cultures, and communities. The third and fourth principles are designing for each student's full participation in the culture of science and challenging the culture of science through social and restorative justice. Each of these principles are intended to address more systemic issues in science education. For example, Thompson et al. (2021) believe students need to question and critique "European science" (p. 63) and teachers must create opportunities for each student to participate fully in sensemaking.

Re-orienting core practices towards whiteness

Sheth's (2019) practice of "grappling with racism" could be an excellent foundation to center equity within the core practices. Like model-based inquiry, which organizes science to disrupt the scientific method (Windschitl et al., 2008), grappling with racism serves as an organizing frame to articulate equitable practices by encouraging teachers to fight racism in science classrooms. Where these two foundational practices differ are the shifts they make theoretically. Model-based inquiry is fundamentally different from the scientific method, transforming the disciplinary elements of AST compared to traditional classrooms. Grappling with racism, while addressing the problem of inequity, chooses to focus on consequences of a larger phenomenon, whiteness (Le & Matias, 2019; Matias & Mackey, 2016).

In the theoretical revision of an episode they described in their findings, Sheth (2019) suggests, "engaging students with the data and work of scientists, both of color and White, who have been establishing the nonbiology of race using various methodologies and epistemologies," (p. 20) while having students analyze racism in science, specifically biology, after eliciting their prior knowledge about the topic. Let me be clear, this is profound work. However, if we only

focus on racism and not whiteness, the force creating the racial hierarchy (Jupp, Berry, & Lensmire, 2016; Leonardo, 2002), the teacher and students could miss how whiteness has entered biology by framing itself as “ethnicity,” “geographic location,” and “ancestry,” a positive rebranding of something historically sinister (Roberts, 2011). It is through these insidious means whereby whiteness transforms and causes us to constantly update our notions of what “counts” as racism, making it a moving target, where whiteness, while able to adapt, is static in its falsity and oppressiveness (Haviland, 2008; Roediger, 1999). This same critique can be made of C2AST as well, especially because they are principles rather than practices. In this way, C2AST is less articulated than AST (it is also new and less researched/described) and therefore, less likely to be taken up more broadly potentially.

In response to this, I suggest a reorientation of Sheth’s (2019) practice from a focus on racism to a focus on whiteness. I believe this reorientation moves science education away from teaching that responds to racism to teaching that directly confronts the root cause of racism, whiteness. A reorientation creates space for science educators to play offense rather than defense. This transition could equip science educators with an arsenal of concepts developed by critical whiteness scholars to support both students and teachers in locating whiteness in science. As Miller (2015) points out, “theories of whiteness focus on how ‘racism is perpetuated in subtle, symbolic, and discursive ways – through talk and everyday text’ (Rogers & Mosley, 2006, p. 467)” (p. 140). Therefore, before entering teaching where students raise questions about race, as was the case in Sheth’s (2019) example, teachers can begin to anticipate such questions because they are already looking for whiteness within the discipline of science and their teaching. This potentially shifts equity work in science away from waiting for instances of racism that can be unpredictable and difficult to define; a consequence of whiteness in my opinion.

In order to shift AST to focus more on whiteness and white supremacy, I suggest merging CWP with AST. Arguing for the importance of equity in teacher education, Stroupe,

Hammerness, and McDonald (2020) say teachers need to develop critical consciousness and core practices. In their words, “Neither a critical consciousness nor core practices - if separate from each other - can help preservice teachers learn to become the teacher that students need” (Stroupe et al., 2020, p. 8). I agree with this statement. In essence, core practices provide a foundation on which to engage in the act of teaching and critical consciousness provides the robust understanding of power teachers need to ethically and flexibly engage in their practice. Still, critical consciousness is often ill-defined and hard to articulate because it has many meanings. For example, Ladson-Billings (2006) argues for critical consciousness when speaking about culturally relevant pedagogy when referring to “sociopolitical consciousness” (p. 37). When describing sociopolitical consciousness, Ladson-Billings (2006) says teachers need to educate themselves about, “both the local sociopolitical issues of their school community... and the large sociopolitical issues.” These suggestions are similar to C2AST (Thompson et al., 2020, 2021). In both cases, there are many ways to go about engaging with the suggestions provided. In fact, Shah (2020) found there is little consensus on how to raise teachers’ critical consciousness, indicating a tension between whether teacher education should focus on moment-to-moment interactions or critical consciousness. By melding CWP with AST, we could engage with both because CWP is focused on critical consciousness and anti-racist practice, while AST is focused on moment-to-moment interactions, science, and teaching practice.

Practice-based teacher education

In order to support interns in learning about core practices, practice-based teacher education commonly uses a combination of representations, decompositions, and approximations of practice (Grossman, Compton, et al., 2009). Representations of practice are ways to show practice, these forms of preparation can include observing a class, watching video-taped lessons,

or reading narratives about teaching (Grossman et al., 2009). Decompositions of practice separate practices into their basic parts, and they include helping teachers “see” specific elements of a practice in order to develop a vision (Goodwin, 1994; McDonald, 2016). The last, and potentially, most important part of practice-based teacher education is approximations of practice where teachers are provided the opportunity to actually engage in using specific teaching practices in controlled settings. While teachers may not require engaging in every aspect of teaching, approximations of practice help focus and hone specific practices that might be easier for more advanced teachers. In order to prepare interns for the practices needed in teaching, many practice-based teacher education programs utilize microteaching, macroteaching, and rehearsals.

Providing an extensive review of microteaching, Grossman (2005) states microteaching was developed to support teachers in utilizing skills in teaching. Oftentimes, these events are video recorded and feedback is provided. Although microteaching is often criticized for focusing on behaviors rather than practices and providing inauthentic teaching experiences, Grossman and McDonald (2008), argue if the actions in microteaching reflect more robust practices and are done in concert with field experiences, a new generation of approximations can be developed because microteaching does provide a chance for interns to use teaching practices.

Rehearsals are a form of microteaching where interns are responsible for teaching a class of peers that “act back” (Lampert et al., 2013). During this time, teacher educators can provide feedback and coach interns on their teaching, creating a cycle of enactment (Kazemi, Ghouseini, Cunard, & Turrou, 2016). This cycle can become more authentic when paired with a field experience. Research on rehearsals shows they do have the potential to support nuanced learning for interns around teaching practices (Ball & Forzani, 2009; Davis et al., 2017; Kavanagh & Danielson, 2019; Kavanagh et al., 2019; Lampert et al., 2013).

Taking rehearsals to a larger grain size, macroteaching is an extended rehearsal that attempts to negate some of the shortcomings of microteaching (Stroupe & Gotwals, 2017). In

short, Stroupe and Gotwals (2017) used macroteaching to have interns teach an entire AST-grounded unit from start to finish. Although Stroupe and Gotwals (2017) wondered if macroteaching is possible without microteaching, they found interns were able to co-develop the experience with their instructors and take on increasingly complex work that unified the separate parts of AST. More recently, Stroupe and colleagues (2021) report teachers who participated in macroteaching developed personal notions about what counted as productive teaching and learning that aligned with AST. Regardless of the approach, approximations of practice have the potential to support teachers in taking up practices.

Practice-based teacher education and critical whiteness pedagogy

Outlining their principles of practice-based teacher education, Stroupe, Hammerness, and McDonald (2020) argue nobody is “born to teach,” teachers should be given a chance to reimagine schooling, teachers should embrace an inquiry stance, learning to teach happens in community, naming practices is important but those descriptions are dynamic and always changing, and learning to teach for social justice requires critical consciousness and core practices. These principles form the foundation of learning to teach in practice-based teacher education, especially in science education. Taking a sociocultural perspective situating teaching as practice, practice-based teacher education is focused on what happens in enactment and how teacher identities develop in learning contexts (Hammerness, McDonald, Matsko, & Stroupe, 2020). By taking a sociocultural perspective, many practice-based teacher educators and researchers focus on what teachers *can do* rather than what teachers do not *know* (Gray, McDonald, & Stroupe, 2021). In this way, practice-based teacher education usually takes an asset-based view of teachers rather than a deficit view of them. Borrowing from Ladson-Billings’

(2006) description of culturally relevant pedagogy, practice-based teacher education is about “being” as much as it is about “doing.”

In terms of learning equity-oriented teaching practices, Kavanagh, Metz, Hauser, Forgo, Westwood Tayler, and Carson (2019), provide evidence teachers can learn to be responsive to student thinking during approximations of practice, especially when the approximation is tightly focused on responsiveness. Regrettably, this is not the norm in practice-based teacher education. In their work investigating how teacher educators taught teachers and how teachers consequently taught students, Kavanagh and Danielson (2019) found major differences in the treatment of social justice and the practice, text-based discussions, being addressed. Mainly, social justice was never “practiced” unless it was around planning, while text-based discussions were frequently practiced. This indicates a need for teacher educators to have teachers participate in approximations of practice in addition to representation and decompositions of practice.

For teachers to grapple with whiteness, teachers will need to focus on the context they are teaching in and relate it to their identity. Ways to encourage this are to have teachers participate in mapping communities and their histories (Taylor, 2018; Taylor & Hall, 2013; Thompson et al., 2020, 2021) or having teachers draft personal critical ethnographies (Calabrese Barton, 2001; Thompson et al., 2020, 2021). Central to this endeavor is not positioning teachers, especially White teachers, as deficit (Lensmire et al., 2013; Settlage, 2011). To take an asset-based approach, Mensah and Jackson (2018) propose helping teachers of Color (re)claim science. For White teachers, this could mean permitting White teachers to be confused and “play” with whiteness in writing and discussion (Tanner, 2017, 2018c, 2018b).

To enact the other practices, opportunities will need to be created to have teachers use the ideas they are learning. This could mean having teachers facilitate conversations about race, gender, ability, etc. Other strategies could include adapting created curriculum by “recoding knowledges” of cherished curriculum (Jupp, 2017) or engaging in sense-making around student

ideas (Jaber et al., 2018; Rosebery et al., 2016). I also believe watching and dissecting a classroom, even the one they are in, for power dynamics and whiteness specifically will allow teachers to begin to alter their vision and make evidence-based claims about whiteness in practice (S. McDonald, 2010). Eventually, teachers will need to engage in rehearsals as a form of micro and/or macroteaching around these practices and enact them with students, or they will remain abstract ideas and be relegated to the ranks of pedagogical models scholars want in classrooms but are thought to be too theoretical.

Given the relative unexamined relationship between science, science education, and whiteness, the lack of understanding about what a CWP looks like in practice, and the need to continue pressing practice-based teacher education to center equity, this study will seek to answer two questions: a) how do white science interns learn to be anti-racist educators and b) how does using critical whiteness pedagogy and practice-based teacher education together support science interns in adopting anti-racist teaching practices. The next chapter will outline the overall design of this study to accomplish the task of having secondary science interns address whiteness in science directly and adopt anti-racist teaching practices. I will also detail the data that was collected throughout the enactment of the design and the methods that were used to understand the enactment practically and theoretically.

Chapter 3

Design-based Research and Storytelling

Design-based research: An introduction

The questions of this project are geared towards understanding, theoretically, how whiteness matters in the learning of teaching science, but also practically, in how to mix critical whiteness pedagogy with practice-based teacher education. This presents two challenges, how to theoretically advance our understanding of whiteness, especially in matters of learning to teach, but how to design environments to produce anti-racist science teachers who can transform how students learn science. In order to address each question simultaneously, many traditional methods are insufficient. For example, some traditional education research takes place in laboratory settings, but whiteness, while present in all contexts, especially in the United States (Jupp et al., 2016; Leonardo, 2002), is best studied *in situ* because it affects everyday life in the United States. Beyond this, studying learning in labs is geared towards producing theory *only* because it is separate from where most, if not all, people learn. Other methodologies focus more on context. For example, ethnography and participatory action research, are also insufficient to producing theory and practice because ethnography focuses on describing culture rather than developing a physical design (Atkinson & Hammersley, 1994; Spradley, 2016) while participatory action research is not meant to produce generalizable theory (MacDonald, 2012). This pushed me to search for a methodology that addresses both theory production and practice. Design-based research (DBR) allowed me to design an environment to answer my theoretical questions about how whiteness impacts learning, and DBR also helped me articulate practice in

ways that are connected to the theory generated (Barab, 2014; Collins, Joseph, & Bielaczyc, 2004).

Many scholars trace design-based research (DBR) back to Ann Brown (1992) and Allan Collins (1992) who described conducting research in naturalistic settings. Outlining the features of DBR, Brown (1992) compared it to engineering, whereby researchers develop learning environments or tools for learning and then study them in the place they were intended for. Overall, for Brown (1992), any design experiment aims to contribute to learning theory, have practical implications, and correct assessments of the design (Brown, 1992, p. 142). Responding to critics who claimed they produced positive findings because they decided to address a problem directly, Brown (1992) said, “If I were creating a true Hawthorne effect, I would not be able to predict which performance would improve. But in fact, we see a coupling of cognitive activities practiced and the type of improvements shown” (p.164). In other words, Brown (1992) was not only changing the ways learning happened in context by introducing an intervention, but they could also predict how the learning changed based on the intervention used. It is this idea that laid the foundation for DBR work moving forward because DBR is intended to advance theory while also impacting practice.

DBR, as a methodology, is primarily used within the learning sciences because learning scientists believe that, “learning, cognition, knowing, and context are irreducibly co-constituted and cannot be treated as isolated entities or processes” (Barab & Squire, 2004, p. 1). When one takes this position, as I have, one must look at learning in situ. More than this, many learning scientists have agendas that call for transformations in learning and teaching within the contexts they work. I am no different. Therefore, to build theory about and produce change around learning and teaching, methods and theories are needed to understand and predict how learning happens within complex learning environments. DBR was developed to address theoretical

conceptions of learning in contexts where learning happens and to develop ways to study learning outside laboratory settings (Collins et al., 2004).

Enacting design-based research

For many learning scientists, DBR is grounded in a belief that findings about learning are not “trustworthy” unless studied, “in its inherent messiness” (Sandoval & Bell, 2004, p. 199). Drawing on Lagemann’s (2002) argument that educational psychology does not produce useable knowledge, Sandoval and Bell (2004) state traditional educational research produces scientifically sound findings, but those findings, “do not adequately explain or predict the phenomena they purport to address” (p. 199). DBR is a way to develop theories of learning as well as practical interventions (Sandoval & Bell, 2004). In order to accomplish this task, DBR engages researchers in an iterative process that strives to discover, explore, confirm, and disseminate (Kelly, 2007).

There is no “correct” characterization of DBR (DBRC, 2003). Still, some scholars have attempted to articulate a framework for DBR to make it more recognizable and accessible to researchers (Bannan-Ritland, 2007; Collins et al., 2004; Easterday, Lewis, & Gerber, 2014; Easterday, Rees Lewis, & Gerber, 2018). Ironically, while researchers have attempted to produce their own explanation of DBR, each characterization and description of DBR is eerily similar. Mainly, DBR is characterized by its difference from laboratory-based research, constant iterations of design and research, the creation of a product or outcome through intervention, and a contribution to theory that allows for more generalized, rather than (and in addition to) local, findings (Barab, 2014; Barab & Squire, 2004; Cobb, Confrey, DiSessa, Lehrer, & Schauble, 2003; DBRC, 2003; A. Kelly, 2004). Yet, with these general agreements each proposed framework varies in their call for strict standardization. For example, Easterday, Rees Lewis, and

Gerber (2018) believe DBR needs to have better articulated processes, in part, to separate it from other methodologies. They describe this process using seven iterative phases of design: a) focus, b) understand the problem, c) define goals, d) conceive the outline of a solution, e) build the solution, f) test the solution, and g) present the solution (Easterday et al., 2018, p. 137). Each of these steps fits within the general characterization provided by Kelly (2007), but it contains more specificity of what happens during each step of a project. Another characterization by Bannan-Ritland (2007) attempts to meld the creativity of design with the standardization often found in quantitative and qualitative methods in education. Again, the phases described by Bannan-Ritland (2007) involve understanding a context, creating a design, evaluating the design, iterating on the design locally, then disseminating both the design and theory broadly. This indicates that DBR, while potentially undefined in specific ways, does have organizing principles.

Cobb, Confrey, diSessa, Lehrer, and Schauble (2003) point out three features across all design research. These features can be interpreted as goals for DBR because they describe what DBR actually does. For these authors DBR projects iteratively develop “humble” theory not just pointing out “what works” locally, should be “test-beds” for interventions, and contest theory, making DBR “prospective and reflective” (Cobb et al., 2003, pp. 10–11). These goals make conducting DBR extremely complicated. This complexity has led some design-based researchers to articulate how to differentiate valid claims from invalid claims. In response to this question, Edelson (2002) points out design can help researchers recognize useful theory that may have been found unhelpful in traditional laboratory studies while also creating space to push back on theory that, after evaluation in context, does not work as claimed. This results primarily from the fact that DBR gains validity internally (Edelson, 2002). In other words, DBR gains validity because the outcomes in the design can be linked back to the design itself. This then can produce the generality that many DBR scholars claim it does (DBRC, 2003).

To create the links necessary between the designed intervention and outcomes, DBR is often completed by interdisciplinary teams. This allows for a wide range of methods to be brought to bear in DBR (DBRC, 2003). In many cases, methods are designed to document the process of enactment (Barab, 2014; Cobb et al., 2003; DBRC, 2003; Edelson, 2002). Given this broad intention, it is not uncommon to see combinations of quantitative and qualitative methods used to analyze and explain designed environments (Bell, 2004; Collins et al., 2004). By using multiple methods, it should show the “consequentiality of the work” (Barab & Squire, 2004, p. 8). In DBR, consequentiality is derived from a presentation of the findings, often in the form of descriptions and narratives that provide insight into the local dynamics of the design and the decisions that were made throughout the project. Without showing the usefulness of the work theoretically and practically, DBR projects fall short of the espoused goals generally.

Design-based research as organizing methodology

Given the plethora of methods available within DBR, some scholars have described it as a “meta-methodology” because DBR does not commit researchers to one theoretical perspective (Bell, 2004; Easterday et al., 2018). The positioning of DBR as a, “high-level methodological orientation that can be employed within and across various theoretical perspectives and research traditions to bring design and research activities into a tight relation to advance understanding of learning-related educational phenomena” (Bell, 2004, p. 245), creates many theoretical camps with little coherence besides the goals and phases described earlier. These different groups create the variability found between DBR projects. Bell (2004) described four camps of DBR that include developmental psychology, cognitive science, cultural psychology, and cognitive anthropology. These camps represent the broad interests of the DBR community that ask different questions about educational phenomena ranging from human developmental growth to

participation in communities. These communities also produce levels of inquiry which run the gamut of focusing on individuals, interpersonal interactions, and community level analysis. Some projects even include multiple levels of analysis.

Understanding DBR is thought of as a pragmatic approach to research, the “what works” is underpinned by articulating the how, when, and why it works in order to connect the design to theory (Cobb et al., 2003, p. 13). Sandoval (2014) presented conjecture mapping as a way to record salient features of a design and how the features are predicted to work together to produce desired outcomes to give DBR a grammar of inquiry. The goal of conjecture mapping is to describe the environment and the effect it will have beforehand; this leans on the idea that DBR is about testing hypotheses about learning. Conjecture maps include high-level conjectures, embodiments, mediating processes, and outcomes (Sandoval, 2014). High-level conjectures describe how to support the kind of learning researchers are interested in supporting. A high-level conjecture is designed to present an argument for learning before enacting anything because in many ways, DBR is about making arguments for how learning should happen. The embodiments outline the *salient* design features of the environment, this includes task structures, participant structures, and discursive practices (Sandoval, 2014). This portion of the conjecture map allows for a rich description of the context and intervention specifically, but it does not include every actor, tool, and activity within the design. From the embodiment, mediating processes are articulated because the functions of the design produce learning that is ultimately connected to and generates outcomes (Sandoval, 2014). From this process, by connecting embodiments to mediating processes, design conjectures are developed (Sandoval, 2014). Design conjectures address DBR’s commitment to producing interventions that work and have implications for practice. By connecting mediating processes to outcomes, conjecture mapping helps produce theoretical conjectures that support theory building as well (Sandoval, 2014). In all, conjecture mapping helps researchers describe the various iterations of their design by tracking what has

been added or removed, and through this explanation, produces a grammar of inquiry for DBR that calls for causal claims by validating outcomes through design and theory.

Design-based research in teacher education

DBR is not common in teacher education (Cobb, Zhao, & Dean, 2009). Part of the problem is no one person can change the circumstances of teachers all together, but instead, teacher educators are in the role of supporting and understanding teachers' learning (Cobb et al., 2009). However, given the recent "practice turn" in teacher education, the field could benefit from DBR because learning for teachers is now focused on core or high-leverage practices (Ball & Forzani, 2009; Grossman, Hammerness, & McDonald, 2009; Windschitl, Thompson, Braaten, & Stroupe, 2012). This is important because new tools designed in conjunction with articulated practices have been found to mediate and support teacher learning around core and high-leverage practices (Borko, 2004; Windschitl et al., 2012). These tools not only need to be understood in terms of their design, but also in terms of how designs produce specific learning. Additionally, task structures such as rehearsals, microteaching, and macroteaching are ubiquitous across practice-based teacher education (Grossman et al., 2009; Stroupe & Gotwals, 2017). In order to understand the designs of such tasks, they need their embodiment and the processes the design intends to produce to achieve certain outcomes described.

The work of teacher education is complicated because it involves designing for two contexts (Windschitl & Stroupe, 2017). Since teacher educators prepare teachers to design their own learning spaces, teacher educators are not only designing an environment to support teacher learning, they are designing an environment to support the design of learning environments geared towards educating students (Windschitl & Stroupe, 2017). This challenge complicates any DBR initiative because the design of a teacher education context must and will have implications

for the designs of K-12 contexts. Additionally, if practice-based teacher education is to remain, practice-based teacher educators will not only need a grammar for core practices in K-12 spaces (McDonald, Kazemi, & Kavanagh, 2013), but also a grammar for understanding “what works” as they design learning environments for teachers to learn core practices (Barab, 2014; Gutiérrez & Penuel, 2014; Sandoval, 2014).

In order to articulate these ideas, Sandoval’s (2014) conjecture mapping can prove to be a powerful tool to guide designs for teacher education (McDonald et al., 2020). Using conjecture mapping for a teacher education context can connect the intended outcomes for teachers to the design for K-12 contexts outlined by another conjecture map. This will allow researchers to study teacher learning, and it will help them understand and articulate how teacher learning relates to designs supporting student learning.

Borrowing from Bannan-Ritland’s (2007) description of DBR and leveraging Sandoval’s (2014) concept of conjecture mapping, I will now describe the context of this project that attempts to understand how whiteness impacts science teaching and learning, how to enact critical whiteness pedagogy and practice-based teacher education together, and describing what an anti-racist science teacher education can look like. I will follow this description with the design and the methods I used to understand and “evaluate” the design. By engaging in this work, I am working to go beyond the, “narrow measures of learning and understand how complex learning ecologies support learning” (Gutiérrez & Jurow, 2016, p. 566), specifically in terms of how learning to teach science is racialized.

This study

The context: SCIED 411W, SCIED 412, and beyond

Currently, The Pennsylvania State University's secondary science program is organized around three parts for interns, SCIED 411W, SCIED 412, and the practicum experience. SCIED 411W is the first experience and takes the form of a traditional teaching methods course. This course is followed by SCIED 412, an embedded methods course containing both a practicum experience combined with a traditional teaching methods environment within local middle school classes and an on campus class that meet at predetermined points throughout the semester (S. McDonald et al., 2020). Finally, the interns enter their field placements and engage in a semester long practicum. This entire sequence takes place over three semesters or one calendar year.

The program has been under development for the past five years. Historically, the design of the secondary science program has been geared towards understanding how to support teachers in developing a professional vision (Goodwin, 1994; S. McDonald, 2016) that supports AST. While this project is geared towards understanding how to design environments to support the vision of AST (Windschitl et al., 2018, 2012), this redesign also took an interest in understanding what designs support teacher learning around equitable science teaching and articulating what equitable ambitious science teaching looks like in teacher education.

The first iteration of the design took place from 2018-19. The design is characterized by Figure 1 (taken from S. McDonald et al., 2020). Therefore, in order to provide a clear vision of this particular study's role in the redesign, I will begin by characterizing the history of the DBR project and then center a discussion on the 2020-2021 design version which will serve as the central focus of this study.

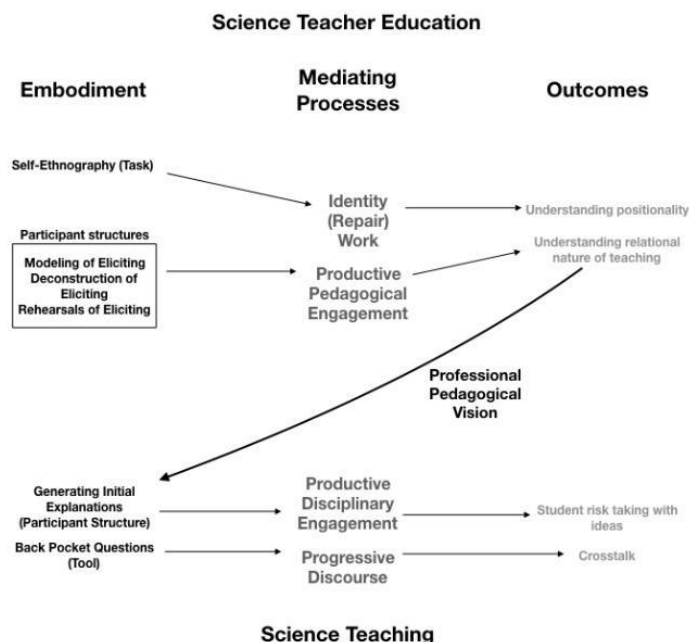


Figure 3-1: SCIED 2017-2018 iteration.

The people

There are a number of people involved in Penn State's secondary science program. Most notably are the interns, whose numbers during the redesign design process has ranged from over twenty to six. SCIED 411W typically includes individuals who intend to be certified science teachers and people who have no intention of being certified. With this said, the sequence is typically dominated by White interns. Since my time at Penn State, we have had only four students who did not identify as White, only one of which went on to be a certified science teacher. Additionally, most of the interns are women. Lastly, the interns focus on science disciplines including physics, chemistry, biology, and Earth and space science.

Other individuals involved in the program are the instructors, field supervisor, mentor teachers, and secondary school students. With the exception of one instructor in SCIED 411W in the Spring of 2019, every instructor, field supervisor, and mentor teacher are White. While the students are more diverse, they reflect the diversity of the State College Area School District, which is predominately White. I focus so much on demographics to highlight the overwhelming amount of White people inhabiting the context we are working in, and any attempt to address race in this context, as this study proposes, needs to recognize this. However, before moving forward, it should be noted between the instructors and mentor teachers involved in SCIED 411W and 412, there is over 70 years of experience using AST. Therefore, the group involved in the sequence, are as close to veterans in AST as exist outside of the founders at the University of Washington.

The historic design: SCIED 411W

SCIED 411W, as previously stated, takes the form of a traditional teaching methods course. This is to say that there is a minimal amount of interaction with a K-12 environment for the interns and it is intended to develop the interns' professional vision through decompositions and representations of practice before entering classrooms (Grossman et al., 2009; S. McDonald et al., 2020). During this semester-long (75 minutes, 2 days a week, for 16 weeks) course, before 2020-2021, there were five major assignments. These included the conceptual interview, theoretical framework, self-ethnography, clinic, and video case study. Each assignment was designed to support interns in gaining the knowledge and skills necessary to enter SCIED 412. The other assignments take the form of in-class activities led, typically by the instructor.

The conceptual interview was designed to support the interns in eliciting students' ideas and recognizing the important science ideas within a student's explanation (Jaber et al., 2018; Rosebery et al., 2016; Windschitl et al., 2012). The student, in this case, was a close friend or

family member who would not fully understand a phenomenon selected by a team of two interns. During the conceptual interview, interns developed an “interview” protocol that required the development of back-pocket questions (Windschitl et al., 2018). They then interviewed and recorded the conversation with their selected “students” and looked for patterns between the two interviews to understand what science ideas the interviewees had about the phenomenon. Although the assignment was primarily designed to help interns elicit ideas about a phenomenon and think about student ideas, it tied directly into another assignment, the theoretical framework while also giving them an opportunity for success in AST. Having success with reform-based teaching is a key component to Luehmann’s (2007) characterization of identity work or how teachers *become* reform-based teachers.

The theoretical framework assignment was designed to help the interns articulate how learning happens, not just taking for granted that learning “just happens” in schools. Through this assignment, which they revised two times (with an optional third revision) in SCIED 411W, interns treat learning as a phenomenon. They began with their initial explanation, then the instructor, as with AST, worked with the interns through various activities and readings that provided evidence or explanations about how learning might happen. Taking the shape of a one-page, 500-word paper, interns described how learning happens. Ideally, this explanation had analogues to understanding learning as an adoption of specific practices held by a community (i.e. a sociocultural perspective), mirroring how many proponents of AST frame learning. Behind this activity was the intention, by the instructors, to help shape the interns’ professional vision to identify learning in ways that are valuable within AST. Recognizing how learning is framed throughout SCIED 411W, the theoretical framework set interns up to interrogate assumptions about how they have learned throughout their life and the impact various communities have had on their learning.

During the self-ethnography, interns were tasked with understanding how their identity mattered in their learning broadly and in science specifically. During SCIED 411W, the interns revised their self-ethnography three times (with an optional fourth revision). The first draft was left open for the interns to articulate the aspects of their personhood that mattered most in their lives, within schools, and around learning. These writings were only shared with the instructor, however, after their first draft, the instructor provided feedback in the form of “wondering” statements, often framed as questions. As with the theoretical framework, after their first draft, the interns were exposed to experiences and readings that provided evidence for learning being connected to identities perceived and held by students. While the interns were developing ideas around learning generally, through the theoretical framework, the self-ethnography strove to support the interns in understanding how sociocultural forces shape learning. It is also intended for our interns to articulate how seemingly “surface-level” ideas, like growing up in a White town, are connected to deep histories and ideologies, for example, believing other groups of people do not value school like you do and fearing nonwhite spaces.

For the interns, their understandings created by the theoretical framework and self-ethnography met the practice-based conceptual interviews during their clinic. For the clinic, the interns, in pairs, planned a 20-minute mini-lesson to be taught to local middle school students. For the mini-lesson, interns were expected to plan with big science ideas by selecting a phenomenon. After, they developed back-pocket questions and a general plan for their interactions with the students they will encounter. Once they had a plan, they rehearsed this plan with their peers. During this time, the other interns and the instructor provided feedback on the enactment. Eventually, the interns taught the lesson to 3-4 groups of middle school students during one class at a local middle school. They then revised the lesson, and taught it again to 3-4 groups of middle school students at a different school. This assignment was designed to prepare the interns to plan and enact AST.

The interns received a video of one or more of their sessions with a group of middle school students to analyze, using video analysis software, for “good science teaching.” The interns described why they thought their coding was good science teaching. The instructor provided feedback during a class session where the entire class viewed specific clips the interns identified. This assignment was designed to continue to shape their professional vision (S. McDonald, 2010, 2016). This was also used as an opportunity to explore connections to the concepts being pushed by the instructor throughout the self-ethnography and theoretical framework assignments.

The historic design: SCIED 412

Following SCIED 411W, the interns enter SCIED 412. SCIED 412 is an embedded methods course because it takes place, almost entirely, within a local middle school where teachers engage in AST daily (S. McDonald et al., 2020). SCIED 412 is also connected with another course, CI 495C that is designed as a practicum course. By combining the two courses, SCIED 412 is able to engage the interns in teaching every other day and pair it with a more traditional methods course like SCIED 411.

Overall SCIED 412 had interns in the middle school for the entire first week of the semester from 8:30 AM to 11:30 AM, then following the first week, for 7 more weeks, every other day, from 8:30 AM to 11:30 AM. During the next 3 weeks, the interns were in their placements (their placements could be with mentors at the middle school hosting SCIED 412 or at other schools in the area) for the following semester every day from 8:30AM to 11:30 AM until they spent the remaining 4 weeks of the semester on Penn State’s campus twice a week, usually from 10AM to 12PM, in a traditional methods class setting.

Beyond the logistics of time, while in the middle school, the interns were placed with one of five mentor teachers. Pending on enrollment, the interns were one-on-one with a mentor or in a team of up to four interns. Additionally, the time the interns were in class begins with the actual first day of school for the local middle school. This allowed them access to how the mentors established the norms of their rooms. While at the middle school, the interns taught alongside their mentors for half the time allotted for SCIED 412. For the other half, the mentors had a prep period where the interns planned with their mentors, but the time was also used to have the interns reflect on teaching, rehearse teaching, and complete other activities. Throughout the semester the interns were required to complete five major assignments, two more drafts of their theoretical framework and self-ethnography, a unit plan, a student case study, and teach at least six lessons.

While the theoretical framework and self-ethnography were continuations from the previous semester, the unit plan was a larger version of the mini-lesson planned in SCIED 411W. To complete the unit plan, the interns documented the enactment of the units being taught with their mentors. In their grade teams (7th grade and 8th grade), they combined what they recorded into a cohesive unit. The goal was to have the interns focus on salient elements of the curriculum. These included planning elements such as a “gapless explanation” and the activities designed to support students’ ongoing changes in thinking (Windschitl et al., 2018), but also what their mentors did in the moment. For example, the interns included back-pocket questions used (admittedly these can also be planned), how the mentors responded to student ideas, or things the interns found useful when enacting a specific lesson in their units.

The interns had to enact at least six lessons during their time in SCIED 412. Three of these lessons happened in the first eight weeks, while the other three, occurred over three days in their placements. For the design of SCIED 412, the first three lessons were the most important. For these lessons, the sequence was relatively the same. First, the interns planned their lesson

with the guidance of their mentor. Some interns chose to teach their own solo lesson, others chose to teach as a team or during the same period. The choice was up to them and their mentor. Once they planned their lesson, the instructors and mentors provided feedback, and once the lesson was taught, it was video recorded. After the lesson the interns analyzed their video for “good teaching,” science practices, and other elements the instructors thought were valuable. The cycle then repeated for the next two lessons.

The student case study was the final major element of SCIED 412. In this assignment, interns identified a student, particularly a student identified as having an IEP or GIEP (gifted individualized education plan). The interns were required to build rapport with this student (as well as other students) and develop a student learning plan for the student. This plan was to be implemented during their time in SCIED 412. By focusing the interns on one student, it allowed them to pull together all of their knowledge and skills around teaching to support a student, who was potentially, traditionally marginalized in classrooms. During the development of the plan, interns were required to justify why they chose the student they did, develop a “map” of the student articulating the multifaceted dimensions of the student’s identity, and create a plan based on their map. When they finished implementing the plan, the interns reflected on their plan and the experience as a whole.

Overall, SCIED 411W and SCIED 412 were designed to engage the interns in representation, decompositions, and approximations of practice (Grossman et al., 2009) as well as the practice of teaching itself. Each assignment played a particular role in developing the professional vision of teachers around AST, combining elements of traditional critical consciousness education and practice-based teacher education (Stroupe et al., 2020), and by the time they entered their field placements for their final semester, were intended to be well started beginners. By engaging in the methods sequence, interns were exposed to and practiced the four

core practices of AST. They were also exposed to theoretical thinking around learning and society that are meant to guide the decisions they made in the classroom as teachers.

The (re)design: 2020-2021 Iteration

Overall, the previous designs of the secondary science program were largely race evasive. When examining the previous iterations, the presence of anti-racist teaching was largely absent. In each of the previous designs, the focus was on producing an understanding of positionality for the interns; this is not race evasive intentionally, but in many ways, by focusing on positionality, it allowed the interns to escape having to think specifically about white supremacy and race. Additionally, the outcomes identified for students were about getting access to high-quality science education. Mainly, if students engaged in crosstalk and risk taking, they would be experiencing equitable science education. As Nasir and Vakil (2017) demonstrated, having access does not always produce equity. Even the mediating processes did not address race. Identity work, as described by Luehmann (2007), focused on interns becoming reform-minded teachers. This is necessary work, but the lens did not explicitly include race, and the absence of a racialized lens from the rest of the design guaranteed the interns would not become anti-racist educators or even aware of racialized dynamics unless it was an unintentional outcome of the program. The other mediating processes surrounded the disciplines of teaching and science, which as previously discussed, are all rooted in systems of white supremacy, and if white supremacy is not addressed directly, whiteness will continue to be reified (Fylkesnes, 2018; Roberts, 2011; Sammel, 2009) or we will only treat the symptoms of a larger problem (Le & Matis, 2019).

The 2020-2021 iteration of the sequence strove to center race explicitly and support interns in addressing white supremacy. While many embodiments of the design described above remained, the parts were recast using a more explicit critical whiteness lens. Given the new focus,

elements were added too. The largest shift occurred in the outcomes of each course and the mediating processes intended to generate the desired outcomes. I chose to break the sequence of SCIED 411W and 412 into two separate conjecture maps because SCIED 411W is intended to support SCIED 412 directly. Overall, the high-level conjecture guiding the design for each environment is, developing anti-racist science teaching requires direct engagement with white supremacy.

SCIED 411W

Although many of the tasks from SCIED 411W remained, the tasks listed in the conjecture map were the embodiments I thought would be most salient to supporting the mediating processes that would produce an outcome of well-started anti-racist ambitious science teacher. The outcome was inspired by Tanner's (2018c) study whereby White high school students were able to talk explicitly about whiteness and able to translate the practices they learned throughout their learning into other situations such as a stage production and, later, a protest when one of them went to college. While I did not expect the interns within this study to be the same as the students in Tanner's (2018c) study, I believed characterizing them as well-started anti-racist ambitious science teachers was appropriate because many of them would be engaging with whiteness and white supremacy directly for only a short time (one semester is not a long time) and SCIED 411W was only meant to be the start or a continuation of their anti-racist journey.

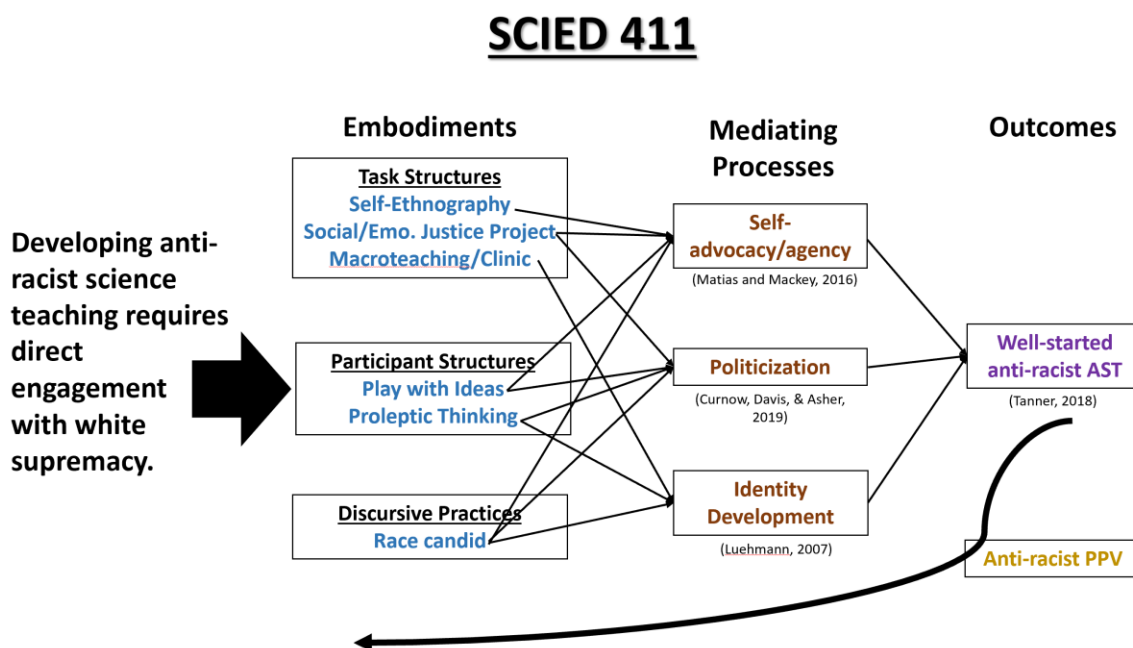


Figure 3-2: SCIED 411 2020-2021 iteration.

The mediating processes

Producing the outcome of well-started anti-racist ambitious science teachers would be supported by three mediating processes. These included, self-advocacy/agency, politicization, and identity development. Each mediating process was intended to impact the interns individually and at the community level, recognizing how their own learning would be influenced by their identities individually and collectively (Bell et al., 2013). For example, their race produces certain storylines that expand and limit the learning pathways available to them (Nasir et al., 2013). By trying to design for these mediating processes, I thought it would push individual interns to be well-started anti-racist science teachers, but also produce a community that was grounded in equity, social justice, and anti-racism.

Self-advocacy/agency was drawn from work by Matias and Mackey (2016). In a class grounded in learning about whiteness, Matias and Mackey (2016) used self-reflective tools to help White interns work through their emotionality around whiteness. Organizing their course into, “three emotional phases” (Matias & Mackey, 2016, p. 37), the authors wanted White teachers to understand their feelings in conversations about race and white supremacy and why they felt the way they did. By focusing on emotions, Matias and Mackey (2016) hoped White teachers would, “take on the racial responsibility of whiteness” and transform their identity from White savior to “racial justice advocates” (p. 48). Therefore, this mediating process targeted the interns' political caring (McKinney de Royston et al., 2017; E. C. Parsons, 2001, 2005) and ability to navigate the complexities of white supremacy in their lives, discourse, and practice. This also had implications for their science teaching. For example, dismantling white supremacy in science will require an interrogation of cherished curriculum (among other things), which oftentimes, interns will need to take on the burden of doing themselves. To accomplish these tasks, the interns would need to be emotionally prepared to do so and believe they could accomplish the task.

By having interns engaged in highly reflective tasks, one being the self-ethnography, they would have opportunities to understand the emotionality they have around whiteness. Through feedback and class activities, interns would be engaged in thinking about how their experiences and ideas are a derivative of whiteness and other social structures. The social/emotional project is designed to help the White interns “share the burden” (Matias & Mackey, 2016, p. 37) by taking action beyond talking and reflecting. This will push them to put their new knowledge into practice. One way Matias and Mackey (2016) suggested beginning this process is having interns post their thoughts to social media. Lastly, the interns would demonstrate their self-advocacy/agency in their teaching of the clinics in SCIED 411W and within SCIED 412 by leveraging the skills and ideas they learned. Connecting these tasks with other activities that

pushed interns to grapple seriously with whiteness, connect their lives to structures, think beyond current structures to envision an anti-racist science education, and taking on the burden of race by being explicit about it in their talk and actions, interns were immersed in an environment that called on them to become a well-started anti-racist ambitious science teacher through self-advocacy/agency.

Politicization is focused on the community. Yes, it takes individuals into account, as individuals influence a community, but as Curnow, Davis, and Asher (2019) contest, politicization is, “ a collective learning process involving not only the intellectual and cognitive processes of developing a political analysis but also shifts in the practices of a group, their ways of knowing, and their identities” (p. 9). They go on to describe how a group of activists became (further) politicized, splintering into two different politicized groups (Curnow et al., 2019). While the interns were not formed to be an activist group (yet), they were entering a politicized profession. Therefore, in order to produce well-started ambitious science teachers, in a system grounded in white supremacy, interns must engage in a, “process of conceptual development or cognitive change,” but also, “a simultaneous process of conceptual, practical, epistemological, and identity development” at the community level as well (p. 1).

The major role of the social/emotional justice project was to push the interns into becoming political. This project could be done individually or collectively, but it would require them to engage with other people as they advance social justice. Additionally, in preparation for the clinics and throughout SCIED 412, interns would be engaged in discussions about what anti-racist science teaching is. I suspected there would be interns who take a more “radical” perspective and those who take a less radical stance. In order to define anti-racist science teaching, the group would need to negotiate collectively how “radical” they should be. Beyond this, by having ways of participating and speaking in the form of playing with ideas, proleptic

thinking, and being race candid, the group would take on practices (hopefully) that will encourage a collective shift in thinking about science teaching and learning.

The third mediating process, identity development, remained from previous designs. This mediating process, taken from Luehmann's (2007) theorizing on how to create reform-minded teachers, is important to keep because it speaks to how the teachers would come to see themselves, individually, as anti-racist teachers. Yes, politicization will play a role, however, teachers need to, as Luehmann (2007) describes, have success with concepts in their practice. While Luehmann's (2007) study centered on reform-minded science teaching, I believed anti-racist science teaching would not be different. Therefore, by having success with anti-racism in science, the interns would be more likely to see themselves as anti-racist and act accordingly in their practice moving forward. Additionally, while the other mediating practices do involve a shift in practice, Luehmann's (2007) theorizing about identity work is specific to teaching, and given the overall goals of shifting teacher practice, it was important that the interns have success in the practices they came to learn.

Embodiments

The embodiments I conjectured would create these processes were a combination of task structures, participant structures, and a discursive practice. Each one, as with the mediating processes, were intended to act at individual and collective levels. By drawing on Gutiérrez's (2016) six guiding principles for social design experiments, I wanted to design environment embodiments that: a) paid attention to history and historicity, b) focused on reorganizing systems rather than fixing individuals, c) viewed culture as dynamic, d) emphasized equity across the design, e) emphasized resilience across individuals, the collective, and community, and f) had a goal of sustainable transformation (p. 192). While each embodiment did not necessarily address

each of the principles, collectively I tried to include an embodiment that connects to one or more of the principles (see Table 3-1 for a list of the embodiments for SCIED 411W and 412 and the corresponding principles). Additionally, I used Gutiérrez's (2016) principles to help inform the design, but I am not engaging in a social design experiment. This study is a more traditional DBR project (Bannan-Ritland, 2007). This means Gutiérrez's (2016) principles were used flexibly. Below is a description of each hypothesized salient embodiment in the conjecture map. I will not describe every assignment, activity, and element in the class here.

Table 3-1: Embodiments and design principles.

Embodiment	Design Principles from Gutiérrez (2016)
Self-Ethnography	a, c, d, e, f
Social/Emotional Justice Project	a, b, c, e, f
Student Case Study	a, b, c, d, f
Clinic/Teaching	a, b, c, d, e, f
Play with Ideas	a, b, c, e
Proleptic Thinking	a, b, c, d, e, f
Race Candid	d, e, f

The discursive practice of being race candid, is drawn from Thandeka's (1999) description of the "race game" whereby they challenge White people to use race identifiers, especially for White people in everyday life. In being race candid, I wanted to produce an environment where interns did not speak around race, but directly towards it and about it. For example, when referring to a hypothetical student, I, and hopefully the class, would push each other to be specific about the student in our mind. This practice could be described as identity candid, however, given my interest in whiteness and white supremacy, I chose to name this practice race candid; even though as Kendi (2019) mentions, you cannot ignore other identities

and be anti-racist. This practice was intended to provide opportunities for success in anti-racism (Luehmann, 2007) by being impeccable in our speech and not making assumptions (Ruiz, 1997). It was also intended to build the emotional capacity of the interns (Matias & Mackey, 2016), especially the White interns because as Thandeka (1999) describes, this will be difficult for them. I also thought race candidness could have ramifications for politicization within the community as evidenced by Tanner's (2018c) study when White high school students began being explicit about whiteness; in their case, students challenged the diversity statement of their high school and argued they could teach elementary students about whiteness, not just privilege.

Most connected with being race candid was the participant structure, play with ideas. Play with ideas was pulled from conceptualization around the need for White people to explore their own ideas around race free from policing (Tanner, 2018c; Thandeka, 1999). This participant structure was meant to promote confusion and exploration, rather than telling interns what to think. This structure embraced notions of principled improvisation (Philip, 2019), that demands every action taken by a teacher is oriented towards justice and teachers engage in the work of, "continuously re-solving fundamentally unsolvable problems" (p. 5). By allowing interns to play with ideas around race, I believed they would engage in self-advocacy/agency because they would need to carry the burden of solving problems (Matias & Mackey, 2016). Additionally, this would provide space for interns to collectively develop new practices that center anti-racism (Curnow et al., 2019). For example, during a class discussion, an intern may bring up the idea of using the high rates of diabetes in communities of Color as a phenomenon. Within this singular statement, interns would need to negotiate conceptions of what a phenomenon is, what data can help understand the phenomenon, and the social structures involved with the phenomenon. All of these elements are complex in their own way. By providing a space for interns to work through these complexities and articulate, clearly, the reasons for why they think what they think could lead to increased self-advocacy/agency. It may also open a space for students to become

politicized because I would not be telling them what or how to think in ways that police them as described by Thandeka (1999). Instead, the group would need to decide how to proceed with limited explicit direction from me as the instructor.

The other participant structure, proleptic thinking centered, “developing deep understandings of the histories of communities, their valued practices, their stories, and their aspirations” (Gutiérrez, 2019, p. 5). In other words, envisioning possible futures for themselves and their students. This structure was born out of an understanding that in conversations about race, White people can feel guilty or resistant (Lensmire et al., 2013). It was also born out of knowing the frustration people of Color can feel around conversations about race, especially with White people (Amos, 2010). In both cases, this limits the ability of conversations and action to move forward in productive ways. By supporting interns in understanding contexts, such as their communities, interns could begin to reimagine spaces. Proleptic thinking was meant for dreaming. By designing for this type of thinking, I thought it would allow interns to have success with anti-racism, especially in their science teaching (Luehmann, 2007) because they would be allowed to think outside traditional structures and notions of what teaching science looks like. Additionally, it gave license to the interns to take stands and shift the ways they think about science, science teaching, and society; a key ingredient to supporting a process of politicization in my opinion because ultimately the goal is to change systems, for which there are a plethora of avenues. For example, interns may decide to use the NGSS practices to guide their instruction, but take a stance that recognizes that the practices are limited in their ability to capture all the diverse ways students can engage in science and engineering. In taking this stance, these interns may accept other ways of doing and thinking about nature in gapless explanations they create and grade regardless of what their mentor teacher thinks. On the flip side, other interns may decide this step is not enough and begin an after-school program whereby community members teach explicitly about Native Sciences.

For the most part, the task structures stayed the same. The self-ethnography would largely remain the same, although small tweaks would be made to the structure. The small tweak made was the level of creative freedom interns received and the questions prompting their thinking. The clinic would also remain the same. However, I also wanted to incorporate macroteaching within the overall design (Stroupe & Gotwals, 2017; Stroupe et al. 2021). By having the interns develop larger units around anti-racism and AST, I thought it could better provide an experience for teachers to experience success in the kinds of practice I would advocate for. Part of the reason for expanding the practice teaching from clinics to macroteaching was the clinics had the interns use the practice, eliciting students' ideas, and that practice, while equitable, is more about access. I also believed it was the most straightforward anti-racist practice, and in order to become well-started anti-racist science educators, the interns would need to think about and engage in other practices. By developing larger units, and teaching them to their peers, I thought the interns would be able to grapple with the tensions that arose when enacting anti-racist AST. Rehearsals and the reflection on the rehearsals would provide an opportunity for the community to decide what is and is not anti-racist science teaching, given that AST is not inherently anti-racist.

The biggest shift in SCIED 411W would be the introduction of the social/emotional justice project. This idea is drawn directly from theorizing by Jeanine Staples (2016) who argues social justice cannot be accomplished without vocalizing how white supremacist patriarchal ideologies and enactments impact people. By describing both the pain and joy (and everything in between), Staples (2016) believes individuals can become more emotionally conscious. This consciousness of self can then support the type of radical social justice work that transforms societies. By engaging interns in a social/emotional justice project, I would provide them a chance to engage in such work. These ideas are supported by Menakem (2017) who argues trauma, which resides in the body, must be dealt with and healed before White people can

meaningfully understand ourselves and white supremacy. I described the assignment as a social/emotional justice project because it could take the form of something social or something emotional. The choice would be on the interns. This project is intentionally ill-defined because it was intended to come from the interns, not from me. With this said, some projects students may engage in are adapting formalized curriculum to be more anti-racist, joining groups on campus that advocate for anti-racist policies, interviewing family members to understand their own learned whiteness in a more robust way, or talking with their friends about race more often. This project would have potential impacts on their self-advocacy/agency and/or politicization because it contained emotional and political components. I did not connect this project to identity work because while they may have success, they may not, and this project would be carried into SCIED 412.

SCIED 412

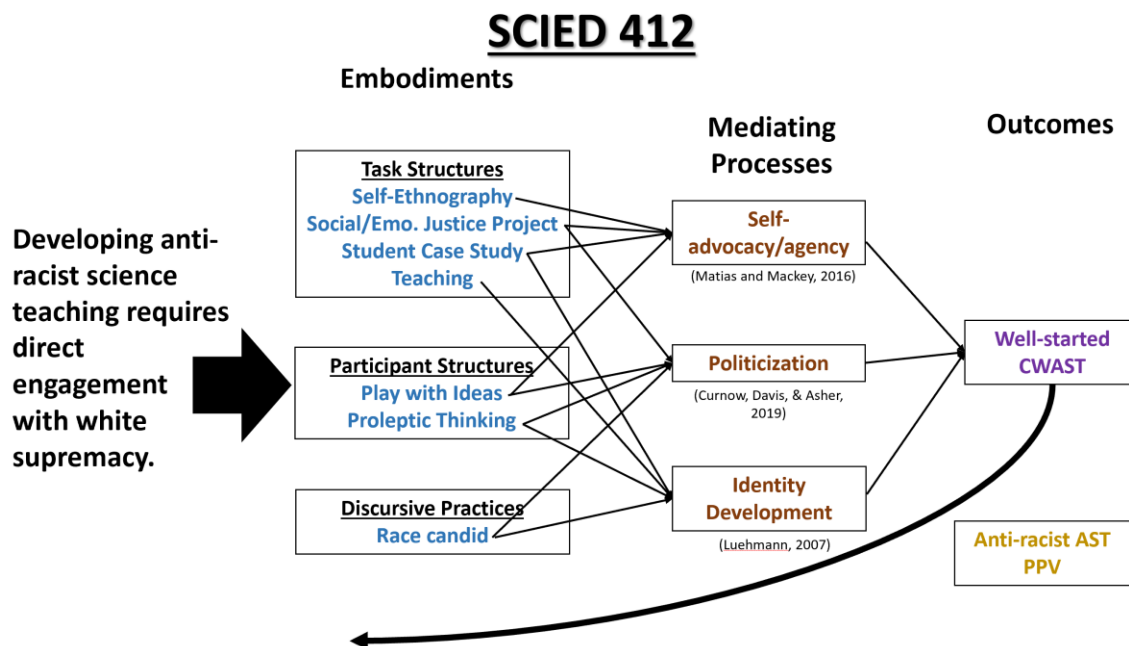


Figure 3-3: SCIED 412 2020-2021 iteration.

SCIED 412 was largely the same in terms of design as SCIED 411W. The only things altered are the addition of the student case study and moving from an approximation of practice to teaching every other day in classrooms. Although I could have compounded SCIED 411W and 412 into one conjecture map, I wanted to keep them separate because, analytically, it allowed me to focus on two separate designs rather than viewing them as one. This way I could understand the differences and similarities between the two contexts; it allowed for changes to SCIED 412 in response to SCIED 411W too. Additionally, the outcomes are then allowed to be viewed differently. Rather than being “well-started” anti-racist ambitious science teachers, I can describe them as well-started critical whiteness ambitious science teachers. I make the rhetorical switch because as they exit SCIED 412 they would be enacting an amalgamation of critical whiteness pedagogy (CWP) and AST rather than just being anti-racist ambitious science teachers.

Given that CWP is not well-defined throughout the literature, the interns would be on the front lines of figuring out, along with the instructors and potentially mentors, what CWP could

look like in science education. Through this they may address the emotionality of whiteness, how to provide students with opportunities to productively use their epistemic agency, articulating how to allow students to be confused and work through race and whiteness in science, making decisions around what does and does not count as science and science practices, or how to alter cherished curriculum to be more anti-racist. Additionally, the interns would need to know how to improvise in their teaching and recognize when their teaching may be racist. This means I felt comfortable labeling them as well-started critical whiteness ambitious science teachers because they may enact a pedagogy very few, if any, science teachers would be enacting. Yet, in order to do this, the interns would have to develop a highly attuned professional vision (Goodwin, 1994; McDonald, 2016), or the ability to highlight situations and make meaning of those situations, that encompasses ideas from CWP and AST, which is why it is professional pedagogical vision that connects SCIED 411W to SCIED 412 and SCIED 412 to the science education classroom itself.

The science classroom

Science Classroom

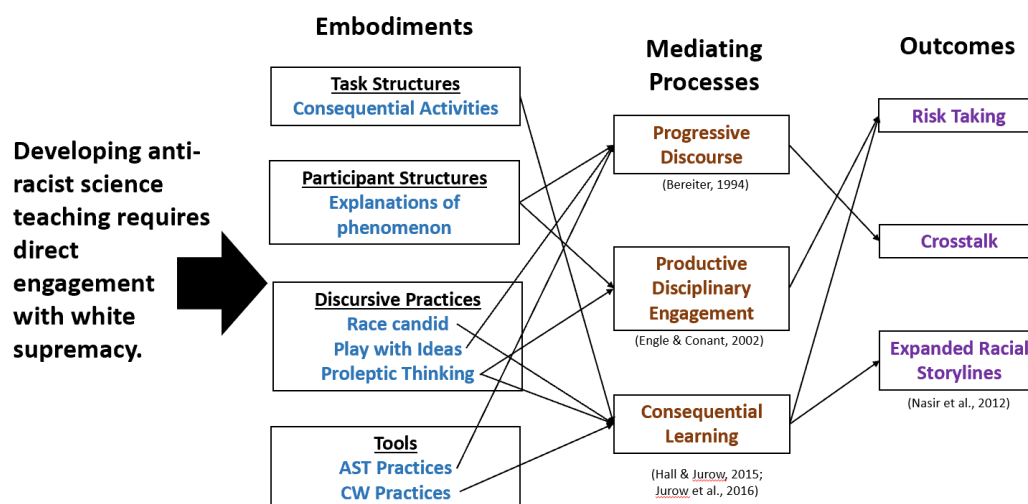


Figure 3-4: Science classroom 2020-2021 iteration.

Since education faces a three-story problem (Windschitl & Stroupe, 2017), I wanted to articulate what a classroom designed for critical whiteness ambitious science teaching might look like. Unsurprisingly, some of the elements in the teacher education context would find their way into the classroom. In this case, the placement of the two participant structures from the teacher education context became general discursive practices used by students and supported by teachers. Beyond this, the tools, in the form of AST (Windschitl et al., 2012, 2018) and CWP that could be articulated in the teacher education context, would be salient because they would centrally organize what happens in the classroom. An addition to this context, were the embodiments of consequential activities and explanations of phenomena. Consequential activities are the physical things that students do in class that are relevant to them and support students in achieving their goals in class; it is the design that takes place to produce consequential learning (Hall & Jurow, 2015; Jurow, Teeters, Shea, & Van Steenis, 2016). Explanations of phenomena refer to what science is, producing explanations of the natural world, which would produce some of the disciplinary aspects of the learning that must take place in science classrooms.

The mediating processes addressed three different mechanisms for anti-racist science learning. Progressive discourse refers to the notion that, in science, there are no “bad” ideas, but some ideas allow the discourse within the community to move forward (Bereiter, 1994). By allowing students to explain phenomena, play with ideas, and engage in science and engineering practices through AST and CWP, teachers could promote conversations that are less about being correct, and are more about making sense of evidence and moving the conversation in a “productive” direction. While this has potential to suppress certain epistemologies and ways of being, the focus should be to create an outcome of crosstalk. By getting students to speak with one another, the community of students could decide what ideas, methods, evidence, and directions are valuable rather than the teacher dictating this.

Productive disciplinary engagement was taken from a set of design principles outlined by Engle and Conant (2002). These principles help produce disciplinarily valuable conversation. Where progressive discourse (Bereiter, 1994) is more about conversation being productive, also a concern for Engle and Conant (2002), productive disciplinary engagement is more concerned with engaging students in relationships. This is to mean, providing students with opportunities to establish norms around problem solving, ensuring the community is responsive to stakeholders, students are able to define and solve problems, and students get the tools needed to do so (Engle & Conant, 2002). The principles have potential to revert to the white supremacist roots in science, but when enacted by a teacher with a critical whiteness ambitious science teaching professional vision, this is less likely to happen. Ultimately, the productive disciplinary engagement would provide a chance for students to take risks. Take risks around what counts as evidence, what problems to solve, how to solve those problems, and how to present their explanations or solutions. In other words, having opportunities to have their epistemic agency recognized and matter in the classroom (Manz, 2015; Miller et al., 2018; Stroupe, 2014).

The final mediating process was consequential learning (Jurow et al., 2016).

Consequential learning is learning that “extends across temporal, spatial, and social scales of activity” (p. 212). In this case, science students would participate in learning that matters to them, their cultural practices, and the social forces that help shape their lives. Consequential learning positions students as having the ability to not only learn science, but impact their communities broadly in ways that expand racialized storylines (Nasir et al., 2013). This type of learning can happen only in intentionally designed classrooms around issues that matter for students, hence the need for a task addressing consequential activities. By combining other structures and especially AST into this type of learning, students would be able to explain phenomena, but also leverage their explanations and learning to do more than succeed on a test or know something about the natural world.

What actually happened in 2020-2021: COVID-19

In March of 2020, The Pennsylvania State University decided that classes would be remote until April 2020. This meant SCIED 411W would be remote for a month when the entire class was intended to be face-to-face. Eventually, as the COVID-19 pandemic grew worse, classes would remain remote for the rest of the 2020 Spring Semester. While the mediating processes of the design did not change, the embodiments did. For example, assignments like the theoretical framework and self-ethnography were shortened significantly. The clinics did not happen in 2020 due to safety concerns and technological constraints. Below is a revised conjecture map of the 2020 SCIED 411W iteration. Notice the removal of the clinics.

Revised SCIED 411

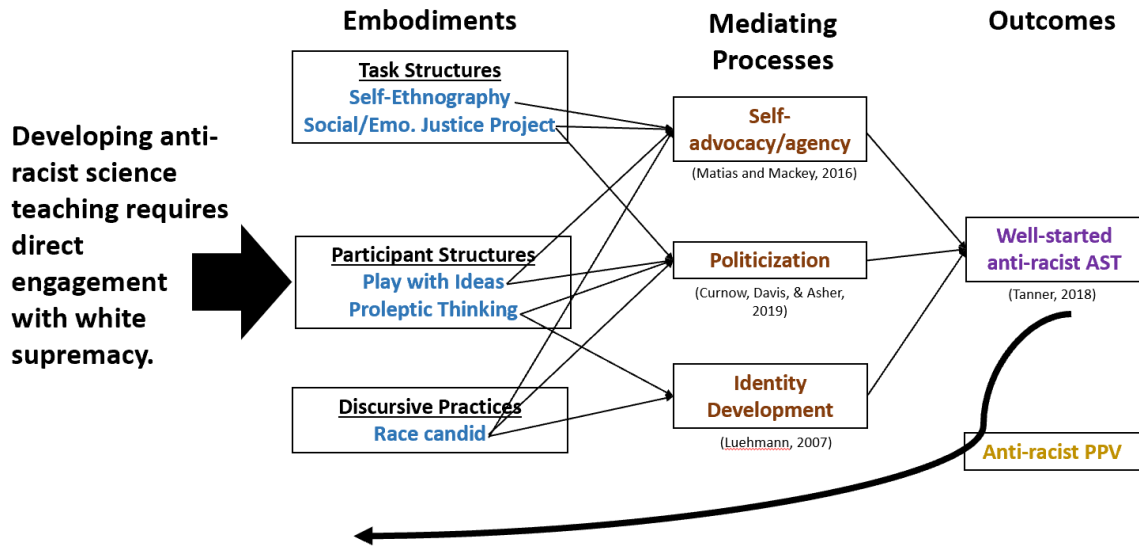


Figure 3-5: Revised SCIED 411 2020-2021 iteration.

The pandemic continued into the Fall 2020 semester. Most of the Fall of 2020 remained remote, but several weeks into the semester, we were able to meet in a hybrid format. This meant some interns were in-person and some were remote. Given the safety concerns, SCIED 412 changed as well. The primary shift was SCIED 412 could not be embedded in the local middle school. This meant the interns did not get an opportunity to teach each day of the course. However, in order to give the interns a chance to “experience” the local middle school, they joined the mentor teachers’ classrooms remotely. The interns also planned a unit, collectively, for a group of high school students participating in an Upward Bound program that would be taught remotely. Interns would also not complete the student case study and other changes were made along the way. Below is a revised conjecture map for the 2020 iteration of SCIED 412.

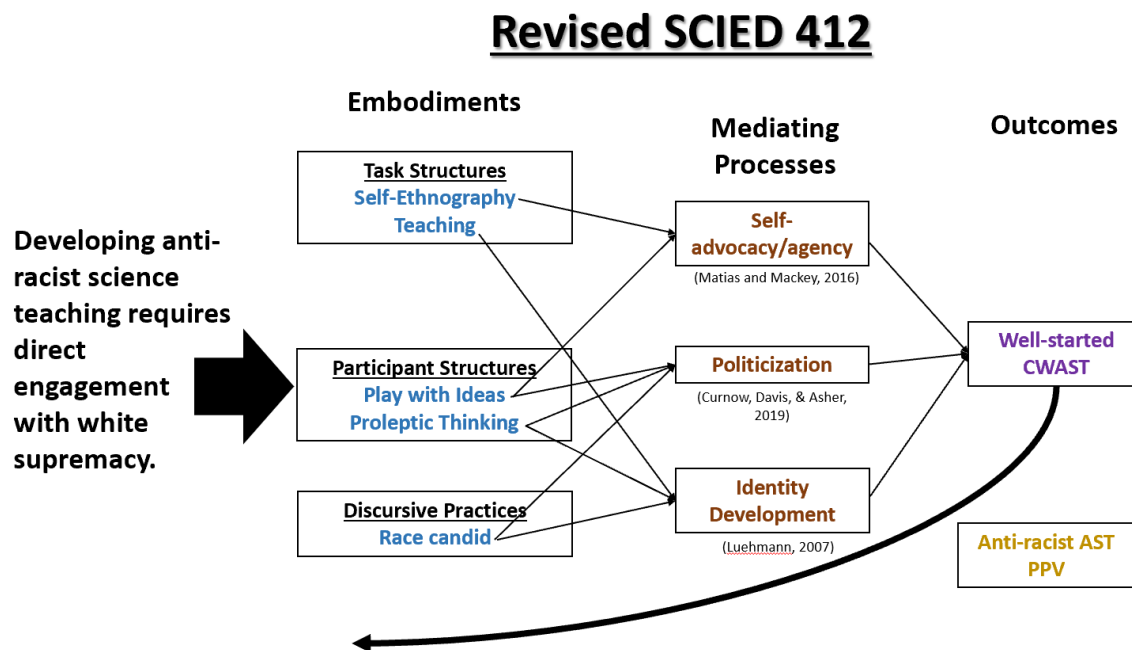


Figure 3-6: Revised SCIED 412 2020-2021 iteration.

By the Spring of 2021, the interns were in the field placements. They remained remote. By the end of the semester, the interns who got vaccinated were able to be face-to-face with their students. With this said, most of the interns remained remote for the entirety of the 2021 Spring semester. While I did not change the conjecture map for what science classrooms would look like, needless to say, the interns' experience teaching and learning remotely dramatically changed the experience they had, and consequently, the learning environments they designed for their students during their field experience.

Data Collection

DBR does not commit a researcher to a set of methodological commitments. Therefore, this project borrows data collection methods from qualitative research to understand the learning that happened within three iterations of the design in 2019-2020, 2020-2021, and 2021-2022. For

this project, focused on the 2020-2021 iteration, I used several methods for data collection (N. Denzin & Lincoln, 2011). The data collected from the 2020-2021 cohort of interns included all the documents from assignments and activities (Marshall & Rossman, 2011b). The documents I collected were all assignments listed in the syllabus, photographs of all in-class assignments, emails, and text messages. When the COVID-19 pandemic began, I also began to save online documents, videos, and other media that were used in class for assignments. I also collected over 125 hours of video and audio recordings from each class session in SCIED 411W, SCIED 412, and all interactions that took place associated with the course but happened outside of class (Marshall & Rossman, 2011c; S. McDonald, 2010; Sawyer, 2014). Lastly, I wrote field notes/reflections on my teaching (Emerson, Fretz, & Shaw, 1995). I made sure to write these after each class or weekly at a minimum. In these reflections I addressed tensions I noticed, my own confusions and wonderings, epiphanies, and anything else of note by including as much low-inference information as possible and my interpretation in the moment. I also wrote field notes to document the interns' classroom teaching in SCIED 412 and in their field placements. I visited each interns' field placement in the Spring of 2021 at least three times.

Since DBR is about understanding the context itself, these data collection methods allowed me to locate convergence, inconsistency, and contradiction within the data (Mathison, 1988). By the end of the data collection, I had data to analyze from three cohorts (2019-2020, 2020-2021, 2021-2022). However, this study only focuses on the 2020-2021 iteration of the design. The reason for this is that the 2019-2020 data set is incomplete because data collection began, in earnest, during SCIED 412, causing me to miss out on data from SCIED 411W. The 2021-2022 data collection is still ongoing. Therefore, the 2020-2021 cohort data provides the most robust evidence concerning the research questions guiding this study.

Role of the Researcher

As a central agent within the study, I took on a participant observer role as, I was, “both a participant (to varying degrees) and an observer (also to varying degrees)” (Marshall & Rossman, 2011b, p. 140). Yet, my role went beyond that of a typical participant observer because I was an instructor for SCIED 411W and 412. This gave me a central role within the design and study overall. Therefore, the data collected was as much about me as it was about the interns. Recognizing this, I was careful to realize my own racial position, as a White man, within a study about white supremacy and the impact my identity inevitably had on each aspect of the study (Chadderton, 2012; Foste, 2020; Vakil, McKinney de Royston, Nasir, & Kirshner, 2016). With this said, in my analysis I worked to play off of tensions that exist within the data and make my racial positioning visible in my analysis and interpretations (Chadderton, 2012). I also engaged in reflection throughout the project to remain in a space of critique of whiteness and white supremacy even as I may have engaged in what some scholars would argue is whiteness (Foste, 2020). By focusing, as a White man, on white supremacy, there are those who might argue I am centering whiteness in dangerous and potentially inappropriate ways. I agree I am centering whiteness. However, siding with a panel of scholars at the 2019 Curriculum and Pedagogy Conference who discussed the role of critical whiteness studies re-centering whiteness, I say, “When hasn’t whiteness been centered?” Having said this, my centering was an attempt to bring white supremacy into the light rather than let it remain invisible in the shadows. For many critical whiteness scholars, including myself, this is the only way to work against whiteness and white supremacy.

Data Analysis

My decisions around data analysis were iterative and evolving. It did not follow a linear path. My data analysis process reflected my struggle to understand situations that had numerous facets which I did not know how to represent or describe. Therefore, in this section I will describe my full process as I struggled with and in the data collected. I came to the conclusion to leverage storytelling to present a narrative of engagement (Ridgeway, 2019; A. J. Rodriguez, 2015; Tolbert, Schindel, & Rodriguez, 2018) of a case study (Dyson & Genishi, 2005; Yin, 2018) centering one white secondary science intern as a way to present what happened during the 2020-2021 iteration of the design. Below is the process that led to the development of the narrative of engagement.

Early in my data analysis, I used what I think is a more traditional approach to qualitative research, coding. Given my goals to, “explain as well as describe” (Corbin & Strauss, 1990, p. 5) how the interns learned to enact anti-racist teaching and how combining critical whiteness pedagogy with practice-based teacher education supported the learning of the interns, I thought grounded theory would allow me to code the data to, “develop a *theory* of this process” (Creswell, 2013, p. 85). By first getting familiar with the data, I thought I would be able to construct codes of what occurred throughout the enactment of the design (Charmaz, 2006).

The process of my coding took place in three iterations. First, I began by creating event maps (G. Kelly & Chen, 1999) within V-Note (<https://v-note.org/>), a video analysis software. The event maps allowed me to become familiar with the video and audio data by coding for what was happening throughout the enactment. For example, I made note when interns were writing reflections, working in small groups, having full class discussion, and when we were talking about science, teaching, and/or whiteness and white supremacy. After creating event maps, I open coded (Corbin & Strauss, 1990). When open coding I started by looking for turns of talk or

moments where I noticed theoretical constructs and the mediating processes I was interested in. The initial codes I used were white shame, white ambivalence, politicization, self-advocacy/agency, and identity development. I also left room to add in new codes and included an “interesting” code for moments and turns of talk I did not feel fit neatly into a singular category. I never got to my third phase which was to find themes and organize the codes in order to tell a coherent narrative about the design.

I never created themes or organized the codes because as I coded, I was not satisfied. My codes were simultaneously not robust and did not portray the complexity I was reliving or remembered. For example, I found myself struggling to categorize the discourse (talk and actions) occurring. I found myself almost exclusively using the code, “interesting,” to describe what I was observing in the video. When combining my coding (Corbin & Strauss, 1990) with the memos I wrote throughout the data collection (Emerson et al., 1995), I was even more unsatisfied. My dissatisfaction only intensified once I looked at the documents I collected from the interns too.

In my frustration, I turned to using storytelling as method. I chose to embrace storytelling because it opened up space for numerous interpretations of the same event to show how whiteness and white supremacy operated in the small everyday interactions (Berry, 2015). I also chose it because anthropological approaches to DBR also leverage telling stories (Bell, 2004), making it a method I could easily merge with my DBR project. By embracing storytelling, I was able to tell a story that did not fit into dominant narratives because it opened up room for attending to individuals’ experiences (Caine et al., 2018). I was also able to engage with the grammar of inquiry outlined by the conjecture maps I created (Sandoval, 2014) without reducing my analysis to discrete, separated, and reduced codes. Instead, I showed how the embodiments produced mediating processes resulting in the outcomes of the design in a holistic, more complex way. Storytelling allowed me to articulate practical outcomes for pedagogy and design while

extending and producing the generalizable theory DBR scholars argue is central to all DBR projects (DBRC, 2003; Edelson, 2002; Sandoval, 2014).

Creating stories and the value of storytelling as research

There are no series of clear steps to create stories because storytelling is not done using standard methods or concrete research methods (T. E. Barone, 1992). According to Barone (1992), stories are made better by experimenting, reflecting, and opening oneself up to other stories and critique. Knowing this, I drew upon a rich tradition of storytelling and narrative methods in educational research to create the stories throughout this dissertation. For example, I leveraged Lamar Johnson's (2017) notion of racialized storytelling to tell stories in the introduction of this dissertation. Below is how I created the stories I used throughout the next chapter.

To begin creating the stories I used in this dissertation, I used the coding I had previous completed. I went back to the videos and found moments that stuck out to me as important. These moments held a sense of wonder for me and therefore, were what Maclure (2013) would refer to as a "glow" in the data. After locating these moments, I engaged in an iterative process of writing and rewriting narratives (Connelly & Clandinin, 1990) tied to my personal, practical, and social justifications for this study overall and specifically using storytelling/narrative as a method (Clandinin, Pushor, & Orr, 2007). For example, each time, I changed, rearranged, and intensified various elements of the stories. This meant some narratives started by focusing on more personal aspects, like my central role in the study as the instructor and researcher, but switched to how White interns were learning about White identity or teaching, a more practical focus. Other times, I was trying to show the larger implications of having White interns practice being anti-racist, but realized the narrative was more about how I, as their instructor was interacting with the interns.

For clarity, at this point I was only writing stories. I did not embed much theory or other research literature. Instead, I tried to focus myself on understanding the people, places, and events as a process that unfolded and was constantly in transition (Clandinin et al., 2007). For example, I spent nearly a month writing and rewriting the narrative of the first day of SCIED 411W in order to understand it more fully. Starting in my field notes, I wrote a memo (Emerson et al., 1995) about “feeling” whiteness in the space and being shocked by the interns’ actions and statements. At the same time, I had not coded anything in the video and audio data other than small moments of “interesting.” By writing and rewriting the story, each time adding and removing different interpretations, I was able to construct a narrative that captured the complexities of the first day of class in SCIED 411W.

I was able to show the “arduous, messy, and contradictory” (The Politics of Learning Writing Collective, 2017, p. 6) work involved throughout the 2020-2021 iteration of the design by using storytelling. This does not mean the stories I constructed describe *everything* that happened because, “Inevitably, unavoidably, narratives reveal some things and hide others” (T. Lensmire, 2019, p. 259). This is not a bad thing though. As Wright (2019) states, citing Clough (1992) and Goodson and Sikes (2001), “all representations of reality, even statistical representations, are narrative constructs and as a result, creative constructs” (p. 181). This means the stories I generated do exactly what all other forms of research does, describe something that happened while leaving out some things too. The advantage of using storytelling outright, rather than more traditional qualitative methods, was the ability to blend, “theory with experience” (E. T. Miller & Tanner, 2019, p. 3) in order to show the “suppleness” (A. Y. Jackson & Mazzei, 2013, p. 264) of the data, how educational context might be transformed (T. E. Barone, 1992), and, “see things heretofore unnoticed” (Lewis, 2011, p. 504). In short, storytelling created a mechanism by which to present the messy magic that occurred throughout the 2020-2021 design in ways that extend our knowledge of about practice and theory.

My goal in writing the stories was not to provide an *exact* representation of what occurred. Instead, I was trying to disclose my thoughts, musings, and interpretations about the, “unsaid, the masked, the contested, and contradictory” (Gallagher, 2011, p. 51). Like Gallagher (2011), I believe,

‘evidence’ is left to stand in for what we already believe. ‘Keeping it real’ and telling ‘real stories’ in other words often anchors researchers to only those things that can be or were spoken in the given context rather than using stories – methodologically – as spaces for probing rival musings and interpretive openings (p. 52).

Storytelling was a way for me to interpret what was happening throughout the design. For example, on the first day of SCIED 411W you will see that the interns did not talk explicitly about whiteness and white supremacy, but the absence of discourse about whiteness and white supremacy does not mean they were absent. The stories I wrote were my way of using my imagination and theoretical probing to produce knowledge because I was not beholden to an apolitical method (T. E. Barone, 1992; Gallagher, 2011).

Since I did not feel beholden to using particular methods and planned to use the stories I wrote in a political, interpretive way that did not recount every detail or occurrence throughout the design, I used what Jackson and Mazzei (2013) refer to as “plugging in” to guide me in embedding theory into the stories I created. Describing how they felt traditional qualitative methods were too simple for dense data and the processes they were using were “insufficient” (p. 261), Jackson & Mazzei (2013), state they challenged themselves to, “use theory to think *with* their data (or use data to think *with* theory) in order to accomplish a reading of data” (p. 261). In practice, “plugging in” takes the form of analysis that disrupts the theory/practice binary and is deliberate and transparent about the questions that were used and emerged throughout the analytic process. In this way, “plugging in” works to tell more nuanced, complicated, and productive

stories by not just saying what happened and instead infusing what was said with theory (A. Y. Jackson & Mazzei, 2013; Mazzei & Jackson, 2012).

When using “plugging in” to embed theory into the stories I created, I started by reading my stories and, literally, writing in theory to further contextualize and explain my interpretations. When writing in the theory, I was essentially “exploring” (Barone, 2007) to see if the theory illustrated what I was noticing in the story generated from the data. I was trying to be ethical in my approach in that I was working to, “make obvious the connections between political forces [e.g. white supremacy] and individual lives, connections not always immediately obvious to those whose stories are being told” (Barone, 2007, p. 557). This meant I was using “plugging in” as a method that, “allows for both the discernment of order and pattern, *and* is attuned to the lively excess that always exceeds capture by structure and representation” (Maclure, 2013, p. 229). Practically, this meant I continued to iterate on my writing as I worked to show how the embodiments, mediating process, and outcomes were all connected in the design while grappling with all the nuance, complexity, and invisible forces playing out in and around the design.

Although narrative methods, like storytelling, do not rely on validity, reliability, and generalizability (Connelly & Clandinin, 1990), I was still able to notice patterns in the narratives I was building. This was aided in large part to the conjecture maps I made because the conjecture map provided me with the language and patterns I was hoping to demonstrate (Sandoval, 2014). The conjecture map gave me a way to enter the data, but the storytelling was my way out. The conjecture map was not complex enough, but the stories I was writing were disconnected. In this way, the conjecture map gave me a way to see connections between the stories I was telling, while the stories provided me an avenue to capture the entirety of the design in all its dynamic nuances. This allowed me to tell a story that produced “humble” theory (Cobb et al, 2003), not just say “what happened” or “what worked.” What resulted was a case study (Dyson & Genishi, 2005) about a White man, Boaz.

The case of Boaz

I chose to focus on Boaz, as a case, because of the magnitude of data, the complexity of the data, and the uniqueness of the data Boaz was a part of. I met with Boaz frequently outside of class, exchanged a multitude of emails and text messages, and he showed up frequently, when I was engaged in open coding, as a participant I was frequently coding “Interesting” around. As a participant, it would be an understatement to say Boaz held a sense of wonder for me (Maclure, 2013). I was constantly returning to him as a person both in the data and outside the research process as a colleague and friend. There was an intensity around Boaz that seemed to “emanate” from the data around him and through him as an actor in the world (Maclure, 2013, p. 228). By engaging in telling a nuanced story about Boaz, as a case, I was trying to resist telling the easy story while simultaneously being able to illustrate the advantages and shortcomings of the entire design. So, while my analytic method revolved around storytelling and “plugging in,” I frame this study as a case study because I am focused on telling a story that is vivid in detail, unites many data sources, is interpretive, is political, and emphasizes how Boaz, the rest of the interns, and myself worked in context together (Marshall & Rossman, 2011a; J. Mason, 2002).

Case studies are highly flexible, allowing a researcher to engage phenomena within real world contexts and are particularly useful when engaging questions starting with “how” (Yin, 2018). This allowed me to create a *narrative of engagement* (A. J. Rodriguez, 2015; A. J. Rodriguez & Morrison, 2019; Tolbert et al., 2018) around how Boaz and his peers learned anti-racist science teaching *and* how combining CWP and practice-based teacher education (PBTE) supported their learning. By narrative of engagement, I am referring to a more, “balanced analysis of the challenges and success of teaching and learning” (A. J. Rodriguez & Morrison, 2019, p. 278). In creating a narrative of engagement, I was able to bring participant voice to bear more readily within my story (Tolbert et al., 2018), realizing I was playing an active role in shaping

their words both as an instructor and researcher constructing the narrative. However, by producing a narrative of engagement, I was able to show learning as more than the outcomes, tell a narrative focused on what the interns did rather than what they did not do, and describe, richly, the struggles and successes during the 2020-2021 iteration, and interpret what happened using theory as I explored, “deeper and unstable, contradictory, and ambiguous elements” (Farrant, 2014, p. 465) of Boaz’s and his peers’ journeys. The case study’s narrative would serve to validate the design because I would be able to connect the embodiments of the design to the mediating processes and outcomes of the design (Edelson, 2002; Sandoval, 2014). In this way, the story could produce a level of generality that DBR scholars claim is important to DBR (DBRC, 2003).

I constructed a narrative that captured the learning of Boaz and his peers’ first day of class through their graduation a year and a half later. I portray what I, Boaz, his peers, and the class broadly was *becoming* (Connelly & Clandinin, 1990; Jackson & Mazzei, 2013; Kumashiro, 2000). To do this, I took the numerous stories I had embedded with theory and placed them in chronological order. I then filled in the gaps where I felt I needed more. More details, more theory, more interpretation. This was especially true after I had my partner Nicole, my advisor Scott, Boaz, and others read, critique, and question what I wrote. Each move I made was an attempt to be honest and therefore, “empirical” in my storytelling as I showed, “the webs of contingencies that constitute their [the interns and my own] life-worlds” (T. E. Barone, 1992, pp. 141–142). To accomplish this, I wrote what I felt, thought, and uncovered as I rewrote, rethought, and reinterpreted the narrative I was constructing.

What resulted is what I think is a messy, muddy narrative case study. By messy and muddy, I mean the narrative does not represent and was not produced through traditional qualitative research. It was produced through repetition of writing stories and grounded in a belief that, as cited by Lewis (2011),

We need to re-narrative the past. We need to tell the past and its stories in ways that allow us to disrupt conventional narrative and conventional history. Such disruptions help us to better understand how racism and social injustice have been seamlessly woven together.

Since I believe oppression and justice are messy and muddy, it only makes sense that the narrative is. Besides, I agree with Farrant (2014) when they say we need to challenge “pure” research because “muddy” processes and finding only makes research stronger, not weaker (p. 465).

I believe in the power of stories. This is reflected in how heavily I relied on stories throughout my pedagogy within the redesign and the racialized stories I told in the introduction of this paper. By using a messy process that led me to use “plugging in” to tell stories which resulted in a narrative of engagement about Boaz, I am working to, “change our social, cultural, and personal lives” through “revealing the world” in an attempt to “revise the world” (Farrant, 2014, p. 467). However, I am not convinced all stories are worth telling. For example, as Lensmire and colleagues (2013) point out, confessionals are often the primary form of pedagogy around whiteness for White people and these can result in anti-racist education failing. Additionally, stories in qualitative research can be both too focused on despair or be disingenuously cheerful (Tolbert et al, 2019). To avoid this, I engage in an openly political kind of storytelling as I worked to, “prick the consciousness of readers by inviting a reexamination of the values and interests undergirding certain discourses, practices, and institutional arrangements” (T.E. Barone, 1992, p. 143) by not telling every detail that happened and spending time interpreting what was underneath, within, above, and around the discourse that occurred. While I have tried to describe, as best I can, like the narratives I present, this section is admittedly showing some details and hiding others (Lensmire, 2019), but I can say with one hundred percent confidence it is *honest*.

Chapter 4

“Becoming” a White Anti-racist Science Teacher

This chapter focuses, with his permission and knowledge, primarily on one participant, Boaz (a pseudonym). Boaz is a White cis-gendered, heterosexual man. In order to properly capture Boaz’s journey as a White secondary science intern, this chapter is told as a chronological story. Within this story are two intertwining themes. The first is Boaz’s journey around his White identity and white supremacy. The second is his learning to be a science teacher. The reason for these two themes is that Boaz learned about science teaching and inquired into his White identity in tandem, often both lines of thinking playing off of one another because Boaz was learning to become a *White* science teacher.

The story describing Boaz’s journey to becoming a well-started anti-racist White science teacher is broken into sections. In each section, I will be interweaving theory, primarily drawn from critical whiteness studies (e.g. Jupp, Berry, & Lensmire, 2016), specifically Reverend Thandeka (1999), Ralph Ellison (1995), and Tim Lensmire (2017b), as well as literature on understanding how interns learn to teach, specifically how interns learn to teach science, using core practices (i.e. AST; Windschitl et al., 2018). The reason for interweaving theory is to help render the complexity in Boaz’s journey visible. Given the narrative structure of this chapter, there is a lot I could talk about. For example, I could focus on the ways Boaz’s Christian faith informs how he understands science epistemically, however, I will only focus on Boaz’s Christian faith as far as it informs his learning to be a White science teacher. I could unpack Boaz’s relationship to masculinity. Again, I am choosing to focus primarily on his journey as a White science teacher because that was the central focus of the redesign of the secondary science program at Penn State.

“Good teaching” vs. “good science teaching”: A tension

On the first day of SCIED 411, I asked the interns to write about what they thought “good teaching” looked like. I then asked the interns to create models of “good teaching” in small groups. Boaz wrote about teaching students content and desiring to, “get to know students far beyond just academics.” Boaz finished his writing by saying, “I think that students won’t care to know until they know you care.” Boaz’s reflection explained how being a good teacher was about building high quality relationships.

Boaz continued to build on what he thought a relationship of care looked like between teachers and students when working in a small group to create a model. After one of his peers said there is a difference between being a “good” teacher and a “kind” teacher, Boaz agreed. Boaz said, “you have to have a mix.” Boaz took the position that teachers need to have high expectations, which is not always “kind” from a student’s perspective, while caring for your students overall. Although Boaz and the rest of the group were not aware of culturally relevant pedagogy (Ladson-Billings, 1995; 2006), they articulated that a “good teacher” is able to balance care for students while also recognizing that the role of a teacher is not to always make students “feel good.” The interns in this group, including Boaz, implied teachers need to help students “choose academic excellence” (Ladson-Billings, 2006, p. 160) by building rapport with students.

Throughout other groups, Boaz’s peers brought up the importance of fostering relationships with students, being passionate, getting to know students beyond the classroom, and being responsive to student needs. Some even mentioned culturally relevant pedagogy (Ladson-Billings, 2006) explicitly. To be clear, Boaz and his peers did not take an explicitly anti-racist stance on teaching, or what Parsons (2005), would call “culturally relevant caring,” a process where teachers fully attend to students’ needs, understand students’ needs and realities as their

own, and then the student acknowledges the care given and understands it as authentic and thoughtful. Still, all the interns showed, either in writing or in their talk, that they thought building relationships of care were valuable in teaching. Content was usually an afterthought as shown by the limited references to “what” students would learn on the models created of “good” teaching. With this said, the interns exhibited little critical consciousness due to their lack of focus on systems of oppression and power shaping the experiences of students in schools. Most interns focused on the need for teachers to be understanding, adaptable, engaging, and empathetic.

After presenting what they thought “good teaching” looked like, I asked the interns to edit their models, however they saw fit, to reflect what “good *science* teaching” looked like. During the discussion, Boaz spoke almost exclusively about content. Boaz was clear they thought students needed to be taught “the facts” and “up to date information.” Boaz was interested in engaging students in “hot topics” (i.e. controversial issues similar to socioscientific issues), letting students form their own “opinions” about the “facts” he presented in class, and telling students why class content was relevant to their lives. When culturally relevant pedagogy came up in discussion briefly, the entire group agreed that culturally relevant science teaching was purely about, “giving students up to date information.” Boaz’s group made no mention of how students would be taught, power, history, or any other element associated with culturally relevant pedagogy.

Boaz was not unique in switching their focus from relationships to content when prompted to model “good science teaching.” When the interns started discussing “good science teaching,” all of them focused heavily, if not exclusively on content. In fact, one group erased everything they had on their white board and replaced it with content objectives including specific science facts and definitions. For example, “Mitosis = cell division.” When I asked this group what differences they had between their first and second drafts, one member of the group

said, “Our content part before had less stuff, in science teaching content is bigger.” Everyone in the group agreed, with one other group member stating science teaching is, “more focused on the content.” The focus on content was something all the interns discussed when creating their models about “good science teaching.”

When describing “good” science teaching, the interns presented a description of a fairly conservative and traditional science classroom. Later, it would be revealed that the type of science teaching advocated for in SCIED 411W and SCIED 412 is different from the science they experienced. The interns were all successful science students as they all had to maintain at least a 3.0 GPA to enter the major and were required to take some of Penn State’s most rigorous science courses. Therefore, it would be surprising if they described science teaching that was different from the kind they had experienced and been successful with. Described by Luehmann (2007), teachers not having experience as both a learner or a teacher with reform-based teaching lack buy-in or confidence to use new teaching practices. This was similar to what I saw on the first day of class. The interns could not even fathom a science classroom that engaged in anything other than essentially telling students facts about the natural world even if some of them wanted to include “labs.”

The first class was intended to show me how the interns were thinking about teaching as they entered SCIED 411W. What emerged from class was that the interns thought science teaching was about content, not relationships. For the interns, content referred to canonical science ideas. Relationships, on the other hand, were about all social phenomena and aspects of teaching that fall outside the content found within traditional science classrooms (e.g. mitosis, forces, atomic structure, plate tectonics, etc.) During the first class, all of the interns, including Boaz, took up a perspective implying that any perspective not supported by canonical science was wrong and/or did not belong in a science classroom. This does not mean the interns thought this consciously. However, the community of interns did make it clear science was about telling

students “the facts.” By arguing students need to learn “the facts” in science, Boaz and his peers positioned all other knowledge, ideas, and worldviews that contradict science as wrong or deficient (McCausland, 2020). What is interesting is the interns collectively believed “good teaching” in general to be about relationships, a position that assumes value in different perspectives and was a contradiction to their position on “good science teaching.”

By positioning science as a discipline rooted in facts, Boaz and his peers were unknowingly evoking a history of science that embraced white supremacy (McCausland, 2020; Roberts, 2011; Watkins, 2001). For example, science has particular presuppositions including nature being knowable and controllable, acquiring knowledge to gain knowledge, and until around the 1960s, although this thinking still exists, a positivist world-view (Aikenhead & Ogawa, 2007). Therefore, it is no surprise the interns believed “good science teaching” meant presenting “facts.” Science is socially constructed (Kelly, Carlsen, & Cunningham, 1993; Longino, 1990). This means white supremacy, a social phenomenon, also influences science given white supremacy’s prominence in Western society. Therefore, when Boaz and his peers spoke about needing to provide students with “up-to-date” information about the world in a way where, as one preservice teacher said, “If you don’t want to believe my facts, that is up to you buddy,” they were embracing a history of science that has historically been involved in advancing colonization and white supremacy (Sammel, 2009). If these teachers were teaching in the 1800s or throughout a large portion of the 1900s, “up to date” information would include race science, eugenics, and social Darwinism, among other, now debunked and rejected ideas (Roberts, 2011; Saini, 2019; Watkins, 2001). In fact, it may be the historic worldview of science being separate from society driving the interns’ belief that teaching in general was inherently different from science teaching.

Ambivalence

Throughout their learning, Boaz and many of his White peers' talk can be described as incoherent. By this I mean the White interns would consistently deflect, contradict, and use emotional and rhetorical maneuvers to avoid speaking directly about race and white supremacy (for examples of these kinds of talk see, Bonilla-Silva, 2002; Haviland, 2008; Lensmire, 2010, Leonardo & Zembylas, 2013). When analyzing the talk of White people, Bonilla-Silva (2002) argued this "incoherent talk" indicates racism on the part of White people. This racism is different from other forms of racism historically because it is an attempt, on the part of White people, to be race evasive (Bonilla-Silva, 2002). White people are still adhering to white supremacist ideologies while trying to appear as if they are not.

Although I do agree the White interns' incoherent talk can be interpreted as adherence to white supremacy, I am more inclined to agree with Lensmire (2010) in that the White interns' incoherent talk revealed, "a deeper ambivalence that needs to be theorized and understood" (p. 162). By white ambivalence, I am referring to the tension that exists within White identities of a longing, a belief in, a striving for, equality in America, when in reality, there is evidence of inequality everywhere (Ellison, 1995). It is in this ambivalence the White interns express both their resistance to and interest in engaging with social justice and anti-racism. I believe if the White interns' incoherent talk was actually a conscious, rather than dysconscious, attempt at maintaining the current racial hierarchy, they would not have engaged in the ways they did throughout their time in the program. Instead, their incoherent talk was a signal of their deeply conflicted White racial self. This made ambivalence integral to the White interns' learning around race, and more specifically, white supremacy (Shim, 2019).

In the case above, I believe the tension between science and relationships in how the interns described "good teaching" and "good science teaching" reveals ambivalence. In other

words, the interns' talk shows a conflict between wanting to be teachers who value their students' ideas, lives, and identities while believing it is their job to relay "the facts." This is similar to how Ellison (1995) describes how White people desire equality. In the case of the interns, they desired classrooms that valued relationships, while being confronted with the reality that science classrooms, in their opinion and experience, are places that only value content. Science classrooms do not value relationships. This is visible in how the interns spoke about science classrooms, with one White intern arguing that science is more "daunting" than other subjects because, for example, "If you don't know what an atom is, you don't know other stuff." Time and time again, content was upheld as the most important part of science classrooms by the interns. Certainly, at this point, the interns were not aware of the implications of their actions, but they did raise a key dilemma, how much of science teaching should be *only* about canonical science? It was clear from the first class that the interns could envision classrooms that valued relationships, but they struggled to recognize how to build or center relationships in science teaching. The interns saw the tension between relationships and canonical content as a zero-sum scenario.

Resistance or ambivalence?

The dilemma about the purpose of science teaching emerged in Boaz's reflection at the end of week one. For the reflection, I asked Boaz and his peers to explain their perception of the class by describing their fears, intrigues, and emotions that came up during the first week. I was starting to guide them in reflecting on and making meaning of their emotions (Matias, 2016; Menakem, 2017). In their reflection, Boaz described being anxious because he perceived the class would, "completely flip my idea of what science teaching should look like." He went further by stating the class went, "against every fiber in my being." Central to this anxiety, Boaz mentioned,

Another fear is the content this class covers. I noticed that it seems like race in the classroom will be extensively discussed. Personally, I have grown to learn the importance of respecting and integrating all races, creeds and backgrounds into whatever scenario in life. However, I don't necessarily want to harp on it in a class designed to teach me about Science Instruction. However, I am sure there is a reason for this.

While Boaz was clearly anxious about the class after the first week, he was intrigued by how his thinking would be affected by the course. Yet, his excitement centered around learning AST. He concludes his first reflection by saying, "Overall, I'm excited to learn about this new, yet difficult, way to teach science," in reference to AST.

Boaz's reflection can be interpreted as resistance to what he would be learning about in class. Boaz's statements could be interpreted as him trying to invoke racist discourse while avoiding being positioned as racist. His statement is akin to him saying, "I'm not prejudiced, but..." (Bonilla-Silva, 2002, p. 46) because he is simultaneously saying how much he values "all races, creeds, and backgrounds," while saying SCIED 411W shouldn't "harp on it in a class designed to teach me about Science Instruction." Boaz wants to be seen as not racist, but he is not interested in grappling with race in any fashion.

Instead of viewing Boaz as resistant to engaging with race, I argue his statements are ambivalent. This is indicated by how, among Boaz's "push back," he also mentions, "the importance of respecting and integrating all races, creeds, and backgrounds into whatever scenario in life." The addendum of a statement, akin to, "I'm not racist," in Boaz's talk, reveals a desire to be associated with ideas of diversity, equity, and inclusion; all justice-oriented stances. Boaz is caught in a dilemma of wanting to be associated with social justice and equity as he simultaneously does not want to engage or talk about it. This contradiction represents his ambivalence.

Boaz was not alone in his ambivalence during the first reflection. For example, a White woman, Erin, stated,

I was very fearful due to the language in the syllabus. From hearing about this course prior to taking it, I was excited to actually start learning the practical skills needed for teaching. The syllabus makes the course seem not like that at all. It seems like it is another version of CI280. I understand and have a deep appreciation that being anti-racist and anti-prejudice is very important for teaching, but I believe that I have already learned a lot about these types of things. Here I want to learn about actually preparing and executing lessons, especially since SCIED 412 is in the classroom. Thursday's class made me feel better about these fears, and I hope that most classes are like that rather than learning about race only (but am obviously still open to learning more about this, just not as the majority of the class). I am really interested in learning about AST and how to use it in a classroom.

This quote demonstrates Erin was mostly interested in learning more about AST and not anti-racism, but like Boaz, made it clear “being anti-racist and anti-prejudice is very important for teaching” (note that she did not say science teaching). This means while Erin could be interpreted as resistant, like Boaz, she is revealing a conflict between wanting to be associated with equitable teaching while not necessarily wanting to learn about it because she had, “already learned a lot about these types of things.”

Pedagogically, I chose to not respond to Boaz or his peers in relation to their opinions on SCIED 411W's focus on anti-racism. I worried I was allowing, specifically, Boaz and Erin, to invoke racist discourses. However, I knew how I responded to each of the interns' statements mattered. I knew, using Luehmann's (2007) description of Sford and Prusak's (2005) description of “significant narrator” (p. 833), I would be a valued and respected gatekeeper if any of the

interns were going to see themselves as well-started anti-racist ambitious science teachers. One misplaced, misguided, thoughtless response could potentially both transform white ambivalence into white resistance, among others. I was committed to creating a space where the White interns could play and be confused with race (Tanner, 2017, 2018b). I also wanted to create an expanded number of identities my white interns could take on than are traditionally available in classes that center social justice (Philip & Benin, 2014). Similar to how Tanner (2016, 2018c) described his quandary around how to respond to Adam, a White student who wrote and read a racist story, *Fuckleberry Finn*, I was torn. I didn't know whether I should point out the contradictions and racism in Erin's, Boaz's, and other interns' reflections, thank them for sharing, or do nothing. I opted to do nothing. Like Tanner (2016; 2018c) I neither encouraged or discouraged them. I believed their responses to be challenges to the type of instructor I would be and the responses revealed ambivalence I could capitalize on later. I decided to let the interns participate in discourse about science teaching and race without telling them how or when to participate because the goal of my course was to have them *practice* being anti-racist in their lives and classrooms. For me, a step in that process was to have the interns *practice* sharing their ideas and thoughts because taking on a potentially new identity is a risk because they may not be successful in their implementation (Luehmann, 2007) and/or be rejected from social groups they care about (Lensmire, 2017b; Thandeka, 1999).

Willing ambivalence

During the second week of SCIED 411W, I had the class talk about texts they engaged in. All of the texts centered on race. Boaz spoke to his small group about being surprised that anthropologists used the terms Negroid, Caucasoid, and Mongoloid in reference to different races historically. He was even more surprised when one of his White peers, Jordyn, was taught the

labels in her biology class. Later in the conversation, the group struggled to articulate how race wasn't "a real thing" but "social" to which Boaz said, "race does exist though." After a long soliloquy by one of their White peers who was worried they spoke too long, Boaz said, "you have more to say about this than I do."

After the class discussed the texts in a large group (Boaz said nothing), they wrote a narrative about, "the first time you realized your race." Below is Boaz's writing:

My first experience realizing I was white happened a long time ago. I will admit that it's not a story full of racism and white privilege. Perhaps a little white privilege, but not much. Talking about race and the concept of white privilege is something I avoid due to personal opinions on the topic, but I digress.

I am not sure what year it was. I was surely in elementary school at that point. I lived in Raccoon Township, a township in Beaver County, Pennsylvania, the county adjacent to the county that houses the city of Pittsburgh. Raccoon Township, along with two other townships, is part of the Hopewell Area School District, a predominantly white school district, with graduating classes of about 180 students. The district surrounds Aliquippa School district. Aliquippa is a former steel town, located on the Ohio River, basically created due to the Jones and Laughlin Steel Corporation being built there in the early 1900s. The town was structured into different "Plans", with each Plan having a number. Different ethnic groups lived in the different plans (i.e. Italians lived in Plan 1, Ukrainians in Plan 2 and so forth); there are still remnants of this today as there are different social clubs in Aliquippa for different ethnic groups (Serbian Club, Lebanese Club, etc.). The steel industry left Pittsburgh, and along with that the Jones and Laughlin Steel Corporation left the city of Aliquippa. As the plant closed, all of its residents left to find employment elsewhere, and the city became a ghost

town. Slowly, others moved into the area, predominantly blacks. With the low-income housing came crime; I am not suggesting that the black people brought the crime, just that it happened. All of this backstory is to say that Aliquippa School District is predominantly a black district; also a small district with graduating classes with at or under 100 students.

This backstory of the history of Aliquippa is to show how I understood race. In elementary school, my grandfather started a church at a building named the Mother Tyler Community Center in Aliquippa; my family started to go to this new church my grandfather pastored. This was the first time I understood my race. I distinctly remember playing flag football. To be 100% honest, no visceral, horrible thoughts occurred. I remember them acting a bit differently than white folks in their speech and action and remember more than anything just the difference in skin colors. This church, in comparison to my grandfather's previous church, was predominantly black. I'm fortunate to have such an innocent experience learning about my race and race being a concept.

At the end of class, I had the interns fill out an anonymous survey regarding their emotional responses to writing their narratives about race and I displayed their responses in a word cloud for the interns to react to. When I showed the interns the results, Boaz was one of the few students who did not use exclusively negative words regarding the experience of writing about the time he realized his race. In sum, he described his feelings as being the opposite of "ashamed, bad, negative and more."

In the following class, I had interns unpack the meaning of their race story. Boaz stated their narrative taught them that, "skin color, although perhaps it shouldn't, is a characteristic that deeply divides us." He went on to say his township is mostly White and the White residents do not interact with the Black residents of a nearby town. Boaz reasoned, "the geography and

differences in income caused this.” Building further, Boaz said, “this probably has deeper ties to skin color and where some black folks are able to live.” Boaz ends his analysis by saying, “We have an idealized society where people are “colorblind;” yes, I think that we should strive for unity in diversity, but “colorblindness” is not possible, nor do I think it should be encouraged. Race should be celebrated.”

It was at this point I noticed significant differences between Boaz and most of his White peers. Boaz was one of three White interns who incorporated history into their narratives, but he was the only one of the three who rarely spoke in class to this point. For example, Oliver, a White man, was the intern Boaz said, “had more to say” than he did. Oliver, in their narrative, wrote about how their hometown was, “famously built by William Levitt” with the intention of making an, “all-white neighborhood. It was built in the 50’s, and if my memory serves, the first non-white family, a black couple, moved into my section in the 80’s.” The other intern Jeremy, another White man, was frequently outspoken in class, and in his narrative, reflected on the settlement of Hmong refugees in Minneapolis. Besides Boaz, Oliver, and Jeremy, the rest of the interns told narratives that were disconnected from history and social structures. The other interns only focused on interpersonal events that took place, in the reading of the narratives, in silos separate from society.

The other thing that separated Boaz from his peers was he expressly mentioned he did not have any negative emotions affiliated with his narrative or the experience of writing his narrative. The rest of the class did. Boaz both in his narrative and reflection on the narrative was clear he was, “fortunate to have such an innocent experience learning about my race” and he did not feel the negative emotions he felt were probably common. You can tell Boaz recognizes the uniqueness of his situation because he is “fortunate” and “the opposite” of negative emotions his peers experienced. The rest of the class mentioned emotions like, sad, guilty, angry, confused,

shameful, embarrassed, and horrified when reflecting on their narratives and when describing the experience of writing them.

Throughout the two days in class focused on writing narratives and discussing race, Boaz continued to demonstrate ambivalence. Simultaneously he claimed he did not have much to say about race in conversation with peers, but he was able to articulate a historically grounded account of the first moment he realized his race. In Boaz's reflections he also juxtaposed what he felt with what most folks probably felt. In other words, he knew his narrative and feelings about race were different from most people. For Boaz there seemed to be a tension between not wanting or not believing in his ability to engage in conversations about race while having a lot to say about race. To be fair, Boaz's lack of sharing in class was no surprise as White people are often socialized to avoid race in conversation and even when we are engaged in conversations about race, engage in sophisticated discourse patterns that can avoid implications in racist behavior, change the focus of conversation from white supremacy, or blockade anti-racist action (Bonilla-Silva, 2002; Haviland, 2008; Leonardo & Zembylas, 2013).

I suspect Boaz's ambivalence is rooted in how his thoughts about race were shaped by his Christianity, something he did and would continue to speak about frequently. By arguing for "unity in diversity" Boaz was trapped in a tension between not believing in race evasiveness and arguing for an assimilationist perspective on race. The contradiction in these belief systems stems from arguing to notice difference while believing that difference should result in unification. In other words, racial differences are valuable as long as they result in a grand organizing identity or society; given the religious undertones of Boaz's narratives and beliefs, at this point, I suspected that meant a Christian identity.

Boaz's perspective mirrors other Christian messaging purporting to value difference while being contradictory or ambivalent in nature. For example, Miller's (2018) ethnographic study of her White children showed that, "they were being taught and were learning that loving

across differences was a virtue” (p. 13). I read Boaz’s statement of “unity and diversity” in a similar way. Additionally, the church in Boaz’s story was segregated (it was just led by a White pastor) as was most of his upbringing, as described by the history he shared in his narrative. This shows that while he was being taught messages of “unity in diversity,” Boaz was living a largely segregated, or ununified life. Beyond this, the interactions that took place between Boaz and the Black people he interacted with at his White grandfather’s church were not interactions designed to dissect and explore differences in meaningful ways. Instead, rather than make sense of the differences, Boaz was left to play flag football and recognize differences were important without knowing *why* they were important. Again, returning to the phrase, “unity in diversity,” there is an implied divinity to differences. God made people different and because of this, we are all also united and the *same*. For Thandeka (1999), there are major flaws in this account of race because it removes the social construction of race and perpetuates the belief that while we are different, for White people, it absolves us from playing a role in oppressive systems. Race is made by God, not by humans. So, while Boaz is expressing a desire to notice difference, that difference is superficial and intended to unite under the banner of Christianity. This may be why Boaz did not feel the same negative emotions described by his peers when thinking about and writing his narrative. He was indoctrinated into a system of beliefs that says differences do not matter *and* the only entity that can fix them is God because it is God who created the differences in the first place (Thandeka, 1999). Ultimately, this thinking may have protected Boaz or absolved him of any personal wrongdoing in his opinion. I am not suggesting here Boaz did do anything racist, but it is worth mentioning how his Christian faith may have been shaping his perspective on race at this point in his journey.

Boaz was and would not be alone in his valuing of Christian thought and values. At this point, one other White intern, Anita, a White woman, had positioned themselves as religious. Through Anita’s talk, she made it clear she thought everyone should be treated with dignity, but

thought too many people put too much stock in race. For Anita, “As a Christian, I strive to be open and love every individual, regardless of race or religion or background.” This statement mirrors Boaz’s claims that “unity in diversity” is important because it simultaneously indicates the importance of difference while undermining it. This is evident later, when Anita states that,

It is natural to be drawn to people who look like you, to feel like you can relate more to people who look like you, to feel safer around people who look like you.

It is something people of every race struggle with. As a teacher of any subject, I hope to teach students through my actions and behaviors that it is important to reach out and make an effort to be understanding and empathetic towards anyone, any stranger.

Anita, like Boaz, was ambivalent about discussing race in class. Both Boaz and Anita drew upon their experiences as Christians to demonstrate their ambivalence by pointing out the value of people of different races while also downplaying them. For Boaz, he argued for an assimilationist perspective. Anita, argued racism was a moral problem. This is similar to the argument of many religious leaders. For example, Ralph Reed argued that social problems, connected to race, are “moral problems” rather than problems that are socially constructed by systems (Thandeka, 1999). In this way, as Thandeka (1999) writes, individuals who espouse these beliefs can, “stand against racism while sidestepping the economic issues for both black and white Americans that King knew were inextricably interwoven within the race issue in America (p. 116). Anita, is taking up this line of thinking. Anita is against racism, but is making it a moral, and perhaps a biological issue, which has deep roots in race science and eugenics (Watkins, 2001), as indicated by her statement that “it is natural to be drawn to people who look like you.” By doing so, Anita is able align herself with anti-racist movements and ideas, like Boaz, but that alignment has limits.

Describing the education for Black people during reconstruction, Watkins (2001) makes it clear that advocates for educating formerly enslaved people were perceived as “progressive.” At the same time, individuals like Samuel Armstrong and more fundamentally believed that Black people were not suited and could not engage in the same kind of education as White people. They believed that race made people biologically different. By invoking the statement that, “it is natural to be drawn to people who look like you,” Anita is invoking those same discourses. Additionally, Anita is engaging in a scapegoating ritual (Ellison, 1995). By leaning into stereotypes about people’s desires to stay with their own race, Anita is using historically racist science discourse to justify the unequal, white supremacist reality she sees around her. By doing so, I believe it is, like with Boaz, absolving her of the moral dilemma facing her because the reason inequality or racism exists is because of the biology of people, something God created, not because she, other White people, and people of Color are “bad” people.

Although Boaz and Anita experience ambivalence driven, in my opinion, by their Christian identity, other White interns also expressed ambivalence in different ways. For Beatrice, they discussed being resistant to discussing whiteness and, “what it means to be white.” Simultaneously, Beatrice went on to say they were striving to talk about race more. This does not mean Beatrice planned on talking more about being White. Instead, Beatrice planned on listening to people of Color and other historically marginalized people more. This is indicated when Beatrice writes the following reflection,

I need to work on focusing on strictly listening and really trying to take in what is being said to me. The end goal of the improvement would be for me to be able to talk about race and what it means to be white confidently. The other end goal is for me to be able to listen to a story and fully take in the words before I jump in with my own opinion. I feel like this will help me because it will force me to focus more on their side of the story versus my input on their story.

This section of Beatrice's writing demonstrates some ambivalence because what Beatrice is talking about is listening, not speaking about being White. However, Beatrice believes by listening more to people of Color they will be able to talk about what it means to be White "confidently." This demonstrates ambivalence because Beatrice is willing to engage with ideas they are resistant to. At the same time, the way they decide to engage is by not actively participating and talking about being White. Beatrice plans on talking about what the experiences of people of Color are in order to learn about being White. I am not arguing Beatrice will gain no value from listening to people of Color, but Beatrice is resistant to *talking* about whiteness and being White, listening to people of Color is, simply, not that. Beatrice is also positioning and assuming people of Color know more about white supremacy, White identity, and race generally than they do. When in fact, people of Color, just like White people, can choose to embrace white supremacy (Leonardo, 2004). Beyond this, Beatrice positioned people of Color as needing to help or save them from being a bigot rather than "sharing the burden" (Matias & Mackey, 2016) and recognizing their own agency in learning more about whiteness and White identity. Therefore, I argue Beatrice is demonstrating ambivalence like Boaz and Anita in that they are espousing ideals aligned to anti-racism while showing their alignment with such ideals has limits.

Ambivalence and shame

Reverend Thandeka (1999) argues White identity is riddled with ambivalence and confusion as a result of white racial abuse. White racial abuse is when the White child is policed by a white authority figure to move from non-white zones into white zones. This policing results in what Thandeka (1999) refers to as white shame, or a lost core sense of self, on the part of White people. Mainly, white shame is the result of a White child learning their desire to connect, genuinely, with people of Color is not allowed by their White community. White shame can

create fear in White people not because we have had negative experiences with people of Color, but because we have had negative experiences with White authority figures. Consequently, this fear has many outcomes for White people, chief among them, a desire to not talk about race, especially our own White identity.

White shame matters when talking about white ambivalence because of how white shame helps explain the confusion and fear associated with affection and desire in racialized contexts. Particularly, it helps explain that fear, which is central to white identities (Frankenberg, 1993; Thandeka, 1999), is not the result of negative experiences with people of Color, but negative experiences with other White people. For example, Thandeka (1999) describes how Jack, a white boy, “knew he had somehow done something wrong” (p. 5) when inviting his Black friends to his birthday party. Another example is of Delores who feared losing the love and affection of her parents if she got into trouble during Civil Rights protests (Lensmire, 2010, p. 168). In both examples, it is not experiences with people of Color that evoked fear and shame, it is the response of White people to specific behaviors demonstrating cross-racial solidarity. Therefore, it is no surprise White people express ambivalence towards racialized conversations and situations because we are constantly negotiating between, our belief that all people are equal while being surrounded with evidence we are not and if we decide to live up to the ideal of equality, we could lose our White community and White loved ones.

White shame emerges

Boaz wrote a reflection at the end of week two showing a continued ambivalence towards race. For the reflection, I asked the class to write about how class that week “(re)shaped your thoughts about what it means to be a raced person.” Boaz wrote that he was still confused as to why SCIED 411W was going to be focused on race as much as it was. He also said he was,

“willing to hear out the lessons and learn as much as I can from them; I am sure it is important.”

Although Boaz said his thoughts on race had not changed, he did say he was starting to, “rethink the importance of it when it comes to entering a classroom.” He went on to explain he was thinking of teaching in Savannah, Georgia, “an area I think is predominately black,” stating,

I’ve not thought before about how much race would matter in these predominantly black school districts. For one, I would be a white man coming into a district to teach science, a discipline historically dominated by white men. How do I show science is not just for white men? In addition, students may bring completely different knowledge and personal stories into the classroom than a predominantly white or latino population would bring into the classroom. These could be utilized in many different ways.

Boaz then said he was, “tired of talking about race, diversity and more.” He explained he is not racist, but based on the readings is, “definitely not an antiracist.”

At this point, Boaz decided to explain why he was tired of talking about race. He said,

It can be hard for me to talk about these items though; as a white man, I often feel that I am viewed as the perpetrator. I grow tired of having to accept responsibility for actions America’s ancestors have committed, and grow frustrated with items like Affirmative Action. I can be called a “racist, homophobe” (which actually happened to me) for my political opinions and that’s okay to say, but for me to question these items in this progressive, liberal society is wrong? I agree that there are issues. Historical gerrymandering and district-lining has caused worse education for blacks in areas; how do we counteract this? I guess that I just don’t know if I agree with how it’s being done. I do think diversity is important; I’m a student leader in a Christian organization that is probably the most diverse ministry on campus. All racial groups are

represented. I have many black friends, with genuine friendships, not just what the media would call “token” black friends. I hope one would see the conflict in my views and how today’s society views me.

Boaz concluded his reflection by saying he was looking forward to exploring race more in class. He explicitly mentioned that he hoped to see why race is so important in SCIED 411W.

Prior to this point, I had not questioned any of Boaz’s individual ideas regarding anything, including race and teaching, for the past two weeks. I had let Boaz and the rest of the interns say whatever they wanted, largely unquestioned. I only asked questions intended to evoke clarification or expand on their thinking. For instance, I asked a group of interns during a discussion about what they learned from the day’s readings, “what feelings emerge when you hear that not saying the n-word is not enough to be anti-racist?” This question was designed to have the group expand on their conversation about the qualities of someone who is anti-racist and reflect on their own perspective rather than challenge anything they might have said. I also made statements intended to affirm them or assuage their worry for logistics aspects of class. For example, in Luna’s reflection journal they expressed excitement over discussing racism in SCIED 411W during week one. I thanked her for her excitement. Liz, on the other hand, said she was concerned that she wouldn’t know enough science. I told Liz not to worry because I often do not remember much science.

Knowing I had not made any comments or questioned Boaz directly, I decided to comment directly on the section of his reflection where he explained how he felt like a perpetrator. In my comment, I stated there was a lot to talk about and asked if we could create a thread to “chat” about what he wrote. I also said it would be fun to talk in person too. I went on to say, “I have felt these things... still feel these things,” in relation to feeling like a perpetrator and being tired. I gave an example of someone saying I was racist because I believe, “white people need space to talk about race in ways that allow us to make sense of it on our own.” I concluded

my comment by thanking Boaz for the honesty and asking him when he feels, “those emotions you describe and when you do feel those emotions, what actions result from them for you?”

It was only the end of the second week of SCIED 411W and Boaz was beginning to enter the first step in taking up an anti-racist teacher identity. Still ambivalent, Boaz was confused and possibly irritated at the fact that SCIED 411W was centering race as much as it was, but he was willing to admit there were probably good reasons for it. Boaz was starting to ask questions and create space for his own thinking about race in relation to teaching science. By wondering how to, “show science is not just for white men,” Boaz was demonstrating an interest, albeit hesitant, about learning more about race, especially in relation to science teaching. These sentiments, paired with his already burgeoning interest in learning more about AST in week one indicated he was now beginning the first step of “repair work” (Gee, 2003), a key element in becoming a reform-based, or in this case, an anti-racist, science teacher (Luehmann, 2007). By showing an ambivalent interest, Boaz was now “enticed to try” or at least engage with, anti-racist ideas and practices.

Among Boaz’s ambivalence, he also expresses white shame. For one, by admitting he is tired of talking about race and diversity because he often feels like the perpetrator shows how Boaz is ashamed of his White identity. Specifically, by stating the need to “accept responsibility” Boaz demonstrates a deep seeded shame of being White. Certainly, it is possible to interpret what Boaz is saying as resistance in the form of wanting to ignore history, but Boaz mentions the ways gerrymandering and red-lining have disproportionately impacted Black communities in negative ways. This shows he is not trying to ignore history and structural racism. Still, Boaz is “tired of having to accept responsibility” for this history. This expression of being tired seems to be the result of Boaz’s experiences in conversations about race or anti-racism in spaces he perceives as “progressive liberal society” rather than not wanting to strive for justice in general.

Boaz's shame and ambivalence, based on this reflection, seem to be derived from spaces he perceives as being a part of "progressive liberal society." By explaining he often feels like the perpetrator in conversations about race and diversity, Boaz seems to be describing a form of white privilege pedagogy whereby White people are expected to confess their privilege and wrong doings (Lensmire et al., 2013). Certainly, white people do have white privilege (McIntosh, 2008) and frequently commit micro and macro aggressions. Yet, Boaz is not disagreeing with the fact that some communities are oppressed and it is White people who have and do create that oppression. Boaz is tired of being seen as the problem, and it seems, using a reading of Thandeka (1999), it is not traditional White authority figures who are responsible for his shame, but those who claim to stand for racial justice because they often position him as the perpetrator, or inherently wrong, in racialized contexts. In other words, Boaz feels shame from progressive White authority figures as a result of being told that his beliefs make him a "racist homophobe" rather than a White person who is deeply conflicted and confused about their positions on race. By engaging in scapegoating rituals around Boaz by calling him a "racist homophobe," for example, "progressives," for Boaz have alienated him and told him he does not "belong" in their community. This is similar to what Lensmire (2017a) describes in regards to White anti-racists and their belonging. By scapegoating Boaz, "progressives" may be signaling their own belonging and identity as anti-racist as they position Boaz, a self-identified conservative, as being "racist" because of stereotypes about people who identify as conservative. This action only serves as a reminder for Boaz that he cannot leave white spaces or he will lose his community and he has no chance of getting a new community if he does lose his community.

Boaz's conflict and confusion comes across in the contradictions within his reflection. He simultaneously argued race is not important or he did not want to talk about race while describing the ways race does matter and asking questions he was wondering about. This is textbook ambivalence because Boaz was expressing the contradictions between his Judeo-Christian

morality, that difference is important and oppression is wrong, with how he was conducting himself on a daily basis, as being tired talking about racialized oppression and working to avoid talking seriously about race (Ellison, 1995).

Boaz was not alone in expressing shame and ambivalence in his reflections and talk at the end of week two. Most of his peers expressed ideas of shame that created ambivalence in their thinking about race. For example, Anita, expressed it was, “hard to be honest with myself, and that it was relieving that there were so many people that have had the same struggle with truth, with reflection, with facing themselves as I did.” In their writing, Anita’s description of having a hard time with the content of the week indicates a level of shame. She was struggling to render her whiteness visible, which for Thandeka (1999) is a textbook response to learned white shame. Additionally, as described previously, Anita invoked the same Christian rhetoric as Boaz that expresses the importance of differences among individuals, but leans back on a biological explanation for race and racism (Miller, 2018; Watkins, 2001). In addition to Anita, Lauren mentioned she has never been taught anything positive about race and did not feel she could attend protests for Black Lives Matter because, “I feel like I cannot relate enough, or know enough. If I were to go to a rally for black lives matter, I feel like other people there would look at me and wonder what I was doing...” For Lauren, she has only negative feelings associated with race, presumably because she has been socialized to avoid explicitly mentioning it for the sake of revealing whiteness (Thandeka, 1999). Additionally, it seems her ambivalence and shame around wanting to take anti-racist action, but not attending out of fear is derived from people within what Boaz would call, “progressive liberal” spaces. While this is not exactly like Lensmire’s (2010) description of Delores who feared attending Civil Rights protests, Lauren is expressing a fear of rejection from a community. Instead of it being her White community, it is the Black Lives Matter community Lauren fears rejection from. With this said, Lauren is not saying that she fears losing her White community outright, but she is saying that she fears not

being able to belong to a new community, which I assume, may be because she knows there would be fallout in her own White community for attending a Black Lives Matter protest. With this said, another reading of Lauren's thinking is she is leaning on stereotypes of people at Black Lives Matter protests, probably Black people, who, because of Lauren's white skin, would reject her. By leaning on this stereotype, Lauren may be engaging in a scapegoating ritual herself in order to feel better about her "not racist" White identity (Ellison, 1995).

At this point, as an instructor, I was interpreting many of the responses to my questions and the weekly reflection specifically as genuine attempts by the White interns to make sense of themselves in relation to race relations in the United States. I saw their writing as taking risks, key element to shifting teacher practice (Luehmann, 2007), to embody an anti-racist identity. When thinking about how to respond to all the White interns, but specifically Boaz, I chose my words very carefully. From the outset I wanted to create a space where the White interns could do exactly what Boaz and some of his White peers were doing. In short, they were questioning, being confused, and expressing honest thoughts about race and white identity. Knowing if I engaged in scapegoating (Ellison, 1995; Lensmire, 2017), I could shut them down by eliciting a response understood as white fragility (DiAngelo, 2011) or Boaz could become outright resistant. Therefore, I decided to invite them to talk more. More than that, I shared my own experiences too. For example, I asked Boaz if we could meet and talk in person and shared my own experience of being frustrated. With Lauren, I asked her, "Why do you think this is the case?" In response to her stating she never learned anything positive about race, I said I too had not been taught anything positive about race until I was in undergraduate. With Anita, I said, "I am wondering what you learned about race from being Christian" after she expressed her Christian identity being central to her perspective on the world. In each case, as well as others, this action prompted the interns to respond with their ideas, helping us start a private and nuanced conversation about white supremacy and race.

My approach to addressing the interns' comments is inherently racialized and it was an attempt to get the interns to practice taking up agency to think critically about themselves and what they thought (Matias & Mackey, 2016). Thinking of Ve'a's (2020) work observing an animal rights activist group, I was having the interns practice thinking with and through their emotions in order to make sense of the world, a form of *guided emotional participation* (p. 28), or a form of practice where emotional responses are the goal in order to help the White interns make sense of the world. I was trying to have the White interns display their ambivalence and grapple directly with and in their white shame. My status as a White man, who has grappled with the same or similar things helped me empathize and sit with the White interns' stories and ideas.

My responses were racialized because I was constantly aware of my position as a White man and tried to use my position to disrupt the interns' discourse about race, white supremacy, White identity, and science teaching (Chadderton, 2012). Yet, many of my responses could have or be perceived as insulating the White interns from critique, thus helping them feel "comfortable," I could have validated their racist beliefs through my thanking, affirmations, and attempts to share similarities between us, and finally I may have missed opportunities to intervene by sharing important information or insights (Foste, 2020). Throughout my entire pedagogy I was faced with contraindications and double-binds. This is part of what Yoon (2012) would refer to as whiteness-at-work. For example, I intended to have the interns reflect, but I did not always question the assumptions embedded in the interns' comments. In the case of Boaz, I went as far as to say I could relate to what he said. While this is true, my training as a teacher educator who wants to support teachers in being anti-racist tells me I needed to "call him out/in" or explain to him why his ideas were potentially racist. Additionally, throughout my comments I used language I knew the interns would perceive as me being polite rather than a direct critique. I spent a lot of time thanking and affirming interns for their honesty and candidness. This may have served to solidify racist beliefs in them, however, as shown by Boaz's and all the other interns' willingness

to continue engaging with me, I believe this choice was appropriate. Beyond this, because I would not know what would happen in the future, I believe learning happens in practice, not by sharing more knowledge. In my own personal memo at the end of week two, I wrote that I did not care what was in the interns' heads, I only cared about what they did in their lives and in practice. For me, the journal was an extended (dare I say, macroteaching) approximation of practice (Grossman et al., 2009; Stroupe et al., 2017) of the type of conversations I was hoping to socialize the interns into. In other words, I used the journals as a space for them to practice being successful (Luehmann, 2007) in engaging in honest, open, nuanced, and dynamic conversations about their White identities and perspectives on white supremacy. Through these conversations, by asking questions and participating with the interns candidly, I worked to have them answer their own questions and realize they could do “the work” on their own (Matias & Mackey, 2016) and part of the work was being confused (Tanner, 2018b) and playing with ideas around race (Tanner, 2016; 2018c).

Good and conflicted

During the third week of SCIED 411W, Boaz continued to expand on their viewpoints around race privately in his reflection journal with me. This time, I prompted the class to respond to comments I had made in their journals and to talk about points of resistance they were experiencing. Like Matias and Mackey (2016) suggest, I was not avoiding any kind of resistance from the White interns. Boaz asked to get lunch to talk more. He also commented on my response to him about being a perpetrator by saying he often feels like a perpetrator when, “the media talks about right-wing voters, or even just white people in general (to a point).” He then described how his church focuses on unity in diversity, but when topics about diversity come up, he always feels like the, “bad guy in the room because I am a white male and I can’t relate to what they

experience.” He was also intrigued by my example of White people talking with each other because, “we don’t do that to begin with.” I responded to his comment by agreeing to get lunch and explaining that “being the perpetrator sucks” and that it is often true because “we (white people) don’t talk about race.”

In addition to responding to my comment, Boaz stated he didn’t think he was resisting anything, but “going along for the ride” instead. Boaz was “intrigued” by race and he returned to describing how he felt like a perpetrator, saying, “Somebody has to take the responsibility of our past ancestors, it is just hard to constantly do that.” I interpret this statement as Boaz rebelling against ideas rooted in white privilege pedagogy whereby White people are asked to confess constantly as a means to “fixing” white supremacy (Crowley & Smith, 2020; Lensmire et al., 2013; Levine-Rasky, 2000).

Eventually, Boaz spoke about how he felt resistant to the “overall belief of the class body.” Boaz thought, “everyone but me is completely on board for everything.” Ushering evidence to prove his point, Boaz brought up the improv session with a White faculty member at Penn State that week. Boaz said he noticed during an activity where the interns were asked to depict a still-image of the relationship between whiteness and science education that,

All of the different groups had elements of power dynamics between whites and other races; many were even throwing out buzz words such as systemic racism, marginalization, and more. Do these folks know the full meaning of these words? Were they just saying what the media has fed them? Did they just do what they thought was expected of them? Yes, to a point I agree with them, just perhaps not to the full extent that they do. Then again, this is a liberal university.

He then ended this portion of his reflection by saying he felt he sounded like a “right wing hawk” and he actually, “leans left on a lot of social issues.” Boaz also made a point to say he thought he was doing a good job questioning in class and wondered if his peers were doing the same while

stating that he thought, “Dr. Tanner was extremely interesting and I thought his time in class was valuable.”

Boaz was still not sharing much publicly, but trends were starting to emerge in Boaz’s talk. First, he was increasingly becoming interested in talking more about race as indicated by his “intrigue.” He was fully “enticed” into talking more about race (Luehmann, 2007). This was different from past statements and reflections that demonstrated a desire to not talk as much about race. Additionally, he moved from actively advocating against talking much about race to stating he was, “going along for the ride” and finding Dr. Tanner’s session about whiteness “valuable.” These statements, while subtle, demonstrate a desire or at least, a willingness to talk more. Boaz was also locating the “media,” perhaps a stand-in for “progressive liberals,” as being what is provoking his shame in some ways. What Boaz seemed to be hinting at is people and structures he perceives as traditionally anti-racist people and structures (i.e. “progressive liberals”) scapegoating him for not believing *exactly* what they believe (Lensmire, 2017a). This creates an immense amount of shame, or what Boaz is describing as being “tired” or feeling like the “bad guy” because Boaz believes he is a part of a group that is inherently wrong. Ultimately, Boaz continues to express an immense amount of ambivalence because he values “unity in diversity” while also constantly being confronted with the fact that the world, and himself, do not live up to that ideal (Ellison, 1995).

Boaz is demonstrating the outcomes of white shame. When Boaz sheds doubt on the intentions and understandings of his peers regarding their actions during the improv session, I interpret him as policing his White peers. Although his statement is done privately, what Boaz is doing is stating, in a subtle way, his displeasure with what his White peers did. He is indicating that he, Boaz, was in a white zone, while his peers, who used language associated with anti-racism, were in non-white zones (Thandeka, 1999). Boaz wanted his peers to return to the white zone where words like “equity” and “diversity” are not used because they risk rendering

whiteness visible. With this said, I believe that Boaz does not raise this perspective publicly because he fears losing his community of peers had he questioned them or resisted in the moment, something I assume he has learned from scapegoating rituals in “anti-racist” contexts based on what he has shared so far (Lensmire, 2017a).

Boaz was now deeply confused and constantly contradicting himself. He expressed values associated with racism by arguing against talking about race, using rhetoric tied to right-wing politics and media, and privately trying to police his peers from a non-white zone into a white zone. Simultaneously, he was arguing for “unity in diversity,” valuing an improv class about whiteness, and desiring to learn and talk more about race and White identity. Boaz is expressing discourses associated with both racist and anti-racist identities. He does not fit nicely into the boxes traditionally made available to White people in anti-racist spaces (Philip & Benin, 2014). Therefore, I read Boaz as desiring more nuanced and complex identities to be made available. One where ambivalence is ok and questioning the doctrine of anti-racism is acceptable.

Around the same time Anita also displayed ambivalence and shame during a written reflection about the improv class taught by Dr. Samuel Tanner. While most interns expressed some level of comfortability with the lesson where the interns were asked to use improv to explore themes of whiteness, science, and White identity, Anita took a noticeably stronger tone towards the lesson. In one of her reflections, Anita spoke about having resistance to, “being in the conversation about race because I feel I have such a wildly different approach to the topic than what I sense a lot of people in class do.” Anita explained how hard it is for her to identify as White because, “whiteness, as described in class, is nothing like me, and nothing like I’ve experienced.” In this moment, Anita was demonstrating how complex white supremacy is because, at different points in history, who and what was and is considered White has shifted many times. Anita described how there are distinct cultures of people who would be identified as White, making it hard to believe that whiteness can be attributed to “white people.” Beyond this,

Anita was adamant most of the practices and values the class attributed to whiteness and White people was, “American culture because Americans across all races do this.” Anita then began talking about the relationship between whiteness and science. Anita said,

I don’t understand why we are making sweeping generalizations about minorities being shut out or excluded from lessons. You may say I’ve never been in the minority position- but I spent six months in Singapore, where I was one of the only white people in the classroom. I’ve never felt excluded for my race like that. I’m not denying racism exists, that racist teachers exist, or that our country has a history of racism. I’m only saying racism doesn’t characterize white people’s addition to science. I just think that anyone can feel excluded from a lesson based on past experience, and we shouldn’t generalize people’s positive or negative experiences based on their skin color. To do this would be itself racist, because carrying prejudice based on the color of their skin is racism. To battle racism only when it pertains to minorities and not in every context would be to perpetuate racism everywhere.

Anita then concluded the reflection by explaining she felt like she can’t even explain her comfortability with the lesson because, “I was told that white people always become uncomfortable when talking about race.” Anita said this did not apply to her for the situation they were describing because, “being asked to walk around the classroom like a white person or being asked to portray an image of whiteness in science and therefore asked to generalize a people group based on race was racist.” Anita ended wondering what the consequences would be if the class had been asked to portray blackness. As a side note, I was asked this question by a group of White interns, specifically Luna, the next week, so I suspect Anita was not alone in their thinking. Anita was just willing to state their thinking directly.

Similar to my response to Boaz, I knew this moment was important for Anita. It also affirmed my belief that critical whiteness pedagogy, the pedagogy employed by Dr. Tanner, was valuable and undeniably anti-racist because it required the interns, particularly the White interns, to grapple with whiteness and White identity directly. Feeling defensive, I wanted to go point by point down through Anita's reflection and explain why I thought she was wrong. Instead, I opted to ask questions. I decided to expand the available identities for White people in the class (Philip & Benin, 2014). I also decided to engage in guided emotional participation (Vea, 2020) by having her dig into her emotions to make sense of her ideas. Therefore, I asked Anita to explain her ideas more and reflected what I thought Anita was saying. For example, on her statement about taking a different approach to race than other people in the class, I said, "Tell me about this approach! I am interested to hear about it." This prompted Anita to respond by saying,

I think race is irrelevant in many ways in modern society. People should be judged by the content of their individual character and experiences, not of their race. I don't see race as something to be prideful of. You can't change it about yourself, how does it make sense to be prideful of it?

To this I responded again with a question, but included a bit of information to get Anita thinking more deeply about their claim, saying, "What makes you say, "I don't see race as something to be prideful of?" Is it only because you can't change it... although I might argue historically this is not exactly true (think Italian, Irish, Jewish folks)." Again, Anita responded. She said,

Yes, purely based on the fact you can't change it about yourself, I don't think its something to be prideful (or ashamed) of. It just is what it is. Maybe that is just coming from my (maybe privileged) background of not having to define it, or not noticing its effects of my experience in this world.

These back-and-forth conversations indicated Anita was willing to grapple seriously with ideas about race when asked. I also, when asking questions, was able to keep Anita in a space of

ambivalence. A space where she was able to be contradictory without punishment and tease through her ideas. For example, she rails against thinking race is irrelevant while being surrounded by evidence that it clearly is considering how she very astutely explains her ideas may be coming from her “(maybe privileged) background” or “not noticing its effects of my experience in this world.” As her instructor, I was working to guide her to sit in ambivalence and grapple with her fears, frustrations, and potentially her shame due to the policing that inevitably occurred during her life to keep her in white zones (Thandeka, 1999). However, when I went into explaining, Anita was less likely to respond. For example, after Anita’s comment above, I explained how I was interpreting her statements and, while I invited her to enter the conversation again, never got a response back.

Teaching as a space to “play” with race

Throughout SCIED 411W, Boaz was also ambivalent about the pedagogical model advocated for in SCIED 411W, AST. Throughout the first three weeks of SCIED 411W, Boaz wrote about how he thought AST was, “an excellent teaching strategy.” Yet, he consistently spoke about how he didn’t think it was feasible to implement *every day*. Boaz had many questions regarding time, logistics, and politics in schools. These questions led him to think he would still implement some lectures throughout his curriculum when he was a full-time classroom teacher. Many of these ideas were grounded in his own experience as a learner and traditional discourses about schools and science teaching. For example, he was acutely aware of standardized testing and the need to have students perform well on those exams. Boaz was not sure AST would be able to help kids “pass the test.” Just like with race, Boaz was simultaneously interested in learning more, but adhered to more traditional perspectives on teaching science. Boaz was not alone in his thinking. For example, T.J. said he needed to see how to plan full units,

not just lessons, before altering their thinking about science teaching from more traditional methods to AST. Other interns were concerned with their ability to “cover” more complicated and abstract ideas in “high-level” science classes. Still, each intern did show interest in learning more about AST.

By the beginning of February, Boaz and his peers were preparing to teach for the first time. They would be engaged in rehearsals of lessons they were developing to mirror the first three core practices of AST (Kazemi et al., 2016; Lampert et al., 2013; Stroupe & Gotwals, 2017), planning for big science ideas, eliciting students’ ideas, and supporting students’ ongoing changes in thinking. At this point, the class was spending time thinking about how to choose a phenomenon in ways that were culturally relevant as well as talking about how race might matter in how they, as teachers, enact their pedagogy. During a class before the rehearsals, Boaz spoke about how he imagined, “race matters in deciding what counts as a valuable science idea.” Still confused about how, Boaz was clear he could see how certain lessons might “appeal more to certain races than others.” As he said in a previous reflection, Boaz wanted to do further research to learn about different ways of understanding and using science that he hadn’t seen as a “White guy.” He also said during a class he would want to talk to his students of Color in order to open a dialogue about his faults and get their input about how they wanted to learn science. Although supporters of AST argue that core practices may not support novice teachers in developing critical consciousness (Kang & Zinger, 2019), what I noticed with Boaz and his peers was their engagement with planning for big science ideas (AST’s first core practice) did support them in thinking more about the role race might play in their teaching practice. In this case, by asking the interns to plan for big science ideas, keeping a culturally relevant pedagogy framework in mind, the interns thought both about science *and* race in ways that were intertwined.

As Boaz and the rest of the interns were thinking about how to plan a science lesson, they continued to be engaged in conversations about race. During one class, the interns were engaged

in a facilitated dialogue about race. Quickly turning to how race would matter in their future classrooms, Boaz, for the first time publicly, stated how he often feels like a perpetrator in race conversations. As he spoke, Boaz said, “somebody needs to take on the burden for the sins of past White, male ancestors.” He explained he felt he needed to, but he struggled to “always” take the “burden” because he felt “vilified by society.”

In reflecting on the dialogue, Boaz focused on his future role as a teacher who may serve students of Color. In his reflection journal Boaz said,

I can only do what I can do to love others. I can't account for all white males. I want to meet my students, all students, including students of color, where they are at. I want to relate to them and bring the richness of their different backgrounds into my classroom.

Boaz ended his reflection by returning his refrain of wanting to, “strive for unity in diversity” and wanting to give, “the Christian love to all my students.” During discussions the following week, Boaz spoke about the dialogue saying, “My job is to teach I feel like, not to be a social justice warrior.” At the same time, Boaz desired to center the needs of students of Color. Boaz wanted to alter his teaching based on who was in his classroom and their needs by centering their experiences, especially the experiences of people of Color. Boaz was also beginning to think about the complexities in being responsive to students because he worried, he would, “single out students of Color in a predominately white setting by catering to them, or feel like I am patronizing them.” Boaz was consistent in conversations about teaching that he was still struggling with where he fell on issues of social justice, in particular race, but he was adamant that he wanted to serve students of Color in meaningful ways.

When talking about teaching, Boaz was more willing to share his thoughts about race. Throughout the facilitated dialogue, Boaz remained silent until the conversation turned towards teaching. Additionally, up until I turned conversations towards teaching, Boaz was only sharing

his perspective on race privately in his reflection journal and during our weekly lunch conversations. What is interesting is Boaz's perspective did not change between speaking about race and White identity in general versus talking about teaching. Boaz still maintained a very Christian oriented framework for thinking about race and was still ambivalent towards race. He was constantly raising conflicts and contradictions, but now he was sharing them publicly.

Boaz was not alone in being more willing to share his perspective on race and/or equity publicly when the conversation was focused on teaching. For example, Luna, in her reflections, stated she was struggling to put her learnings about race into the lessons she was planning. Explaining further she said, "Part of this struggle is due to my ever-present resistance to talking about race. I was never encouraged to talk about race as a child or growing up so I think the subject has always seemed a little taboo." Erin was similar in that she expressed feeling, "extremely judged and uncomfortable when I am put on the spot in a room full of strangers" during activities about race. However, in a conversation about picking a phenomenon for their rehearsals, Luna, Erin, and I engaged in the following conversation,

Luna: So, we have a phenomenon that we think is pretty cool. Which is a reaction in a bag. You mix a few things and it changes color, gets really hot, and it expands and all this stuff is happening. And so, I think from there we have all these really good back-pocket questions probing what is going on. We are trying to think of a driving question to make it relevant to students.

Erin: And learning about this kind of stuff, chemistry is really hard.

At this point I pause them to talk about a phenomenon where students explain what happens when sugar burns as well as a phenomenon where students explain why one ball bounces and another one doesn't. I end by asking them what can they get from those units to help explain why their phenomenon *could* be anti-racist? After a brief moment, Erin says, "Everyone is at the same place. Nobody has seen it," in reference to their reaction in a bag. Laughing, Luna says, turning to

Jordyn, “That is what you said, either everyone relates or nobody relates!” After a short back and forth about an actual driving question, they settled on using a reaction in a bag and asking the driving question, “What is happening in the bag?”

What makes the conversation with Luna and Erin so revelatory is prior to this conversation, the class had created a list of ideas on how to choose a phenomenon that would be considered “anti-racist.” The list of ideas included the kind of language they used in the driving question (it should not be technical), presenting a phenomenon with pictures or videos, choosing topics students can relate to, sourcing ideas from students, getting involved in the community to get ideas, do research on the Internet, and talking to students in general. The interns spent almost an hour trying to develop a common language to guide their practice (Windschitl, Thompson, Braaten, & Stroupe, 2012). In essence, they were defining sub-practices that would make the first core practice of AST “anti-racist.” Additionally, what Luna and Erin said went against what the class had agreed made a phenomenon “anti-racist.” They were arguing a phenomenon could be anti-racist because *no kid* (or at least most kids) had not seen the phenomenon. It was precisely because the phenomenon was *not* relevant to any or most kids that made it “anti-racist.” For two interns who had frequently discussed being nervous or resistant discussing race and anti-racism, they are taking a risk by going against the thinking of the class. They were now “playing” with race in their teaching (Tanner, 2018c).

Part of what I believe allowed Boaz and some of his peers to begin voicing their opinions publicly, rather than privately with me, was discussions about teaching and engaging in the practice of planning a science lesson gave them a space to *do or practice* the work of anti-racism in a “real-world” context. So far, we had only discussed what we thought rather than actually *use* the ideas and practices we had been discussing in an approximation of practice (Grossman et al., 2009). Rather than assume the interns would use the theory and ideas they had been presented with and discussed previously, the interns had an opportunity to practice it in an approximation of

practice (Kavanaugh & Danielson, 2019). In the case of Luna and Erin, by choosing a phenomenon, developing a driving question, and planning a lesson to elicit students' ideas, they were given the chance to practice living up to the ideals they espoused in their reflection journal. They had both expressed a desire to teach in equitable ways. Erin even said she was already familiar with how to teach in culturally relevant ways. For Boaz, talking about teaching provided an avenue for him to raise his concerns without directly saying he wasn't on board with everything in class. He was instead able to ask questions about "singling out" or "patronizing" students by using the type of pedagogies the interns were describing. He was questioning AST, *not* anti-racism, which he had learned was not appropriate.

Perhaps the context of engaging in a planning practice or discussing teaching more generally allowed justice to be made "peripheral" to the core practices or science (Philip et al., 2019), but I argue by practicing planning and discussing teaching in the context of planning an "anti-racist" lesson, created a space for the interns to "play" with and practice ideas concerning race and teaching. By this I mean the interns were taken out of a context where they are aware of the "rules" of the game and placed in a context that was ill-defined and required them to improvise. While this does not necessarily fit traditional notions of "play," I do believe that word fits best to describe what the interns were doing because of the emergent nature of their questions and actions. Boaz was able to ask questions. Erin and Luna could go against what their peers said in ways they had not up until this point. By not imposing my own "rules" outside of the need for them to choose a phenomenon with a driving question, the interns were able to try out new ways of thinking and express their perspectives on race, science teaching, and race in science teaching.

Rehearsals provide a context to try

During Boaz's rehearsal, he spent most of his time listening and asking other interns (the students for his rehearsal) to focus on what they observed. Boaz's group asked the class to explain why a crash dummy was impacted differently by two different scenarios, one where a weight was dropped on a car and the other where the car was dropped nose first into the ground. The first question Boaz asked a group was, "how did the car look? Were there any differences?" Later, when one of the interns tried to explain the differences using the word, "elastic," Boaz followed up by asking them, "What was elastic?" This talk urged the group to return to what they observed during the two different drops. When leading the whole group discussion, Boaz opened by asking the class what they observed. As the class began to explain what happened using energy, Boaz asked them to provide evidence for, "any ways the energy got dispersed." Throughout the rehearsal, Boaz listened and prompted his peers to return to the evidence they had to justify their explanations. Throughout his teaching, Boaz demonstrated an ability to use basic discourse moves like revoicing, pressing, and probing (Windschitl, Thompson, & Braaten, 2018) in ways that were responsive to what his peers said. While I did pull Boaz aside as a short "teacher timeout" once to encourage him to respond to his peers (Stroupe & Gotwals, 2017), my pedagogy was largely withdrawn. Unlike other studies where teacher educators scaffold and constrain what happens in approximations of practice (Kavanaugh et al., 2019), I let the interns teach unencumbered minus pulling them aside when they were circulating to chat. Throughout the rehearsal, the interns were able to use the discourse moves proficiently and in ways that were not routine, a common critique of core practices (Kennedy, 2016).

In his analysis of his teaching, Boaz highlighted how conversations did not always go in the direction he thought they would and was starting to think about eliciting students' ideas in terms of anti-racism. Although Boaz was concerned about students saying the "right" things and

having conversations going in particular directions, he was intentional in saying he allowed the conversation to “expand in different directions.” He also admitted it was difficult to think on his feet. In the future he planned to prepare more about what different students might bring up and compared teaching to a “performance.” Boaz felt because of these reasons, eliciting students’ ideas, “could or could not be” anti-racist. For Boaz, he felt he needed to elicit more “backstories.” He also said not drawing on prior knowledge could move eliciting students’ ideas towards racism. The example he chose to use to explain this point was another group that had students explain why bees chose certain plants to land on. Articulating his point, Boaz said,

I didn’t think any one group did anything that was anti-racist in nature. I do feel that all groups were not racist in their approaches. They did topics everyone could relate to, regardless of their racial background... I don’t fault any group for this, I feel that finding anti-racist ideas can be hard. I would like to mention that for the group who did the bees, this may not be the best idea for anti-racist ideas because urban environments may not have a lot of greenspace and bees.

He ended his analysis by mentioning he felt none of the groups were racist in their eliciting delivery, but in the future they should all make more of an effort to think about who is in the room and make the lesson more relatable to them.

Boaz’s reflection and teaching were not necessarily unique. Certainly, differences existed, but overall, the entire class taught proficiently, in my opinion, used discourse moves and, in their reflections, stated how difficult it was to be responsive to student ideas. With this said, what is interesting about Boaz’s reflection on his teaching is he focused both on the planning and enactment of his and his peers’ teaching. This is different from what Kavanaugh et al. (2019) found because in their study, teachers, “overwhelmingly identified how they considered social justice issues in the design of their lessons” (p. 19). In this case, Boaz was focused on his

enactment of AST, but was also concerned with how each practice, both planning for big science ideas and eliciting students' ideas could be used in service of anti-racism.

At the end of February, after the class's first rehearsal, I asked everyone in class to check-in with me about where they were at and how I could better support them. At this point, Boaz's candidness was not new. In his reflection Boaz explained he felt AST was far more engaging than traditional teaching, but he felt it was far more difficult than other styles of teaching *and* for all the effort, most of AST teaching was probably, "simply not racist." Boaz was just not convinced of the "feasibility" of AST in everyday teaching and didn't know if the benefits outweighed the work and potential lack of return. Then, he turned to talking about race. Boaz explained he had, "really enjoyed engaging with the material [about race]. I enjoy how much examination there is to do and that we don't have to have a right answer immediately. I also enjoy how a rightist or leftist agenda on race isn't being thrown on us." Boaz went on to explain how much he was enjoying our conversations at lunch, which had become a weekly occurrence at his urging, and he was excited to keep exploring concepts like power and whiteness.

Like with planning, engaging in the rehearsal gave Boaz an opportunity to practice teaching in anti-racist ways. For Boaz, this meant supporting interns in connecting their explanations to evidence in the form of observations. He also encouraged interns to clarify what they meant when they used particular words. More than that, Boaz *listened*. Frequently, before the rehearsal, Boaz spoke about wanting to meet students where they were at and show students he cared. By listening, I believe he was trying to figure out where interns were, what they were thinking, and show them he cared about their ideas. Boaz was demonstrating interpretive power, or an attunement to students' ideas and sense-making (Rosebery et al., 2016). By *listening* closely to what the interns were saying, Boaz was able to support their ideas by asking questions that sought clarification and evidence to support their reasoning for the differences between the car drops. This indicates Boaz was beginning to think about anti-racist teaching in nuanced ways.

Rather than force the conversation to be *about* race, he taught in a way that honored and recognized what interns were saying by allowing conversations to “expand in different directions” based on what was said rather than where Boaz wanted the conversation to go. In other words, he was “creating space” (Haverly, et al., 2018) for students’ epistemic agency (Miller et al., 2018).

In Boaz’s reflection, he also displayed concrete ideas about specific anti-racist teaching practices that did not come across as ambivalent. For example, he was clear he wanted to elicit more “backstories” and he thought no group delivered a lesson that was actually anti-racist because the phenomena chosen were general rather than specific. Boaz even went far enough as to critique a group’s phenomenon because he did not think students in an urban environment could meaningfully connect with the phenomenon. Even though I believe Boaz’s critique is rooted in stereotypes of urban spaces and the assignment was for the lesson to be relevant to the interns in the class, not imaginary students, Boaz started to take stands within the conversation about anti-racism. These are stands that are solid rather than ambivalent, and they are stands that indicate Boaz believes anti-racism requires more than just delivering a quality science lesson guided by AST. Anti-racism in science education requires specific practices he was beginning to articulate for himself.

I theorize Boaz was not ambivalent in his teaching or the analysis of his teaching because rather than being about ideas or beliefs, the rehearsals were about practice. Consistently when talking about anti-racism, Boaz struggled with ideas and how they aligned with his ideological beliefs. Whereas in teaching, being a good teacher aligned completely with his ideological thinking. For Boaz, being a good teacher required him to listen to students and *care* about their ideas, qualities of culturally relevant and anti-racist teachers (Ladson-Billings, 2006). Additionally, while Boaz believed AST was just “not racist,” the core practices did not conflict with his ideological beliefs, but created an opportunity for him to enact an anti-racist practice

even if he wasn't yet completely on board with all of the ideas surrounding anti-racism. By having the rehearsals be about practice, Boaz did not need to worry about his beliefs because, for him, being a good teacher, required him to do anti-racist things as he was guided by the core practices he was willing and interested in trying out.

Practice-based teacher education supported the CWP in SCIED 411W because for the interns, good teaching generally included many idealized versions of anti-racist teaching. For example, Anita, in planning for the rehearsal, stated that her "subconscious" more than her race affected what she viewed as a valuable science idea. Still, Anita said that she grew up in a "wealthy, primarily white suburb, and students may not think what is 'normal' and 'typical' to me is the same as them." Therefore, Anita said she will need to work hard to make sure her decisions and speech as a teacher is "equitable and accessible to everyone." Additionally, Anita wonders if it is ok that some learning in science, for example, about photosynthesis is, "just gonna be not racist?" Anita said she felt that, "we might be trying to apply morals to amoral topics." In Anita's statements, she is beginning to clearly articulate a stance on anti-racism through her planning for teaching. In regards to equity, Anita doubts the role of race in her thinking, but argues clearly her upbringing (invoking her race) will matter in her teaching and is impacting how she plans to teach. Anita is still holding on to a belief that racism is a moral issue rather than a systemic one (Thandeka, 1999). Later, Anita begins to think about what anti-racism looks like in a classroom. Rather than argue anti-racism or equity is *always* important like many of her previous statements, she begins to argue that some things students learn about might not be ripe for anti-racism in regards to the content. Still, Anita does say giving students access to the content can be regarded as anti-racism. Like with Boaz, conversations about teaching and the rehearsals gave Anita a space to take on a stance and not be ambivalent about race. Instead, Anita is clear and begins to take on the stance that anti-racism is more about how one is teaching rather than *what* one teaches. This again defies Kavanagh et al.'s (2019) findings that conversations about social

justice in teaching happen in regards to planning rather than enactment. Yes, Anita mentions planning, but she is more concerned with *how* she teaches in the moment rather than the planning she is putting in behind the scenes, even though that is also important to her.

Other interns took up similar stances to Boaz and Anita. At this point in the semester, many interns were arguing AST was not anti-racist on its own, but without explicit, proactive thinking about anti-racism, was “not racist”. They had recently read a few chapters from Kendi’s (2019) *How to be an Anti-racist* and adopted the “racist,” “not racist,” and “anti-racist” language from the excerpts. Additionally, interns were beginning to question, like Anita, how content in science could be “made” anti-racist. Instead, they began to think about how content was taught and the norms established in class. Across the board, like with Boaz and Anita the rehearsals and conversations about teaching provided a space for the interns to try being anti-racist teachers rather than talk about it. They also provided the interns with opportunities to be “motivated to put in a lot of effort” and have “meaningful success” with AST and anti-racist teaching (Luehmann, 2007). In this way, the interns were fully engaged in meaningful “repair work” (Gee, 2003; Luehmann, 2007) as I, their “significant narrator” constantly affirmed their efforts and successes along the way.

As the teacher educator in the community, I rarely, if ever, gave “answers” to the interns. In fact, it became a running joke that I would answer a question with a question or, when talking in small groups, would walk up, ask a question, and walk away. The goal of this was to have the interns use their own agency to solve their quandaries. As demonstrated by the success in the rehearsals, their robust reflections, and more, the interns were starting to take ownership of their teaching and their learning about anti-racist science teaching, rather than relying on other people and sources. In short, whether they realized it or not, the interns were “sharing the burden” of anti-racist teaching (Matias & Mackey, 2016), and beginning to develop a critical pedagogical discourse (Stroupe et al., 2021), or personal theories about what counts as good science teaching.

Noticing nuance in anti-racist teaching

During the second rehearsal, focusing on supporting students' ongoing changes in thinking, Boaz continued to listen to ideas but rather than focus on observations, had everyone justify their ideas with evidence. During this lesson, interns were using engineering practices to create models that simulated the car drops, this time, with an egg. One group wanted to design a giant web to catch the egg. Boaz asked them the purpose of the web and to justify why a web would work. Another group wanted to get, "the biggest box possible" and fill it with packing peanuts. Boaz followed by asking them to justify why a big box would work over a smaller box filled with packing peanuts. Finally, at the end of the lesson, Boaz prompted students to share, "the one element of their design that puts their design above the rest." Throughout the lesson, Boaz and his co-teachers worked to share authority with the interns operating as students. The final question, asking each of the groups to share a part of their design that was "above the rest" shows Boaz and their co-teachers were willing to position students as knowers and share epistemic authority, rather than lecture or tell students what was right or wrong (Haverly et al., 2018; Miller et al., 2018).

In their analysis, Boaz decided there were anti-racist elements in his group's lesson and noticed students were using a lot of science talk. He justified his lesson being anti-racist because students were engaged. He explained he and his co-teachers would sit or kneel when talking to their peers, physically changing power dynamics between them and their peers. He also believed having students engage in "debate" (i.e. argumentation), a practice in science with specific norms, was important so everyone's ideas are "respected." Specifically, Boaz thought making norms of conversation explicit in their lesson and asking students to share the part of their design they thought separated their design from the rest was anti-racist. While he did identify these aspects as anti-racist, Boaz was clear to mention he felt these things were done unintentionally and is

noticing them in retrospect. With this said, Boaz began to explain how it is difficult to notice anti-racism and white supremacy in his teaching because, “I am in a classroom full of whites, in a college where white students attend. In a diverse classroom, or different socioeconomic classroom I may notice it more. We are at a college where systemic processes do support me being there; I probably don’t notice it as much as I’m there.” Boaz then spoke about the importance of adapting to individual students and still wanting to connect content to students’ backgrounds and using student input to develop lessons.

Again, Boaz is getting a chance to practice anti-racism in his teaching through the rehearsals, but this time, is beginning to complicate and create nuance around what he considered to be anti-racism in teaching. He outlines having talk norms, physically changing power dynamics between the interns and himself, as well as structuring share outs in ways that honor students' ideas as anti-racist elements of his lesson. Boaz makes it clear these parts of the lesson were “unintentional.” What is striking about this is that if these elements of the lesson were unintentionally done and are considered anti-racist, he is integrating anti-racist practices into his teaching without realizing it. He is taking on the identity of an anti-racist teacher or “being” anti-racist (Ladson-Billings, 2006; Luehmann, 2007). Boaz is describing anti-racist science teaching is becoming a practice he is taking up within the context of SCIED 411W.

Boaz also points out the environment in which the lesson took place can work to mask white supremacy. This shows Boaz is not only integrating practices he believes to be anti-racist into his repertoire of teaching, but is also able to understand what happens in the classroom within the context it is taking place. For him, the context is a majority White classroom at a primarily White institution and the context works, consequently, to mask whiteness because it is so ubiquitous within the context.

At this point in the semester, Boaz and his peers were beginning to understand anti-racism as a process. Specifically, they were thinking about AST as the what of teaching and anti-

racism as the how. This is exemplified by how Boaz describes AST as “not racist,” but then is able to identify elements of his lesson that made it or could make it anti-racist. It is not AST that was anti-racist but how Boaz and his group delivered the AST aligned lesson. In other words, the AST practices mediated the interns’ ability to engage in anti-racist teaching. For example, Kerry mentioned he was “putting words in the mouths of the students” and believed that was a way whiteness was creeping into his teaching. In Kerry’s example of his own teaching, he was describing how he engaged in pressing and probing (Windschitl, Thompson, & Braaten, 2018), but carried pressing and probing out in a way that was potentially embedded in whiteness. To correct this, Kerry believed next time he would work to use the language of his students because, “what is deemed accepted discourse in class determines what science ideas are deemed relevant or valuable” and “students of color are often excluded from classroom discussions when they don’t conform to the accepted discourse, which in my “classroom” is largely influenced by my whiteness.” Kerry was articulating and identifying the culture of power in science and how science is often White property (Calabrese-Barton & Yang, 2000; Mensah & Jackson, 2018) because they are noticing and drawing connections between norms of science, schools, and society in relation to whiteness. Another intern, Oliver, believed their lesson wasn’t anti-racist. They said, “The development of this activity was really pulled from noticing an issue prevalent among all of the groups, and coming up with a way to address it.” Ironically, this is *exactly* what is called for in AST; teachers should adapt class and plan based on student ideas. This is also something I would argue *is* anti-racist because their lesson was rigorous *and* responsive to students’ ideas (Thompson et al., 2016, 2013). With this said, Oliver believed their lesson was not anti-racist because it did not actively, “break down and rebalance any power structures.” For Oliver, since their lesson did not create “new forms of discourses, participation, or engagement” (Calabrese Barton, Tan, & Birmingham, 2020, p. 8), in their opinion, their lesson was not anti-racist. These examples indicate, that along with Boaz, other members of the class were beginning

to see anti-racism as a process because one can engage a class in AST, but what happens in a lesson is what makes it anti-racist or not. They also had a very high standard for what “counted” as anti-racist evidenced by Oliver’s and others’ desire to “break down and rebalance” power structures.

Identifying shame and white enculturation

Once the class finished their rehearsals, I had them turn their attention to their social/emotional justice project (SEJ). Specifically, I wanted to know what they planned on doing for the project. Boaz wanted to critically examine anti-racist and white supremacist patriarchal ideologies. He initially wanted to turn our lunches into a podcast that included guests. Boaz wanted to talk about a question and present it to two different groups, one consisting of people of Color and another consisting of White people. From there, he wanted to analyze the discussions. When COVID-19 caused everyone to go into quarantine and our class moved remote, he was distressed he would not be able to accomplish his goals because he was, “really looking forward to doing it.”

At the same time as Boaz was thinking about his SEJ, he was also beginning to think deeply, with the rest of his class, about how they learned to be their race. Noticing the nuance of questions from the start of class, Boaz stated this was way different from a question asking when they learned to be their race. Boaz spoke about family, peers, media, and other adults teaching him generally. However, he expanded on his thoughts saying, “Oftentimes, we are afraid of rejection from our social group of peers and model how they treat races for fear of ostracization from the group; this has happened all my life.” Continuing this line of thinking, Boaz was curious if racist practices could be passed down and began to question whether he learned to be White in science classes. He explained how, “it was assumed I would be a scientist, engineer, lawyer,

doctor or other “male” career like this.” He described how science “affirmed these plans society had for me” and he always knew, “math and science are for the guys and reading and social studies are for the girls” according to society.

Boaz and his White peers were now starting to articulate how White people become White in ways aligned with Thandeka’s (1999) notions of how White people become White. In his description of how he became White, Boaz mentioned fear of rejection from his White community explicitly. Another student, Kerry, described becoming White like stepping outside in the rain. He said, “You step out of your door perfectly dry and stay relatively dry - but you are continuously (if slowly) getting wetter and wetter.” Again, this process mirrors some of what Thandeka (1999) describes. While absent of the theme of White racial abuse, Kerry is starting to realize we become White through socialization over time. He even, in his description, states he does not believe we do not notice the moments because he makes it clear that, “I realized I wasn’t terribly thrilled with my experiences so I chose to define myself differently - largely by moving to a dramatically different and more diverse area.” I read this as him not finding community in his White community, so he was, in a way, forced to leave in order to find a new one. Another student, Oliver mentioned that children, “before they’re exposed to society, are perfectly happy interacting with people who look different from them” and began to describe whiteness as, “something that we [white people] feel as a part of our identity.” Oliver clearly understands White children are created not born, and the word “feel” indicates Oliver knows whiteness is not something that is not unnoticed, but it is viscerally felt within our bodies (Menakem, 2017; Thandeka, 1999). Additionally, Oliver began to question White people’s connection to whiteness. Oliver knew we feel whiteness, yet we do not want to let go of it because it provides us power. Yet, for Oliver, he wondered, “Why are we [White people] so reluctant to let go of our whiteness” because, as he stated later about his socialization, “It wasn’t really until the middle of high school where I think I started to realize that people were making jokes at the expense of a

whole race of people and the impact that that could have on how I was thinking about those people.” This connects to Thandeka’s (1999) explanations because in order to fit in, Oliver had to engage in groups (white zones) that made jokes about different races and participation in these groups shaped his perspective on people who were different from him. He also recognizes whiteness is felt, and although he does not make the direct connection to the “walking on eggshells” feeling Thandeka (1999) describes, Oliver is attuned to how whiteness exists in white bodies, he is able to feel whiteness-at-work (Yoon, 2012). In many ways, the White interns were beginning to pick up on ways they were socialized to be White. In some ways their thinking feels obvious, but it was becoming increasingly nuanced and complicated because as Erin said, “learning about your race seems continuous to me, never ending.”

The interns were also beginning to connect white supremacy with science. Boaz made the connection between how he was encouraged, as a White man, to enter science. Anita was less clear than Boaz, stating, “I don’t know” when asked if whiteness is supported by science and/or if science is supported by whiteness during class. Anita was the person who raised the issue by saying whiteness was supported by science and vice versa, she said that,

I just threw it out there to talk about. If whiteness is the history of prejudice against minorities in the United States, I would say that science has a history with that as well. By leaving other races out of the science community for a long time, science is founded on White people.

Lauren argued, “People who had power, or wanted power, used whiteness and science to justify themselves. They “created” facts or found and labeled differences among people to say people who are White are better or smarter in some way.” Lauren also began to tie her learning to be White to science saying, “I don’t think I straightforwardly learned about my race or how to be White in science, but I think I learned my race from the people who made science or “created” the facts.” For Boaz, Anita, and Lauren, they were beginning to make connections between

science and whiteness. These were connections that at the beginning of the semester, they would not have made given how they described science as largely objective and separate from society.

The work the interns were engaged in, while not a traditional rehearsal, could be understood as approximations of practice. Part of “being” a culturally relevant teacher for Ladson-Billings is “being” for justice (Ladson-Billings, 2006). Matias and Mackey (2016) affirm this belief in their stance that White teachers need to “share the burden” of race. Leonardo (2004) is also clear that being anti-racist is a *choice*. Kumashiro (2001) also advocates for constantly changing practice or we risk engaging in oppression. All of these scholars advocate for anti-racism being a practice not knowledge. Each time the interns engaged in conversations about white supremacy and race, they were grounded in practice. By practice I am referring to a process of doing or carrying out an idea (Lampert, 2010). A process of developing a common value and discourse (Goodwin, 1994), developing a culture (Lave & Wenger, 1991), and having opportunities to “do” or rehearse the work of anti-racism (Kavanagh et al., 2019; Lampert et al., 2013; Philip, 2019). Although the interns were not engaged in traditional approximations of practice, the in-class activities like taking pictures of “whiteness on campus,” weekly reflection journals, and especially the SEJ, were intended to be approximations of practice around what it means to “be” anti-racist. The interns were engaged in doing their own theorizing and racialized storytelling (Johnson, 2017) constantly throughout SCIED 411W. In other words, they were practicing what it means to *be* an anti-racist teacher beyond their moment-to-moment interactions with students.

Taking agency in the conversation

By the end of March, about a month into quarantine due to COVID-19, Boaz began to critically think about his cultural practices. In a reflection asking him to reflect on how he speaks

in different contexts, Boaz described potentially embracing norms of whiteness in his everyday life, yet he begged the question, “Is me participating in what I perceive to be my normal wrong?” as he acknowledged, “I live in a society where white language and action is the “normal” and other types are not the “normal.”” He began to weave a stream of thought that could be summarized as taking the position that he does not uphold white supremacy when he lives his life as normal, but does when he encounters other perspectives and “gets upset.” Drawing upon his experience in the Christian church, he described getting frustrated and annoyed when visiting Black churches because of the “call and response” he perceived as being different from “white churches.” He continues his story by extending his thinking to, “hearing dialogue and loud laughing that is contrary to what I hear in white circles.” He then acknowledges his White norms seep into how he talks about race, stating he would often avoid certain words, assert ignorance or uncertainty, and even provide safe self-critique in reference to an article they read in class by Haviland (2008) about how White people talk about race. Extending his thinking to science teaching, Boaz said certain issues in science may be raced and gendered, but in chemistry and physics (his subject areas), “there is less of a chance of the talk of specific science being raced or gendered.” He believed teachers should explain the history of science being racist and sexist, but make it clear that “anybody can be a scientist or practice science” today.

As the semester waned, Boaz continued to focus on white supremacy and turned his analysis of white supremacy toward science teaching. During one class, Boaz argued other ways of knowing that are not Eurocentric or “White,” add important elements to science that are currently lacking. For example, Boaz thought it was important to acknowledge evidence is important, but evidence is varied and dynamic, especially when explaining things we cannot currently explain. In a reflection, Boaz argued Sheth (2019), an author who we read in class, was overly critical of science teachers who were trying to be anti-racist. Boaz argued while he understood presenting “token” diversity is problematic, he also believed having conversations

about scientists of Color in science classrooms was an important first step in anti-racist science teaching. Boaz said he wouldn't simply show scientists of Color, he would have conversations about how those scientists got to where they are today including how they dealt with racism. Finally, he spoke at length about AST being, "not racist" because it does not, "challenge the way science is supported by whiteness and directly meet it and have conversations when it's clearly seen in the classroom." Boaz was critical of the fact that AST disregards the ways whiteness has affected science and science education as structures in society. For Boaz, AST was excellent at, "not discriminating as to what counts as science," but lacked a way to address power dynamics. To fix this, Boaz suggested a principle be added to AST that explicitly required discussions of power, specifically around white supremacy. He thought Sheth's (2019) ideas could be a good start.

With about a month left in the semester, Boaz was fully expressing self-advocacy and self-agency (Matias & Mackey, 2016). By self-advocacy and self-agency, I am referring to interns critically and honestly theorizing about society, in particular, whiteness and anti-racism. Boaz does this by asking tough questions and attempting to answer them for himself. For example, he questioned if him acting in alignment with his cultural practices, such as language, is white supremacist. He decided he can talk and act how he wants, but those actions are embedded in larger systems and historical contexts. Additionally, he pointed out how white supremacy is relational. He showed this by explaining he can act and do what he considers his "norm," but what he does in the presence of those who he knows are "Others" is what matters in terms of anti-racism. Boaz also started to critique, from the perspective of anti-racism, pedagogies intended to center equity. For example, Boaz built on the argument that presenting scientists of Color can be a hindrance to justice by elaborating on how he would present scientists of Color to his future class to ensure students receive the full understanding of their lives rather than simplistic descriptions that leave out any complexities. He was also able to see the positives of AST as well

as expand on it pedagogically by saying AST is excellent in terms of science, but does little to address power in classrooms.

Boaz was not alone in his new found agency. Kerry began to think about anti-racist discourse as “aspirational” or something that may not be entirely possible, but within that potential “cop-out” or defeated stance, Kerry made it clear the goal of anti-racism may not be to “void” whiteness. Instead, Kerry thought society should strive for talk that is, “not devoid of emotion or avoiding conflict.” Describing the role of anti-racist practices in a classroom, Kerry believed, “the key is providing the safe space for students and others to talk openly about their points of view and bring parts of their own lives to the classroom.” Liz, in her self-ethnography, dissected messages around race she received as a child and how she would act as a science teacher. Liz outlined how she was frequently given messages that “racism is bad and everyone is equal.” Liz then says her former teachers knew racism, “was an issue so they promoted diversity, but it wasn’t completely effective.” Wondering how to fix this, Liz explained the common solution was to, “show them [students, particularly students of Color] a black role model.” Liz made it clear she believes that just showing scientists of Color is condescendingly telling students, “you can do it too.” Therefore, she suggested she will only show scientists of Color who contributed to their field in meaningful ways and she would, “rather send the message that if you go into science, you will be building off all these other people’s work who are from all over the world and have varying backgrounds.” Liz also had a conversation with me about the diversity posters around campus, believing they were condescending and tokenizing people of Color. In both examples, Kerry and Liz thought through their own lines of thought. While both expressed shame around their previous thinking about race due to their naivety, in fact, Liz stated “ignorance is bliss” when it comes to race, neither Kerry or Liz wanted to dwell on the shame. They also did not pity people of Color. Instead, they dissected society as best they knew how and

took a stance. They displayed the ability to engage in what they believed to be anti-racism rather than waiting for me, their instructor, or someone else to give them an “answer.”

For the interns, especially Boaz, they were now “grappling with racism” (Sheth, 2019, p. 19). Each intern, in their own way, was now desiring to work towards equity, knew ways white supremacy shaped the lives and experiences of themselves and their students, and they were engaged in doing work to confront white supremacy. Every SEJ project would deal with race even though the interns could have chosen any topic or theme. The interns all began to theorize about anti-racist teaching and the consequences of various pedagogical practices. They questioned taken-for-granted ideas and were candid with themselves and others about white supremacy. When they weren’t able or failed to be anti-racist, I am confident each of them at least desired to be and knew how to be as evidenced by their collective discourse.

Theorizing White identity

Boaz’s SEJ presentation was his final engagement with SCIED 411W. His presentation described and analyzed several conversations he had with me and other White men about race. He called it, “White Men Talking ‘bout Race.” In his presentation he described themes he noticed emerged from the conversations. At first, he critiqued the participants. He stated we all engaged in practices of power-evasion and maintaining whiteness through numerous discourse practices including changing the topic, asserting ignorance, silence, safe self-critique, affirming sameness, joking, and focusing on barriers to multicultural education. He also noticed the words feel, people, Black, and White were most common. He was clear Black came up more than White and whiteness was rarely mentioned.

Central to Boaz’s presentation was what he called the “Pepper Story.” During this moment Boaz stated he would always have racist thoughts because of the structure of society, but

he is now more concerned with what he does after having a racist thought. He uses an example of riding the bus that same day with no other White people and thinking a person of Color smells unpleasant. Boaz is clear what he *thought* was a racist idea because he applied it to all people of that race, however, he said he now, rather than hold that thought, he interrogates it to understand why he thinks it and how he came to think it. In response, another participant said he believes we learn what we think from our past. This same participant goes on to describe how if you ever only went to a store and got green, “bland” peppers, you wouldn’t notice any other pepper and would “gravitate toward the green peppers.” They eventually said as you learn about different peppers you can “appreciate them for what they are,” but know they are still a pepper. Ultimately, this participant was arguing we can grow by thinking more about different peppers, or in other words, if we educate ourselves, as White people, about different races, we can solve racism.

In analyzing the narrative, Boaz asked, “What is my role as a White man in making the colored peppers?” He quickly picked up on how none of the White participants, with the exception of him and I, shared personal stories. The other participants instead opted for metaphorical abstract thinking as shown in the Pepper Story. He also noticed the White participants, other than him and I (again), only wanted to talk about policy or would describe being uncomfortable when experiencing new things. Boaz was clear to say for him, he realized his uncomfortability came from feeling superior and believed other participants struggled to acknowledge how power mattered in their interpersonal experiences. Boaz pushed on how participants worked to disconnect themselves from systemic oppression. Mainly, Boaz was critical of individuals who claimed to “have made it” by saying they educated themselves. He wondered what it means for White people to share stories about racism and show flaws in their practice of anti-racism. Moving forward he believed we, as White people, need to, “give ourselves some credit for actually actively participating in white supremacy and talk about it.” He

implicitly argued White people need to examine our history and how it matters in the present, for example, in our feelings of ownership over spaces and culture. Ending his presentation Boaz said,

I came into this class being apathetic to race and those sorts of issues because in college you are fed a very political view regardless of the left or right. Everyone has an agenda they want to push on you. This was the first classroom where I could have these conversations and transform. I was a person who didn't care and was apathetic but now care and on my way to being an advocate for social justice. I thought that there would be so much political divide and there was so little political divide. So, I am now wondering if there could be a new model for learning about social justice. I call it the apathy to advocate for social justice model.

Apathy to Advocate for Social Justice Model

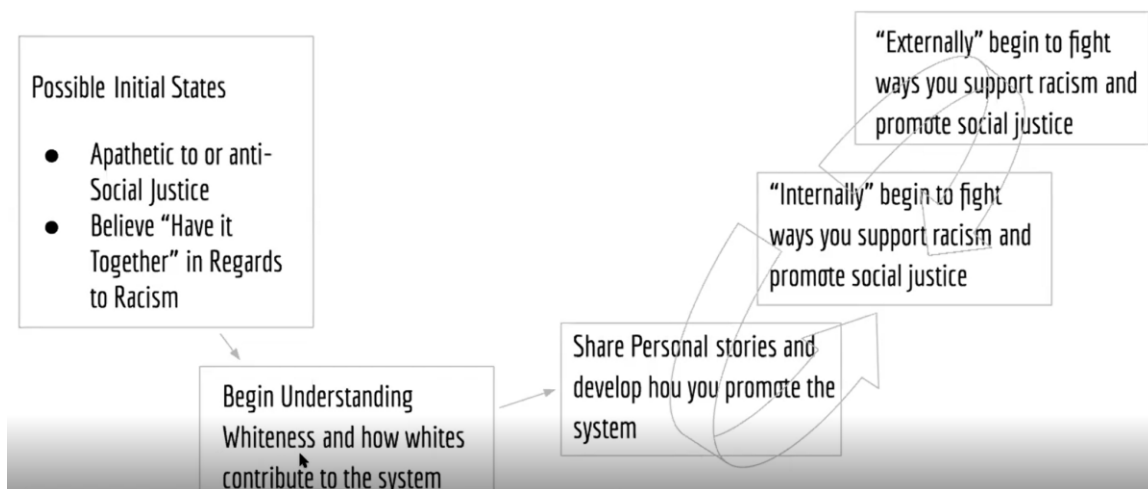


Figure 4-1: Boaz's White identity model.

As Boaz described his model, he argued the model is not linear, but is active, iterative, and grounded in his own experience. This is different from some models of white identity development (e.g. Helms, 1990). When he finished, Jeremy asked if Boaz thought a racist thought can ever “really” go away, but instead, rather than worry about the racist thought, it is how we

respond to the thought that matters. Boaz believed social justice is about impact and action rather than thoughts and morals. So, Boaz told Kerry he did not think racist thoughts went away, but it was how we chose to respond to those thoughts externally that mattered most in anti-racism.

Boaz was now an active participant in the conversation about anti-racism. He was certainly not perfect, but he would be the first to admit it. What Boaz's SEJ demonstrated is he no longer was burdened completely by white shame, in fact, he embraced it. He was willing to admit his shortcomings, but did not dwell on them. He was able to critically analyze White people too, theorizing how he feels White people can and do evolve in our critical consciousness to achieve a less impaired sense of self (Thandeka, 1999).

Boaz's peers also demonstrated self-advocacy and agency in their participation in anti-racism. Luna spent time dissecting her own talk and people's responses to her playing the "Race Game" described by Thandeka (1999). She found she struggled at first, and the struggle never went away. However, she became more adept at navigating the varied responses of apathy, confusion, intrigue, to outright hostility from others. Luna explained with her own mother, she felt the policing action of someone, who for her, is a White authority figure. Oliver engaged the "religious kids" in the class in conversations about religion, whiteness, and science. He intended these conversations to, "develop Christian community in a context where it's unexpected and to deepen understanding of how Christian principles prompt social justice, not impede it." Lester chose to create a "workbook" that contained racialized narratives from people he spoke to and surveyed. The workbook was designed to get readers to engage with different stories in a way that would hopefully prompt critical self-reflection. Other projects included works of art that were presented in galleries, having the class engage in activities designed to push our collective thinking, curricular units, and more. Each project was unique to the person who created it and each project was the culmination of a semester's worth of engagement with anti-racism as evidenced by the centering of race in each project. Future iterations of the class have decided to

write poetry, journal, create playlists, and more. While later iterations of the project have not been entirely focused on white supremacy, they are all built to resist systems of oppression.

A well-started White anti-racist science teacher

Coming into SCIED 412, Boaz quickly positioned himself as the person who grew the most in SCIED 411W, willing to be vulnerable and critical of himself, and working towards being an “external advocate for social justice.” He was starting to narrate himself as a White anti-racist teacher (Gee, 2005; Luehmann, 2007). One of the ways Boaz lived up to his willingness to be critical was when he explained he thought, progressive discourse (Bereiter, 1993), a concept introduced early in the Spring 2020 semester, had potential for whiteness in how teachers guide discussion and privilege certain ideas over others. He was vulnerable in that he still struggled with how to balance letting students “go down their own path” with making sure they “aren’t getting into the wrong information.” He recognized a tension in rigorous and responsive teaching (Braaten & Sheth, 2017; Windschitl, 2002). Yet, he was clear he thought it would be easy for a White teacher to consider White students’ data and ideas more valuable than a student of Color’s.

Boaz continued his questioning from his SEJ and continued to think more about structures than interpersonal relationships. During a discussion about Derrick Bell’s (1992) *Space Traders*, Boaz wondered how often the current system “uses Black folks for the benefit of White people.” He was also critical of the Christian community in a reflection pointing out that, “the church historically has not responded in the way to black brothers and sisters that Christ calls for us to.” Boaz focused on the policies advocated by some Christians. He mentioned the policies mirrored Nazi Germany and “preached a prosperity gospel” for only White America. He stated he did not want to be a part of such a church and believed the church needs to, “apologize for our past and change, actively showing how we are different from our ancestors.”

As Boaz was thinking about society more broadly, he was starting to put his vision for anti-racist science teaching into action. Planning a unit with his class about COVID-19, Boaz was adamant the unit needed to focus on social justice. He stated COVID-19 was disproportionately impacting poor communities and communities of Color, the same demographics as the students they would be teaching. He wanted to make sure the class did not have a, “random thrown-in lesson for the social justice piece. It should encompass the unit as a whole.” Boaz was describing their obligation as interns to consider the political and moral implications and needs of the unit. Yet, he wanted to ensure students received “the right” information. Although Boaz was concerned about balancing the social justice aspects with science, he wanted to do as much as possible to make the students of Color feel welcome and not just make the classroom a space where White teachers “speak down” to students of Color.

Other White interns also began to position themselves as being more anti-racist teachers coming out of SCIED 411W. For example, Lester spoke about his work with Upward Bound and having conversations with Anita and myself throughout the summer having helped him, “to understand and apply critical thinking towards teaching, communicating, and curriculum development.” Lester also said his work with Upward Bound over the summer helped him, “better understand AST, planning lessons, and anti-racist practices.” While Lester did not attribute his thinking purely to SCIED 411W, it is clear from his statements his prolonged engagement with the kinds of teaching and thinking articulated in SCIED 411W was informing his interactions in SCIED 412 as a more anti-racist educator. Also having prolonged practice and success with the kind of teaching I advocated for in his work with Upward Bound, Lester was more fully identifying as an anti-racist ambitious science teacher (Luehmann, 2007). Lester is an example showing how important having practice with anti-racist teaching is because he was still highly ambivalent, if not the most resistant, about AST and anti-racism at the end of SCIED 411W in my opinion. Frequently, in my memos, I would write about how I felt Lester was

“lying” and being “dishonest” with me in relation to his language and ideas regarding class material. However, in SCIED 412, Lester would begin to integrate his new thinking into his planning of the COVID-19 unit. He argued the end of the unit, which would focus on vaccines, could either embrace or resist white supremacy because of historic inequities surrounding medical care in the United States. While Lester was clear he wasn’t sure how to go about addressing the historic inequities, he knew it was important to and he was willing to try, even if his attempt might be wrong. It was Lester and Boaz who took up the most race candid lesson of the COVID-19 unit, choosing to focus on data that revealed the disproportionate impact COVID-19 was having in communities of Color versus White communities. The student group they engaged, I should note, contained a split of Latinx students and White students.

Both Lester and Boaz are examples of interns who were growing in their anti-racist identity as White science teachers. Boaz and Lester both, as did other interns, point towards their growth from SCIED 411W, through the summer, and entering SCIED 412. For context, the summer of 2020 was filled with protests around police violence against Black people, particularly in regards to the murders of George Floyd and Brianna Taylor. This prompted many of the interns to reach out to me personally over the summer, like Lester and Anita, to continue talking about racial justice. In many ways, SCIED 411W continued throughout the summer for most of the interns. Still, Boaz and Lester show that the interns were beginning to integrate anti-racist thinking, proactively, into their planning and teaching practice. For Boaz he was aware of the systemic injustices revolving around COVID-19 and did not want justice to be a one-off lesson. Lester was similar in that he was thinking about historic injustices in the medical field and wanted to find ways to incorporate that knowledge into the COVID-19 unit.

Beyond their developing anti-racist identities, the interns were learning to plan intellectually challenging tasks beyond what they did in SCIED 411W. In SCIED 411W, the interns planned two full lessons. One focused on eliciting students' ideas and the other focused on

supporting students' ongoing explanations based on a macroteaching model (Stroupe & Gotwals, 2017; Stroupe et al., 2021). Now, the interns were working together to plan an entire unit. While they had support from OpenSciEd units (<https://www.openscienced.org/covid-19-health-equity/>), they alone were responsible for planning lessons where students would explain a phenomenon, use data to construct models, and develop arguments with evidence (Kang, 2017). What the planning showed was many of the interns still struggled with seeing science as practice rather than content. However, by having the entire class collaborate on one unit, the instructional tasks, with the exception of one group, were focused on science as a practice as the students they were teaching worked to explain how to make decisions around COVID-19 to protect our community because the rest of the intern community could hold one another accountable.

Feeling solid as a White anti-racist science teacher

By the end of September, Boaz started attending virtual classes with a local middle school where he observed and assisted a mentor teacher who uses AST in their practice. Boaz still thought it would be “easier” to lecture at students, but he acknowledged how engaged students were and how lecturing would “take away” students’ agency. Still, he and his peers questioned using AST in future. Curious about this tension, I asked the group to reflect on whether their fear of using AST was rooted in whiteness. Boaz’s response was, yes. Boaz feared students not “meeting content” he was expected to cover in a system that privileged passing tests. He thought students not knowing things would get him fired. He struggled with this though because keeping the system supported the status quo and he did not want to hold a job and not be an advocate for change. Like the teacher described by Braaten & Sheth (2017), Boaz and many of his peers were caught in a tension between wanting to teach in a way they wanted and believed in versus what they knew and thought society and schools demanded. The goals, in the interns’ opinions, were at

odds. This trend would continue for the remainder of Boaz's and the other interns' time in the program.

As the semester progressed, Boaz began to think more about how whiteness and white supremacy exists in science classrooms. Reflecting on his virtual observations, he separated white supremacy and whiteness, saying, "I have not seen any outward, explicit white supremacy... I think I would rather look at how I see whiteness, and perhaps therefore white supremacy." In Boaz's analysis, he honed in on how science is presented. In his opinion, the science in the class he observed was, "very Eurocentric." He pointed out how each lesson took on a similar format and wondered if there is "whiteness in that." His opinion was if there was no freedom in how students explained phenomena, the class had whiteness. Boaz understood equitable teaching as "creating space" for students to share epistemic authority (Haverly et al., 2019) and use their epistemic agency (Miller et al., 2018; Stroupe, 2014). Moving beyond the science being taught, Boaz also mentioned four or five White boys participated most of the time. This gave him concerns for how the culture in the room was designed for these boys to succeed. He thought this reified the idea that White men succeed in science.

In his own COVID-19 lesson, Boaz hoped to not replicate what he was seeing in the middle school classroom he was observing. Instead, he hoped, by giving students space to ask their own questions, observe data that was explicitly racialized, and make comments about how to address the systemic racism the data demonstrated, he would be creating an anti-racist lesson. He hoped to not just be a White man telling students of Color these things, but wanted to center their stories, experiences, and ideas. He wanted to have a class where tasks framed science as practices (Kang, 2017) and he was integrating historical, political, and moral dimensions of science/teaching into his classroom (Morales-Doyle, 2017).

Right before he left to observe what would be his practicum site for several weeks (Boaz had a different practicum from the middle school classroom he was observing), Boaz reflected on

how he was thinking about facilitating conversations in classrooms. For science, he was beginning to stress having students engage in cross-talk (Windschitl, Thompson, & Braaten, 2018). In other words, Boaz wanted students to connect their ideas to their peers' ideas. To do this, he was starting to ask students questions that got them to respond to what their peers were thinking, for example, asking, "how do forces interact and cause temperature changes?" to students who are arguing that forces and temperature changes cause a tanker car to implode. Again, going beyond science, Boaz emphasized talking about race is also important and he believed people need to understand themselves. Telling a story about a friend who was upset that a guest pastor, in their words, "was glorifying criminals," Boaz described asking them about their feelings and to share a personal story that explained their feelings in regards to their statement. He then said that he asked questions to have them "unwrap their personal narrative" about how they came to be their identity and how that relates to others.

What is important to note about Boaz's thinking at this point is how core practices are mediating his understanding of anti-racist science teaching. In particular, Boaz is interested in getting students to engage in cross-talk, something called for in AST. He is also interested in expanding on what is called for in AST by saying that he wants students to understand themselves more fully and expand how students think about science beyond Eurocentric science. Through the example he shares about his friend, I assume he is interested in asking students about their emotions in order to get them to think about themselves more. He was, in a way, engaging in guided emotion participation (Vea, 2020) because he was targeting emotions, although I do not think he had specific emotions in mind, to make sense of their thinking. He was also integrating stories into this facilitation about race. Regardless, Boaz is leaning on core practices to navigate the situations he is encountering. The story with his friend shows how core practices are not decentering justice (Daniel & Varghese, 2019; Philip et al., 2019), but instead provided Boaz with ways to engage in anti-racist action both inside and outside the classroom.

Boaz also displayed a continued ambivalence that is impacting his own ideas of teaching. Boaz was able to articulate that his hesitancy to use AST is grounded in whiteness. In his articulation, he described fear. Primarily these are fears of being removed from the science teaching community because he fails in having students learn what he is mandated to teach them by standards, etc. This moment displays how ambivalence remains even though Boaz is currently adamant in his desire to teach in anti-racist ways. It shows how Boaz realizes the risks he will take if he is to embrace new forms of teaching (Luehmann, 2007). This also shows how practices of whiteness, primarily white racial abuse (Thandeka, 1999), works to shape what teachers do. Boaz *still* fears losing his community, but this time, it is a science teaching community rather than explicitly being about race. By scapegoating AST as not being anti-racist enough or able to help students pass exams, this may be Boaz's attempts to feel solid in his more traditional teacher identity by embracing stereotypes of more progressive teaching strategies (Ellison, 1995). In this way, Boaz's ambivalence is a representation of his fears drawn from white shame (Thandeka, 1999). With this said, Boaz recognized his fears as being rooted specifically in whiteness rather than some other ideology.

Boaz was again not unique. Many of the other interns were both critiquing AST and using it as a way to think about anti-racist teaching. For example, when analyzing an observation of a middle school classroom, Lester highlights one way that AST may fail to be anti-racist. Describing a conversation where students were asked to think about the relationship between energy and sound based on a demonstration, Lester thought the facilitated conversation "neglected the students' ideas on elasticity (returning to shape)." What Lester was left wondering was how to balance validating students' ideas with moving towards a goal, again highlighting the perceived tension between anti-racist teaching and doing what the interns felt was expected (Braaten & Sheth, 2017; Windschitl, 2002). He saw a contradiction in AST where teachers were required to validate student thinking, but were also supposed to achieve a goal. By using AST as

a pedagogical model, it was extending Lester's thinking around anti-racism because he was able to notice particular teacher discourse moves and think about the consequences of those moves. In this case, Lester was thinking about revoicing and its role in affirming student thinking and how to balance revoicing with questions designed to get at a particular goal. T.J. was another example. In a reflection during early October, T.J. said he struggled to notice white supremacy in observations in classrooms using AST because, "AST has more equitable elements." However, he did say there is still room for historically marginalized students to, "feel they can't speak up and do not feel like they have a share in forming the claims and explanations in the class discussions." To navigate this, T.J. said they learned talk moves need to be employed in a way that seeks to be anti-racist. For T.J., it is not the discourse moves that are anti-racist, but how they are used that make a classroom anti-racist.

Across the board, the interns still expressed ambivalence in the form of fear. During one particular class, I noticed the class was expressing doubt in AST as a pedagogical model. During the lesson, I again asked the class if their fear of AST was rooted in white supremacy. After having the interns write a reflection on the question, I asked them to share what they wrote. Luna shared first. To summarize what Luna said, she was struggling with doing something different and balancing believing in doing something right, but feared pushing back on a system that made her "feel elite and smart." Luna feared losing status by changing the system in her own classroom. Following Luna, Liz shared. At one point Liz said for her, "It is easier to accept something that is safe and wrong than something that is questionable and true in general." Other interns shared themes about wanting to be successful and believing resisting white supremacy would be a quick way not to succeed. In short, they still did not want to get fired in their future jobs. So, while the interns were expressing a desire to teach in anti-racist ways, they feared doing so, creating some resistance to AST, which across the board, the interns agreed was "not racist" rather than "anti-racist."

Good science teaching is anti-racist

In Boaz's field placement (not at the middle school), he described being bored and witnessing a classroom that was "not AST." Focusing more on homework and note taking, Boaz described a classroom focused on science as content (Kang, 2017). Boaz stated the week was "pretty long and somewhat exhausting." He also explained watching the class, "pushes me to not want to teach in this style at all. In fact, in my first lesson I am somewhat breaking the mold and using videos and real-world examples that I hope the kids will enjoy." He still believed AST is difficult to employ and is not convinced students can learn everything they need to know using AST, but he wanted to, "use a lot of its principles."

During his second week in practicum, Boaz began to think about what he would do differently than his mentor. For example, Boaz thought he would rather have students talk through their homework rather than tell them if they are right or wrong. He also wondered what would happen if students in his AP Physics class were put in teams to discuss their thinking about concepts presented in class. In his lessons, he described having students think about situations involving Rickey Henderson and Evel Knevel as well as analyze and graph data they used to explain the relationship between force and distance. He was surprised by, "how AST can empower students to participate because they feel their ideas are valuable (which they are) through the culture I create in the classroom and in turn want to participate." Boaz was now showing his new stance on teaching and engaging in a critical discourse about it (Stroupe et al., 2021). He was embracing AST more and more.

As the class began to move to hybrid, with some students in-person and some remote, Boaz became more interested in his mentor's class. Boaz commented over and over how much more students are speaking. The students talking more completely eliminated his critiques of his mentor that were previously littered throughout his observation notes. With this said, he is

increasingly concerned that a student who is legally blind is not getting enough support and notices it is usually the boys who participate, two things he eventually asks his mentor about. He wanted to provide other ways of participating. They address both issues, altering how class is run by checking with special education teachers and implementing new practices around how they call on students by randomizing and incentivizing it more.

After his final week in practicum, Boaz was beginning to think about how he would teach the following semester. Explaining that, “Equity is giving every student what they need to succeed in the classroom and justice is righting the wrongs that have caused injustice and oppression in the classroom,” Boaz wanted to create more space for students to participate and elicit their ideas more directly. He also said lecturing was “not equitable” because students do not have a chance to contribute their ideas. Boaz was maintaining a vision of science education that embraced epistemic agency (Miller et al., 2018; Stroupe, 2014) and student funds of knowledge (Moll et al., 1993). He didn’t want to force quiet students to share their ideas, however he thought students could share ideas in many ways, for example verbally, in a virtual chat thread, or on a virtual or physical white board. Boaz thought science should be accessible and responsive to student needs. He also planned on having an explicit conversation with his classes about the participation of men and women in science to show them the inequitable ways the class was currently operating as well as integrating “other ways of knowing and thinking about science.” Boaz’s teaching was articulated as one that addressed whiteness in science (Le & Matias, 2019; Mensah & Jackson, 2018) and was grounded in heterogeneity (Bang et al., 2010; Rosebery et al., 2010). Boaz was honest in that he thought these things would contribute to equity but not justice in the classroom; he was not sure how to address justice, yet he did believe providing access to as many students as possible was a part of justice in teaching. This statement mirrors other studies of preservice teachers learning about social-justice pedagogies (Morales-Doyle, Varelas, Segura, & Bernal-Munera, 2021).

At the end of SCIED 412, Boaz took stock of his experiences over the past year. As he moved into his student teaching, Boaz described becoming more anti-racist because he was put in a situation he was not silenced in or belittled. He had chances to take on multiple, complex identities throughout the course (Philip & Benin, 2014). He realized doing self-work led to external changes in his actions, most specifically he stated he was beginning to reevaluate his political beliefs and wanted to talk more about race. He was further rewriting his identity as a teacher *and* a person in general (Luehmann, 2007). Leaning on the relationship between fear and whiteness, Boaz told a story about staying in an Airbnb in a predominantly Black neighborhood in Newark, NJ. Explaining how he feared the Black community members dancing and talking outside the house only to find they paid him no mind and were, obviously, harmless, Boaz tied this moment to how he has always been taught to fear Black people. He then argued he believes White people, “point to crime rates, we lock our doors when entering urban areas, we even create schools separating us from them. This is rooted in whiteness and fear. This plays out in interpersonal ways. I feared exiting my vehicle; what if I were mugged?” Ending his final reflection, Boaz said,

...the ways I think about science teaching are much different than the vision of good teaching I arrived with. While I always wanted a classroom full of relationships, my thoughts on what science is and what is important for students to know have changed. Science is more than just a Eurocentric practice taught in schools. It’s more than vocabulary and memorization. It’s about learning and explaining the world around you using a set of authentic practices. I want to now have a classroom that focuses on really being able to explain science using different ways of knowing blended together. I also realized that one must be an advocate for social justice as a human, even more important as being an adult figure and possibly a role model in the kids’ lives that you are teaching. Good

teaching isn't just achieving standards and having good relationships with kids. It's accomplishing that within an anti-racist model, multiple ways of knowing and explaining what science actually is and applying it and the strategies used to learn about it to the real world and future.

Sliding backwards, but not really

While Boaz showed significant promise moving into his field placement, what actually transpired was much different. Opening one lesson, Boaz said, "I am thinking today that we will go over the homework, do the notes, and then we will do the lab if there is time." Boaz then opened his slide show which was stored on Peardeck, a software that allows teachers to embed different activities as well as control what students are seeing and when. Boaz then proceeded to have students ask questions and provide answers to the homework that was assigned the day before for almost 30 minutes. After the homework review, Boaz had students answer theoretical questions. Most of Boaz's questions were intended to make sure students were saying the correct thing rather than the pressing and probing questions he displayed throughout SCIED 411W and 412. The last thing Boaz had students do was take notes. Throughout the entirety of the lesson, Boaz's mentor teacher kept cutting him off to explain content about the problems or restate what Boaz had explained during his lecture. Boaz's lesson was framing science as content (Kang, 2017) and did not hold any of the features he articulated he wanted his teaching to be previously.

This trend continued throughout Boaz's field experience I witnessed. Boaz would have students go over homework for the first third of class, have students talk about theoretical questions or share about a larger project they were working on at home, and then he would lecture. For example, in one lesson, after going over homework, students shared about instruments they were creating to display an understanding of waves. Unfortunately, students

only shared what they did and played a song on their instrument. In fact, the activity seemed to be a long term homework project rather than a fully integrated part of the curriculum. However, wanting students to do something “interesting” Boaz pushed his mentor to include the project in the curriculum. Regardless, the core of what Boaz engaged his students in was homework review and lecture notes.

In conversations with Boaz after each lesson I watched, I inquired into the change in his pedagogy and challenged him to try to return to some of what we spoke about during his time in SCIED 411W and 412. Boaz agreed he wanted to do more “AST-type stuff.” In fact, he talked about a lesson where he had students make observations and claims about a pendulum in order to understand forces. He likened what he did to a “Native sciences” approach (Bang & Medin, 2010). Not seeing the lesson, I cannot speak to if this is true or not, however his statement does indicate Boaz wanted to extend his pedagogy in creative and potentially equitable ways. This ambition is further amplified by how Boaz spoke at length about wanting to find places to have students embrace, “other ways of knowing” and to “question their thinking.” However, Boaz said his mentor had a particular vision of what science class should be and it did not align with what Boaz wanted to do. Boaz was struggling with a political dilemma of how to navigate the power structures of teaching (Windschitl, 2002). In truth, he was living the fears he and his peers described about their fears of AST; the pedagogy was too “radical” and would cause them to get into trouble (i.e. fired).

Boaz was being policed by his mentor (Thandeka, 1999) because any time Boaz would deviate from a script of close ended questions, his mentor would jump in to take over the lesson. For example, when going over a homework problem, Boaz asked a student if they would share their thinking on how they solved the “conceptual question.” The student explained. Boaz then followed by asking members of the class to, “share what they thought. What did they agree with? Disagree with?” At this moment, Boaz’s mentor jumped in to explain their thinking, then told the

class they were ready to “move on.” I refer to this as policing because in Boaz’s placement, white zones were traditional teaching methods, methods that are proven to marginalize students, especially students who are already marginalized in science. Boaz was invoking a nonwhite zone by enacting a pedagogy that was more equitable. This connects to McCausland’s (2020) findings in which teaching assistants would engage in closely patrolling the borders between white and nonwhite zones in the science labs they taught through pedagogical practices of control, rooted in notions of science and science education that are antiquated and grounded in white supremacy.

Boaz did say he was learning a lot from his mentor. For example, Boaz described learning a lot about work life balance as a teacher. Boaz said, “I am really struggling with balancing life with work so I try to get through it and throw in something different once a unit.” For me, this indicates a way that Boaz was learning anti-racist teaching from his mentor. Boaz was learning the value of protecting himself, of taking time for himself to recoup and recover. During one conversation after he graduated, Boaz said he knows he won’t be able to be the anti-racist teacher he wants to be if he doesn’t take time for himself to reflect and center himself. He said he learned from his mentor that enjoying life is just as important as your teaching because you can’t give “everything” to your students if you don’t enjoy your life too.

Boaz may have struggled to teach the way he wanted, but he did manage to change some of his mentor’s teaching practice. Boaz described how his mentor wanted to incorporate more questioning and less lecture during homework reviews. Boaz also mentioned that his mentor planned on using the questioning practices within Peardeck in the future to give students an opportunity to think through their ideas. By the end of his field experience, Boaz was excited to be finished, but also thought he had found his vision of what he thought good science teaching was, saying, “I think I want to do a lot of AST and sometimes, I think I will just need to tell students information. Both strategies are useful in different ways.” Boaz was describing a vision of teaching that was not necessarily ideal in relation to reform efforts or potentially anti-racism in

science education, but he was describing a vision of teaching that was dynamic, contextual, and worked for him and his students in his opinion.

As Boaz began searching for a teaching position, he wanted to be able to continue to grow. During a final meal with me before he graduated, Boaz said he did not want to work in an all-White school. He spoke about his time tutoring emergent multilingual students at a school for the past year, how interesting he thought planning his lesson for the Upward Bound students was, and that he knew he had a lot of work to do personally. Boaz had been struggling with his new perspective on the world, stating at one point in December of 2020, “It would be easier to just not be aware or think about this stuff. I find myself wanting to go back. I keep feeling tension with my family because we just don’t see the world the same way any more and they don’t get it.” Now though, Boaz was clear in his commitment to being anti-racist. In the end, Boaz found himself moving far from home to take a job in a school that was interested in revamping their curriculum to align more with the NGSS using AST as a pedagogical model. Given the choice between two schools, Boaz chose the more diverse school that would let him teach how he wanted to, a mix of lecture and AST, but also centering the voices of students, especially those from marginalized backgrounds.

For Boaz’s peers, they too had moments of “backsliding.” For the most part this was the result of entering field placements that did not embrace AST, let alone anti-racist teaching. In one class, I watched a White mentor teacher berate kids online for not having their cameras on, insinuating they would get lower grades because of their cameras being turned off. Liz was the intern in the class. She stayed silent through most of the exchanges, but also parroted the “benefit” of having cameras on. After the class we spoke about the interactions. Liz was upset and felt her mentor’s interactions hindered her own ability to build relationships with her students. Liz also managed to do small things to build relationships with students. Liz tried to joke with students, provided different suggestions for how to engage with the material they were

working on, and created an entirely separate virtual room for students to come talk with her one on one in. Some students, especially those online, opted to come visit her instead of asking the mentor teacher for help. So, while I noticed Liz use very traditional teaching and engage in parroting harmful comments from her mentor, I also saw her resisting her mentor's practice in subtle ways. For Lester, he was enthusiastic to teach with his mentor and use a more traditional style of science teaching. However, even in his pedagogy, he asked open-ended questions, positioned girls as knowers by asking them more questions than the boys, and he did his best to celebrate "Women in Science Day." This highlights that even if Lester enthusiastically embraced more traditional science teaching, he still maintained discourse practices from AST and ideas, although shallow, from learning about anti-racist teaching. I surmise interns backslide because their placements were not fully aligned with their teacher education experience, a common problem in teacher education (Kennedy, 1999). However, as the interns navigated teaching, they relied on core practices they learned and *practiced* to respond to the, "constant in-the-moment decision making that the profession requires" (McDonald et al., 2013). As a result, the interns having engaged in approximations of practice and actual teaching practice throughout their teacher education course supported them in fully adopting specific teaching practices that they could not "get rid of" even if their placement did not support them in using AST or anti-racist teaching.

Other interns found ways to push back on their traditional mentor teachers as well. Luna incorporated a whole unit that drew upon AST in a class her mentor wasn't particularly concerned about and, in the words of Luna, "didn't always give the best education to." Luna wanted to change this dynamic. Jordyn, frustrated by her mentor's insistence on lecture, found ways to have students explain models and answer questions verbally, in the chat box, and separately in journals. This small practice showed that Jordyn, while teaching in a very traditional way, was trying to find ways to resist what was typical in her class. Erin was similar to Jordyn.

However, throughout her lecture-style class found moments to ask students meaningful questions. In one exchange, a student told Erin they were confused. What followed was a sequence of questions designed to scaffold their thinking. In our debrief sessions, Erin and the rest of the interns were frequently asking for new ways to teach in the ways they wanted to. They wanted to know how to be deviant and navigate the complex politics of teaching.

With interns who were placed in classrooms that did use AST. They grew in their ability to teach using AST exponentially. In one class, I remarked that T.J. and Oliver did “exactly what I would have done” when facilitating a conversation about atomic structure. While these interns did improve the AST practices, they did not focus much on anti-racist teaching, something their mentors were not concerned with. With this said, the interns did contribute to building norms that could be thought of as anti-racist. They used “whip-arounds” to build classroom culture and help students learn about each other. The interns let students share in the chat and verbally. They created norms for small group work in break out rooms. One intern, King, even found ways to get a particularly rowdy group of White boys to calm down and allow more space for the girls in the room to speak. King also built such strong rapport with students that they affectionately used a nickname to refer to him and knowledge of this nickname spread throughout the school. King was, based on the interactions I saw, someone the students in his class looked up to. In truth, T.J.’s, Oliver’s, and King’s classrooms mirrored the kind of classroom advocates of Critical Ambitious Science Teaching describe (Thompson et al., 2021; Thompson et al., 2020).

Like Boaz, some of the interns chose to teach in schools that are diverse in a number of ways. Luna is now teaching in Philadelphia Public Schools, for example. Luna is also continuing her professional development by participating in a project focused on developing culturally relevant and sustaining science units alongside Boaz. Others went to their home districts. While I have no way of knowing now how they teach, I do know by the end of their time in Penn State’s secondary science program they were different teachers. Whether that means they are anti-racist,

I do not know, but from what I saw during their time in the program, I have a very strong idea they are at least well-started anti-racist ambitious science teachers. The rest is up to them.

Chapter 5

Possibilities in (White) anti-racism

I presented this study as a narrative of engagement centering the learning trajectory of Boaz, a White man learning to be a secondary science teacher. The purpose of centering Boaz was to present an in-depth case study of a White secondary science intern's learning that could support answering the questions of how White secondary science interns learn to be anti-racist educators and how critical whiteness pedagogy and practice-based teacher education combine to support the learning of secondary science interns. Boaz's journey was contextualized by integrating the learning of other White interns, my own thinking as an instructor for SCIED 411W and SCIED 412, and theory drawn from critical whiteness studies (CWS) and practice-based teacher education (PBTE). Throughout the narrative white shame (Thandeka, 1999) and ambivalence (Ellison, 1995) played a major role in the learning of Boaz and his peers. Additionally, by combining CWP and PBTE focused on AST, the interns had opportunities to take up a multitude of discourses in relation to anti-racist teaching by practicing both anti-racism and science teaching. This process was not linear, in fact, it was messy. On the whole, it raises possibilities and perhaps some tensions for preparing secondary science teachers to be anti-racist educators.

A brief recap

In Chapter One, I discussed the experiences that led me to this dissertation study through the use of racialized storytelling (Johnson, 2017) and highlighted the need for science education to begin to grapple with whiteness and white supremacy directly rather than focusing only on

racism. Racialized storytelling created an opportunity for me, as a White man studying whiteness, to demonstrate the stances I take towards white supremacy, whiteness, and science education (Chadderton, 2012; Foste, 2020). It was my attempt at revealing “where” I and science education live(d) (Gordon, 1997). In an effort to begin to imagine living elsewhere, this study asked how White secondary science interns learn to be anti-racist and how critical whiteness pedagogy and practice-based teacher education work together to support secondary science interns learning to be anti-racist educators.

Chapter Two focused on discussing a brief history of science and white supremacy, critical whiteness studies (CWS), critical whiteness pedagogy (CWP), and practice-based teacher education (PBTE). The purpose of Chapter Two was to first demonstrate the inextricable link between science and white supremacy historically. I also spent time outlining the literature around CWS, particularly CWP, and PBTE. The chapter ended with an argument that CWP and PBTE are both necessary to help teachers learn to be anti-racist educators.

This study was a part of a larger, five-year, design-based research project. This means the goals of this project are to contribute both to theory and practice. Chapter Three outlined how data was collected and analyzed to accomplish that goal. In short, a case study approach was used along with Jackson & Mazzei’s (2013) conceptualization of “plugging in” to produce a narrative of engagement (Rodriguez & Morrison, 2019) in order to tell a story about Boaz’s learning and the design as a whole. From there, Chapter Four told the story of Boaz’s learning and the design.

This final chapter will be a discussion of the narrative of engagement. While there is much I could discuss, I will focus this chapter on three major ideas. The first is learning to be a White anti-racist is messy and requires grappling, in a direct way, with white shame and white ambivalence. This grappling should be supported and happen in a community, but ultimately, must be taken on, personally, by White people. The second area of discussion will revolve around the relationship between traditional anti-racist/critically conscious/multicultural teacher education

and PBTE. I claim, based on this study, in order for teachers to shift their practice, they need elements from *both* forms of teacher education. Finally, I will discuss what I am calling critical whiteness practice-based teacher education.

Shame and ambivalence in anti-racist learning

Boaz and his peers dealt constantly with white shame and white ambivalence. At the beginning, Boaz and his peers displayed ambivalence in how they embraced and questioned the focus SCIED 411W took on race and white supremacy. They simultaneously wanted to be seen as and espoused valuing ideas connected to anti-racism, but they did not necessarily believe a course focused on science teaching should center anti-racism as much as SCIED 411W and SCIED 412 did. Boaz and the other interns shifted from this perspective, starting to embrace anti-racism more fully, but as Boaz's struggle with feeling like he was losing his White community or not being sure of the practicality of both AST and anti-racism all the time, still grappled with ambivalence. In terms of shame, Boaz and his peers struggled with their past experiences with race and white supremacy. Boaz did not like being positioned as a perpetrator and his peers overall had negative feelings towards past experiences with racism. By the end of their time at Penn State, Boaz and his peers still struggled with white shame, but were more willing to sit with it and move beyond it, taking more concrete stances towards anti-racism that were increasingly less ambivalent.

The White interns' experience of white shame and ambivalence throughout their time in Penn State's secondary science program was not a surprise. Prior research has demonstrated that shame and ambivalence are central to how White people experience their racialized identities (Crowley, 2019; Ellison, 1995; Lensmire, 2017b; Shim, 2019; Thandeka, 1999). In fact, Matias (2016) highlights a multitude of ways shame and other emotions matter in White identities and as

White people learn to teach. Throughout their learning the White interns in the 2020-2021 iteration were forced to grapple with their white shame and ambivalence.

What the narrative of engagement suggests is white shame and ambivalence may not be able to be “overcome” by White people. In other words, White people who have been raised in a white supremacist society may always experience white shame and ambivalence. This study shows this in a number of ways, for one, Boaz and his peers still experience shame and ambivalence after grappling with these emotions for over a year. I am aware this data is limited and a more longitudinal study may glean different results. However, leaning on my participation in the iteration as the instructor, at multiple points, I indicate I *still* experience white shame and ambivalence. In my racialized stories in the introduction, I express/feel white shame and ambivalence. I have been seriously engaging with race, my White identity, and grappling with white shame and ambivalence for over ten years. White shame and ambivalence have yet to disappear for me. The same was true for the White interns upon their graduation in May of 2021.

This project suggests white shame and ambivalence are central to the racial storylines that expand or constrain anti-racist action for White people (Nasir et al., 2013). Throughout the data there are examples of how white shame and ambivalence informed the racialization of the White interns and their learning throughout the 2020-2021 iteration. For example, Boaz described being policed and scapegoated by “progressive liberals” (Ellison, 1995; Thandeka, 1999). These actions resulted in him feeling like a perpetrator and being ambivalent about participating in conversations about race and social justice. The racial storylines about his White conservative Christian identity closed off possibilities for him to take on an anti-racist identity. As Boaz participated in Penn State’s secondary science program, white shame and ambivalence were normalized and, therefore, he was able to take on the identity of a White conservative Christian anti-racist as he learned about anti-racism. For Anita, her ambivalence and shame caused her to push back constantly on the importance of race, constraining her anti-racist learning and action.

However, like Boaz, she was positioned as being able to maintain ambivalence and shame *and* be positioned as being anti-racist. This new racial storyline expanded her opportunities to take on an anti-racist identity. Ultimately, as Anita left SCIED 411W she saw value in the ideas presented in class and continued to meet with Lester and I throughout the summer as we discussed social justice related to Black Lives Matter and more.

By expanding racial storylines for White people in relation to anti-racism by including white shame and ambivalence, not as barriers to anti-racist action and learning, teacher education can create more opportunities for White interns to embrace justice-oriented teaching practices. There are many models describing how White people and White teachers develop in relation to race (e.g. Helms & Carter, 1990; Hill-Jackson, 2007). In their model for White pre-service teachers, Hill-Jackson (2007) describes three stages of development for White interns. The stages include unconscious, responsive, and conscious - critical consciousness. Without going into detail of each stage, teachers in the unconscious stage are positioned as not knowing much about white supremacy while teachers in the conscious stage are, “aware of white privilege” (Hill-Jackson, 2007, p. 31). Although Hill-Jackson (2007) agrees teachers may move around between stages, what their model and others (e.g. Helms, 1990) indicate is there is a “right” and “wrong” way to be an anti-racist White person or educator. This has implications for White people’s experiences with white shame and ambivalence because white shame exists to tell White people what is “right” and “wrong” as a White person (Crowely, 2019; McCausland, 2020) and white ambivalence is the articulation of the struggle between what White people *want* to be and *believe* we are and the fact that there are consequences, potentially negative, if we give into those feelings. By articulating what White people and teachers are “supposed” to be, we limit the possible journeys and identities White people can take up in relation to anti-racism because we send the message if White people do not meet a certain criterion, we don’t “belong.” By expanding racial storylines for White people, we tell White people we can add to identity rather

than take away or limit our White identities. In this way, expanding racial storylines provides White people the opportunity to take on an anti-racist identity.

Every person wants to belong to a community and White people are no different. The power of the white racial abuse resulting in white shame in White communities is that White children realize they will not belong or be exiled from their White community if they enter nonwhite zones (Thandeka, 1999). Ultimately, this results in a deep ambivalence where White people scapegoat people of Color to justify our White identities (Ellison, 1995). Even when White people manage to enter anti-racist spaces, nonwhite spaces, we can scapegoat other White people to signal our belonging (Lensmire, 2017a). By narrowing racial storylines of White people to linear models of development or not including shame or ambivalence as central factors in White identities, White people are told we will not belong if we are not aligned or feel white shame and ambivalence. This can only work to limit anti-racist action for White people because we need to belong somewhere. We cannot expect White people, or any person, to give up parts of their identity or expect White people to give up their community *before* they belong in another community. To be fair, I do not believe it is ever appropriate to tell someone they should leave their community, let alone when. Regardless, if White people cannot belong in anti-racist or nonwhite zones because we do not fit a criteria or we cannot feel white shame and/or ambivalence around race, we will only have the white shame and ambivalence reinforced and remain in our white zones maintaining status quo. Maintaining whiteness and white supremacy.

Philip and Benin (2014) argue teacher education programs mediate the identities teachers can take up in relation to race. For White teachers, they describe teachers who are allies and committed to learning, allies committed to working with other people committed to social justice, and teachers who did not consider race relevant. Throughout this study, White interns took up numerous identities in relation to anti-racism and teaching. So many in fact, I do not think I could articulate them all, and by the end, none of the interns saw themselves as being fully anti-racist.

However, I believe they were acting in ways I would consider to be anti-racist. At the same time, white shame and ambivalence were constantly present. Ambivalent White identities and White identities grounded in white shame were available to the White interns in this study.

Creating space for white shame and white ambivalence in the identities of the White interns provided opportunities for anti-racist action and learning. Rather than dissuade or limit the White interns from expressing shame and ambivalence, I encouraged it pedagogically. For example, I praised Boaz, Anita, Erin, Liz, Lester, and others each time they questioned the pedagogy in class and when they critiqued ideas I and others would argue were aligned with anti-racist teaching. I did not view them as resisting, instead I viewed their ambivalence and shame as opportunities. I theorize White interns expressing shame and ambivalence were caught in a border space between a white and non-white zone (Thandeka, 1999). In this space, they were being forced to negotiate between entering a white zone or non-white zone. To give into their impaired sense of self or the ideals they claim to espouse (Ellison, 1995; Thandeka, 1999). In these moments, White interns were making our interactions, making the program, “*a site of hegemonic struggle among White people*” (Lensmire & Snaza, 2010). In other words, by expressing shame and ambivalence, White interns were pushing for an acknowledgement that race, and by extension White identity, is complicated and it should be treated as such. It was in moments of white shame and ambivalence within the border spaces of white and nonwhite zones the interns could grapple meaningfully with their White identity.

When white shame and ambivalence appeared in the White interns’ discourse, I argue they were taking up self-advocacy/agency (Matias & Mackey, 2016). Self-advocacy/agency is represented by White people being able to “feel the burden” of white supremacy and engage in practices that represent a humanizing education (Matias & Mackey, 2016). In other words, White interns are able to “be” anti-racist rather “do” anti-racism (Ladson-Billings, 2006). White shame and ambivalence are marked by the conflict the emotions mediate for white people. Thandeka

(1999) describes white shame as an internal civil war while Lensmire and Snaza (2010) point out ambivalence is the, “mediation of conflict” in the White self (p. 419). Knowing this, when the White interns were expressing white shame and ambivalence, they were negotiating between choosing to embrace white supremacy or not because anti-racism is fundamentally a choice (Kendi, 2019; Leonardo, 2002; 2004). The expression of white shame and ambivalence required the White interns to figure out their own stance, articulate their own confusions, and “play” with race in order to understand themselves, Others, and society in relation to white supremacy (Tanner, 2018c).

Navigating white shame and ambivalence was crucial to the White interns having success with and seeing themselves as anti-racist. Having practice and success with any form of practice is crucial to the “repair work” articulated by Gee (2003) as cited by Luehmann (2007). The practice I describe is the practice of being confused and “playing” with race (Tanner, 2018c). If “being” anti-racist is positioned as White people working to understand society and themselves in relation to white supremacy and beyond, then any time a White intern was grappling with white shame and ambivalence, they were practicing anti-racism because often, white shame and ambivalence go unnoticed and unacknowledged given how ubiquitous they are in with and in White identities.

With this said, I argue white shame and ambivalence are central to the learning of White people in relation to race. In fact, white shame and white ambivalence are important conditions for learning and should be targets for learning around race for White people. White shame and white ambivalence act and acted as social practices for the white interns (Vea, 2020). White shame took the form of the interns struggling between white and non-white zones, attempting to police one another, and fearing losing their White communities for engaging in anti-racist actions. White ambivalence included the desires and longings of the White interns to be seen as and engage in anti-racist action while also not being sure if it was appropriate or fearing the

consequences of such actions. In this way, the class context created new emotional configurations for the White interns (Vea, 2020). Without creating moments for white shame and ambivalence to be revealed and having the interns grapple with those emotions as they were confused and “played” with race as a form of self-advocacy/agency in their self-ethnographies, discussions in class, and social/emotional justice projects, they may not have been able to be successful and take on more complex identities in relation to white supremacy and anti-racism.

White shame and ambivalence form part of the emotional configurations for White people as we participate in white supremacist contexts. The White interns never left a white supremacist context given Penn State’s location in the United States, a country’s whose history is riddled with white supremacy, coloniality, and other systemic oppressions. Therefore, the White interns were constantly confronted with having to navigate emotions of shame and ambivalence around race. This means that what shame and ambivalence will always, probably, be a part of White identity and needs to be addressed by anti-racist educators if we are to prepare White people to take on anti-racist action or be anti-racist teachers. Rather than force White people to be something we are not, we instead need to expand the racial storylines to include white shame and ambivalence with anti-racism because those two emotions, those two practices, shape how we feel, make sense of, and engage in practice as White people.

Critical whiteness pedagogy and practice-based teacher education

Typically, PBTE exists outside of the traditional education teachers get around what is commonly referred to as diversity, equity, and inclusion. The debate around core practices, the teaching frameworks advocated by practice-based teacher educators, exemplifies this divide. Practice-based teacher educators claim teachers need to know how to enact complex forms of

practice and the only way for interns to learn these practices is engaging interns in the work of teachers through deconstructions, representation, and approximations of practice (Ball et al., 2009; Grossman et al., 2009). On the flip side, advocates of more “critical” approaches to education describe how PBTE may be decentering justice and instead centering whiteness and other oppressive ideologies and discourses (Daniels & Varghese, 2019; Philip, 2019; Philip et al., 2019). What the research says is PBTE is not always successful in supporting teachers in adopting equitable teaching practices (Braaten & Sheth, 2019; Kang & Zinger, 2019, Shah, 2020; Kavanagh et al., 2020) but it is still excruciatingly hard for the anti-racist/reform minded ideas advocated for in more traditional teacher education into K-12 classrooms (Knotts, 2016). This, to me, indicates neither perspective is the solution.

What the 2020-2021 iteration data suggests is both traditional “critical” teacher education and practice-based teacher education must work in tandem. Examples of this do exist. This is tangentially supported by the literature. For example, describing principled improvisation, Philip (2019) suggests by engaging in improvisation that is oriented towards justice in teaching provides interns with a space to learn both about teaching practice and power. The type of teaching described is not very different from what Stroupe et al. (2020) referred to as disciplined improvisation. The difference between the two articles is that Philip (2019) started with a focus on justice while Stroupe et al. (2020) focused on AST. However, both sets of authors contend that practice is important in the development of teachers, they simply disagree if practices should be articulated before teachers enter a context. The 2020-2021 iteration of the design implemented aspects from both camps because of the value in both perspectives, and, by the end of the interns’ engagement, many of the White interns displayed anti-racist teaching practices and espoused ideas that indicated them taking on a well-started White anti-racist ambitious science teacher identity.

Throughout the 2020-2021 iteration, AST served as a valuable foundation for the White interns' learning about anti-racism and anti-racist teaching. For example, the interns were most excited to learn about AST, not anti-racism at the start of the program. Eventually, as the interns practiced using AST practices in rehearsals and then with Upward Bound students in an online learning environment, they began to critique AST as being "not racist." This led to conversations about how to "make" AST anti-racist. For example, the interns engaged in conversations about how to choose a phenomenon for a unit that was culturally relevant. The interns pointed out that it was *how* they taught rather than *what* they taught that made a difference. Many of them, including Boaz, articulated other practices to add to AST, for example, asking students about their life histories and experiences. In this way, the interns were guided by AST, they were well-started beginners at using the practices, but in order to make AST anti-racist they improvised and extended the practices. In other words, they engaged in principled/disciplined improvisation (Philip, 2019; Stroupe et al., 2020). However, without having the interns engage with more traditional elements of social justice-oriented teacher education, they would have never brought up the concerns they did. For example, after reading Kendi's (2019) *How to be an anti-racist*, the interns took up the language of "anti-racist" and "not racist." Additionally, by engaging in conversations about white supremacy, the interns articulated whiteness was hindering their acceptance of AST as a teaching method.

In responding to the critiques of core practices and practice-based teacher education, Critical and Cultural approaches to Ambitious Science Teaching (C2AST; Thompson et al., 2021; 2020) suggests four principles or objectives. The principles are developing critical consciousness, learning about and prioritizing students' communities and cultures, designing for each students' participation, and challenging culture through social and restorative justice (Thompson et al., 2021). These principles are not unlike the goals described by Matias and Mackey (2016) of their course using CWP. In fact, many of the assignments suggested by both sets of authors are

assignments I had the interns engage in. For example, the social/emotional justice project mirrored the “taking the burden” assignment (Matias & Mackey, 2016) and I had the interns engage in a form of autobiographical writing in the form of the self-ethnography (Thompson et al., 2021). What was crucial to the assignments I provided were they were delivered as approximations of practice (Grossman et al., 2009). Each assignment was designed to support the interns’ learning social justice by engaging them in the work of someone trying to “be” an anti-racist teacher (Ladson-Billings, 2006). I had the interns *practice* social justice not just read and talk about it.

As the interns practiced social justice, they got better at it. Similar to their teaching, as they practiced, they began to take up the new practices they were engaged in (Luehmann, 2007). For example, after having a conversation about how White people do not often refer to ourselves as White, Luna decided to engage in a project where she would use “White” as an identifier in *all* situations; when talking to a cashier she said that she was picking something up for her “White mom.” Boaz was similar. He was learning that talking about emotions and sharing stories were central to learning about White identity and engaging in anti-racism. Boaz then designed a project around talking about race with other White men and noted the White participants’ reticence to share stories and emotions. As they entered their placements, even Lester, who was excited to be able to teach in more traditional ways integrated anti-racist themes, although superficial, into their classroom without realizing it by making a point to call on the women, for example. This shows that interns need opportunities to practice anti-racism by merging practice-based teacher education with more traditional notions of social justice teacher education. Teachers cannot just be told about justice, talk about equity, and be “filled” with new knowledge and awareness.

By practicing social justice and anti-racist teaching, the interns were able to embody what they imagined an anti-racist science teacher would be. In other words, by having time to talk, think, and practice being an anti-racist science teacher, the interns were able to actualize their

proleptic thinking about themselves and education (Gutiérrez, 2019). For example, at the beginning of SCIED 411W, the interns described what “good teaching” and “good science teaching” looked like. Good teaching was highly relational. Good science teaching was about content. This tension was a constant struggle throughout the 2020-2021 iteration, however, while always a struggle, the interns got opportunities to describe, imagine, and try out how to merge the relational aspects of teaching with the content driven parts of teaching. This culminated in the virtual unit where the interns delivered a unit where students were engaged in highly relational, justice-oriented conversations as they learned science. They brought their vision into reality. Had the design not included opportunities to talk about theory *and* give the interns a chance to practice their ideas, I do not believe they would have been able to do what they did when planning the COVID-19 unit. By integrating two “different” camps of teacher education, the interns were able to articulate and carry out their own perspective on what constituted good science teaching (Stroup et al., 2021).

Critical whiteness practice-based teacher education

CWP and PBTE work well together pedagogically. CWP is, in most respects, outside of the goal to help people learn social justice (although I am not convinced that is the goal of white privilege pedagogy, but I digress), the opposite of white privilege pedagogy. White privilege pedagogy is mostly about helping White people learn about and acknowledge their racialized privilege. In short, it is about telling White people information that is supposed to make them “better” White people. This view of learning is diametrically opposed to most PBTE courses because it is a cognitive rather than sociocultural framing of learning (Stroupe, Hammerness, & McDonald, 2020) because white privilege pedagogy is about giving White teachers knowledge. Additionally, white privilege pedagogy, reduces White people to a monolith, flattens the issue of

justice, creates resistance, and is ultimately not about action (Crowley & Smith, 2020; Lensmire et al., 2013). In other words, the framing on learning positions White people as deficit (Gray, McDonald, & Stroupe, 2020, Lensmire et al., 2013). In short, white privilege pedagogy is not about *practice*. CWP, on the other hand, is about engaging White people in action. Matias and Mackey (2016) describe the “sharing the burden” project. This project is proposed as CWP. During the “sharing the burden” project, White interns look up things they want to know on their own. This project reflects a form of pseudo-critical whiteness pedagogy, in my opinion, even as it is framed as being critical whiteness pedagogy. I use the word “pseudo” because as much as the project is having the interns engage in research to learn about race and white supremacy (a practice of anti-racism) the end goal is for the interns to get knowledge they did not have before. The interns are engaged in activity to be *told* things by someone else. This is not entirely unlike white privilege pedagogy in my opinion. Tanner (2018c) provides another example of CWP whereby high school students engaged in youth participatory action research and wrote an improvisational stage production about whiteness. This is an example of CWP because the students were given freedom to figure out their projects, engage in action, and were not “told” anything by anyone. Yes, they are given guidelines and provided community norms, but ultimately Tanner (2018c) does very little throughout the process other than present new ideas and activities and have the students make sense of them. Anything they feel, say, etc. is essentially inbounds as demonstrated by Tanner’s (2018c) reaction to a blatantly racist story read by a White student. CWP is about *practicing* to be anti-racist. Since CWP is about practice, it merges well with practice-based teacher education.

In addition to being focused on practice, CWP and PBTE are similar because they both position learners as knowers, include iterations, and feature improvisation. By positioning learners as knowers, I mean both pedagogical models do not focus on what teachers cannot do. Instead, they focus on what they can and will do. This is evident by Tanner (2017; 2018b)

permitting students to be confused and “play” with race. It is also evident when Stroupe, Hammerness, and McDonald (2020) state, “teaching is not natural, magical, nor is anyone ‘born to teach’” (p. 6). In both examples, learners are given grace and treated as who they are, learners. They are not supposed to automatically be anti-racist or be teachers. Additionally, when describing the learning within PBTE, there is often a cycle of inquiry (Hammerness, McDonald, Matsko, & Stroupe, 2020; McDonald, Kavanaugh, & Kazemi, 2013). In CWP this takes the form of students engaging in activity and then reflecting on it. For example, Jupp (2017) writes about how their process of figuring out difficult knowledge in relation to race was, “never finished, nor was it simple or linear” and described some moments of their learning as “acting out/working through on race, whiteness, power, and privilege” (p. 20). As an advocate for CWP, Jupp (2017) is describing learning about race as a cycle of inquiry. This is also how PBTE is described. For both CWP and PBTE, you engage in various activities and practices within real-world contexts, reflect on them, and then do it all again. This is also not dissimilar from what Philip (2019) proposed. It is in the iterations that both CWP and PBTE embrace improvisation because “what works” in one context may not in another. Teaching and learning about race and science require a person to constantly adapt, extend, constrict, and react.

The design I enacted embraced these ideas. First, I trusted my interns. I saw them as knowing *a lot* about race, whiteness, science, and teaching. I required them to answer their own questions and come back with answers. I believed in them. Additionally, as they returned with questions and answers and more questions and answers they engaged in activities. Nothing in the program is a “one-time” event. They wrote iterations of the self-ethnography, they engaged in multiple rehearsals, and they reflected on everything they did, constantly. Lastly, the projects and classroom activities were intended to be improvisational. For example, I gave almost no directions on the social/emotional justice project. It was up to the interns to develop, design, create, carry out, and report back on what they did. I also gave little direction for their rehearsals

and limited the scaffolding of the COVID-19 unit to items I knew they needed, for example, being told to write a gapless explanation. As a result, the interns got to practice being *successful* with teaching, anti-racism, and anti-racist teaching because all of the work they did was framed as them “constantly becoming” (Kumashiro, 2000) in order to see themselves as anti-racist educators (Luehmann, 2007).

CWP and PBTE also complement one another where the other lacks. CWP provides PBTE with a focus on equity, particularly white supremacy, and provides a language for social justice. PBTE frames a way to practice social justice and a foundation on which to build an anti-racist teaching practice. One of the problems with CWP and other justice-oriented teaching pedagogies is they are ill-defined. This makes sense. Many social justice pedagogies are highly contextual and rely on large, macro-level ideas. PBTE, while guided by ideas about equity, are about well defined, micro-level practices used in classrooms to achieve specific goals. In this way, PBTE provides the foundation on which to analyze and think about whiteness in teaching. For example, the interns critiqued AST for being “not racist” and made suggestions throughout the program on how to make it more “anti-racist.” On the flip side, PBTE allowed me, as the teacher educator, to think about CWP in terms of approximations, decompositions, and representations of practice. For example, I showed the interns different videos of teaching as a representation of practice to have them think about anti-racism and AST. I had them break down “anti-racist” teaching into discrete practices, and then they engaged in an approximation of practice by engaging in activities that social justice educators do, for example, the social/emotional justice project. In this way, PBTE guided how I thought about structuring my CWP because it forced me to think about what anti-racist educators “do” and how to “be” anti-racist. In this way, this study deviated from most PBTE literature that says interns do not get to practice being anti-racist educators outside of talking and focusing on planning (Kavanagh & Danielson, 2019; Kavanagh et al., 2019; Kang & Zinger, 2019).

I propose critical whiteness practice-based teacher education (CWPBTE) as “what could be” (Gordon, 1997/2008) in teacher education. The foundation for CWPBTE is the need for interns to successfully practice justice-oriented praxis and pedagogy. This can be accomplished by merging both CWP and PBTE. This could be profound for teacher education because it would support interns in enacting the theories that are typically taught in teacher education in practice.

Above describes some of the features of CWPBTE. These features include letting people, especially White people, be confused about race (Tanner, 2017), play with race (Tanner, 2018b), use their agency around race (Matias & Mackey, 2016). However, there is one feature that is unique to CWPBTE I do not believe exists within either CWP or PBTE. This unique feature is the development of low-high spaces for interns. Throughout the project, the White interns expressed white shame and white ambivalence. The White interns were raw and honest. Lester, who initially lied about his first memory of race, acknowledged his lie and grappled with the shame and ambivalence around his true memory. What occurred in the course at times was the honest, provocative, sometimes racist sharing by White people about race. What became privileged within SCIED 411W and 412 was the sharing of complicated stories, honest feelings, and critiques of care. This was aided, at times, by “white talk” because it allowed us as a community or in our interactions to understand one another (Max & Pennington, 2003). While what happened during the 2020-2021 iteration is different from the low-spaces described by Lensmire (Lensmire, 2011, 2014, 2017b) where incredibly provocative, bombastic, and racist sentiments were valued, the iteration is similar in that the White interns did not hold back. The White interns struggled openly with concepts being presented. In one class, several interns got into a heated argument over whether the story of Adam and Eve was “scientific” that reached the point of nearly screaming at one another. In other classes, interns were near tears due to their vulnerability. Penn State’s program was a space that was honest and occasionally the “quiet” stuff was said out loud, the space was also a place that was not “politically-correct,” the interns had

“leeway” to say what they thought, and the interns did not “shame” one another for what was said. The main difference is rather than participate in the low-space as a scapegoating ritual (Lensmire, 2011), the interns were creating a space that allowed them to learn. For example, Thandeka (1999) is clear White people fear losing their White community for entering nonwhite zones. The low-high space created was a form of “basement culture” (Lensmire, 2011; 2017b) that shielded the White interns from having to share with their White community their entrance into nonwhite zones so that they could “be braver” later (Lensmire, 2010). The low-high broke down the common binary between “good” White people and “bad” White people (Jupp & Slattery, 2010), replacing it with a space that did not value “good” or “bad” White people, it valued multiple identities, all of which were doing their best. In the low-high space, stories were not framed as confessions. Rather than be an end for anti-racist action, they served as beginnings. They were a form of reconciliation, or a way to come back into relation with oneself, our White communities, and the world more broadly. In many ways, the sharing took the form of racialized storytelling (Johnson, 2017) and even empowered the White interns (Max & Pennington, 2003). The White interns shared a story and made sense of it, they self-actualized as they critiqued whiteness and white supremacy. The White interns worked toward ideal versions of themselves even if they would never reach the destination (Gutiérrez, 2019). In no small way, the sharing of the story acknowledged the wounds and trauma white supremacy has created in and on theirs and Others’ bodies (Menakem, 2017; Staples, 2016). Telling stories helped the White interns heal and “become” someone else (Kumashiro, 2000; Luehmann, 2007). You see this with Boaz as he learned throughout the program. His thinking about the world, himself, and education shifted frequently as he shared about his life and made sense of it in relation to white supremacy. As the White interns learned, they moved out of the low-space where they practiced all manner of things and eventually entered “high-spaces” that valued political-correctness among other things. For example, Boaz is now teaching, using his version of AST in a mixed Latinx and White school. He

also began to critique his family's beliefs and tried out new pedagogies in his placement even though his mentor did not necessarily approve. All of this happened after he feared and was ambivalent towards the anti-racist component of the program.

Implications

This study has implications for design-based research, teacher education, science education, and critical whiteness studies. This dissertation highlights how White interns grapple, constantly with white shame and white ambivalence and that critical whiteness pedagogy and practice-based teacher education work together to create opportunities for interns to *practice* doing and therefore, “becoming” (Kumashiro, 2000; Ladson-Billings, 2006), anti-racist and anti-racist educators. As I show throughout the narrative of engagement, the interns, especially Boaz, had messy journeys to reach where they ended up.

Implications for design-based research

Imagination and prolepsis in design-based research

My dissertation was a design-based research project and was analyzed using storytelling. When constructing the project, I created conjecture maps (Sandoval, 2014). The conjecture maps were a way for me to specify my theoretical conjectures and design conjectures. In essence, the conjecture map was a way to explain how the learning environment I designed led to mediating processes that produced the outcomes I desired. Conjecture mapping helped me identify and test all the salient features of the learning environment so I could iterate on the design for the five-year project and contribute to theory and practice.

Conjecture mapping contributes to research that is deductive. In other words, by using conjecture mapping, design-based researchers begin with a premise or theory to guide their research. For example, when conjecture mapping, I articulated how particular embodiments would lead to specific mediating process which ultimately produce the outcome I desired. I then used methods to confirm or reject my hypothesis. Sandoval (2014) is clear in their writing about conjecture mapping that it is a way to make hypotheses about learning. I used it similarly.

One aspect of conjecture mapping that Sandoval (2014) does not mention extensively is how conjecture mapping can be a form of proleptic thinking (Gutiérrez, 2018, 2019). Conjecture mapping forms a grammar of inquiry for DBR (Sandoval, 2014). This means conjecture mapping allows for investigating designs in a rigorous way, but DBR is not *only* about studying learning in situ. It is about creating novel learning contexts (DBRC, 2003). Describing social-design experiments, Gutiérrez (2018) is clear that DBR must have a “future-oriented agenda” (p. 91). What they mean by this is DBR should transform the world for the better and the experiments, or iterations, should be to understand how the design can and does change the world. In this way, conjecture mapping provides a structured, yet improvisational and social dreaming space, where design-based researchers can think about what the world can and should be.

This is how I approached my project, and specifically, my conjecture mapping. Each of the learning environments I articulated were ideal environments I hoped would make the world better. By better I am referring to helping teachers become anti-racist in their teaching practice and overall praxis as humans. I wanted to *imagine* and then make *real* a learning environment different from those I had seen and experienced previously. I wanted to create a learning environment by combining practice-based teacher education and critical teacher education. I wanted the learning environment to be improvisational, practice-oriented, and allowed for people to take up a multitude of identities. I wanted a dynamic environment. My conjecture maps had all

of this emotion, thought, desire, and *imagination* baked into them. Conjecture mapping providing me an avenue to create what could be.

Imagination is something design-based researchers do not talk about often. When describing DBR, most scholars focus on contributing to theory and practice, constant iterations, and a commitment to examining learning in situ. Bannan-Ritland (2007) does attempt to meld the creativity of design with the standardization found in quantitative and qualitative methods in education, but even in their articulation of DBR, there is little attention paid to DBR as a process of imagination or prolepsis. Gutiérrez (2018) gets the closest to this stating prolepsis is, “an important design principle in the development of youths’ future selves and a future-oriented agenda” (p. 91) because for them, learning is about organizing possible futures (Gutiérrez, 2018). Although Gutiérrez (2018) supports using imagination and prolepsis in DBR, they do not fully describe why it is important to DBR.

By using conjecture mapping as a space for prolepsis and imagination, I was able to meld the past with the present and (re)imagine the future. By merging past with present, I am referring to leveraging the shortcomings of my past anti-racist learning and the failures of teacher education to fully address our collective failures in order to create a more racially just future. For example, I learned to *always* listen and do what people of Color told me, this, in part, led to me using the n-word, something I was uncomfortable doing but felt I had to do because it was encouraged by people of Color and I felt it signaled some kind of greater “belonging” for me in relation to communities of Color. Had I had a greater sense of self-advocacy/agency (Matias & Mackey, 2016), I probably would not have done what I did. Therefore, in my conjecture map, I imagined a future where White interns, White people, would be able to and feel comfortable taking stances in relation to race. Although the entirety of the past and present are not explicit throughout the conjecture map, the process of conjecture mapping itself oriented me towards the future so I could imagine it and make it a reality. With this said, I now believe using conjecture

mapping can also help articulate our assumptions about the past and current understanding of what is creating our present, extending the use of conjecture mapping beyond DBR and allowing it to guide research grounded in other methodologies.

Using conjecture mapping like I did further DBR's capacity to "be of use" (McKenzie, 2009). By "be of use" I am referring to design-based researcher's ability to, "push ourselves further, support each other better, in engaging individually and collectively in modes of research that intervene more centrally in the social and ecological challenges we face" (McKenzie, 2009, p. 218). Through designing, guided by a proleptic and imaginative use of conjecture mapping, for example, DBR holds the potential to speak truth to power, or dare I say, *design* against and for power. This call is not unlike calls of other scholars to design learning environments that center equity and justice (Bang, Faber, Gunneau, Marin, & Soto, 2016; Gutiérrez, 2018; McKinney de Royston & Sengupta-Irving, 2019). By adding imagination, explicitly, into the design process, we can imagine alternatives that address our current predicaments through social activity, like learning, in order to produce new, "social imaginaries" (McKenzie, 2008, p. 224).

Before moving on, I want to be clear using imagination in research is not new and it holds potential to unlocking new possible futures. For example, Khasnabish and Haiven (2012) state, "imagination has and continues to be mobilized by social theorists as a key to radical social change" (p. 411). They also argue radical imagination is something we do and do together because it is, "constantly in the dialogic process of reweaving itself in both explicit and subtle relation to those people, institutions, and forms of power that surround us" (Khasnabish & Haiven, 2012, p. 411). In this way we can call our imagined futures into being. One way I did this is through conjecture mapping (Sandoval, 2014). Beyond this point, imagination is important in all facets of research (Gabriel, 2015; Shaw, DeLyser, & Crang, 2015). Without imagination, we run the risk of reproducing research that is routinized and stale (Gabriel, 2015). Therefore, by embracing imagination as a means to create new futures and richer research, we as a DBR

community can, “show how things always exceed their concepts, and how the world is inevitably messier than our theories of it” (Shaw, DeLyser, & Crang, 2015). One way I suggest we can start doing using more imagination in DBR is by using conjecture mapping as a space to imagine.

Storytelling and design-based research

My dissertation was a storytelling dissertation. I view and understand this entire dissertation as one big story where I tell numerous, more obvious stories within. The reason I used storytelling so extensively is because stories create opportunities for discovery in relation to the past, present, and future (Johnson, 2017; Lewis, 2011). I used storytelling because more traditional methods like coding, failed me in displaying the complexity within the learning environment I created. The coding did not allow me to render the invisible aspects of the learning environment and what happened within in it visible, storytelling did (Gallagher, 2011).

Conjecture mapping explicitly requires researchers to break down learning environments into salient features to enable researching the learning environment created. It is a process of reduction as a means to articulate a holistic learning context. By having a learning context broken down into its constituent parts, researchers can be clearer about how learning happens and what learning is accomplishing. This is a good thing because learning can be taken for granted. Still, by breaking down a learning environment into its parts and hypothesizing how those parts are connected, researchers can engage in research that attempts to justify and confirm those connections. Again, this is not bad, it is, in fact, what conjecture mapping was designed to support (Sandoval, 2014).

What is one of conjecture mapping’s strengths, its explicit demand of articulating individual, salient features, may also be a potential pitfall. By reducing a learning environment to what is articulated, researchers may treat a designed learning environment in pieces. By this I

mean, researchers could look to understand the learning taking place in the designed environment as *only* consisting of the embodiments and mediating processes described. It may sound like I am making an old argument that DBR is creating a Hawthorn effect, but conjecture mapping's grounding in forcing researchers to hypothesize learning, allows researchers to show, how embodiments lead to mediating processes that create outcomes avoids a Hawthorn effect (Brown, 1992). Still, I cannot help but realize using conjecture mapping may cause researchers to miss what was not articulated, potentially simplifying the learning that is taking place in the designed environment.

This was my problem. When I engaged in coding, I only focused on what was visible in the discourse and actions of the interns and I. I was feeling and noticing other things, but those things did not fit neatly within my codes, codes that were generated based on my conjecture map. Thankfully I also had a code for "interesting." Anything that didn't fit one of my previous codes, went into the "interesting" code. Sure, I could have created more specific codes. I could have increased the grain size of the codes too. However, I was frustrated the coding was breaking down what I thought was a complex and nuanced space into neatly defined moments. Additionally, had I done this, I would have created a jumbled, incoherent matrix of words; this process probably would have been even more complicated than I bargained for and rendered the multitude of codes meaningless. While I have no way of knowing this, because I stopped coding, this is what I think would have happened. Regardless, had I adhered to coding, I know I would have broken the learning context down into small snippets, missing the overlapping, masked, and nuanced processes playing out. Rather than being messy (Farrant, 2014), I think my research would have been sloppy (Tanner, 2014).

Storytelling helped me show the learning environment in all its messy glory because it gave me a method to understand the people and events as always in transition, as a constant, unfolding process (Clandinin et al., 2007). Storytelling let me be political and explore a multitude

of connections in tandem (T. E. Barone, 1992). By using a method that allowed me to be messy (Farrant, 2014; Tanner, 2014), I was able to show the learning environment in totality without breaking it into salient parts as conjecture mapping requires (Sandoval, 2014).

Showing the learning environment as a whole, and not as salient parts, allowed me to show how embodiments produced to mediating processes that led to learning while showing how different embodiments were connected to one another, how mediating processes impacted one another, and how more than what I suggested as an outcome occurred. Storytelling was my avenue to describe more than what I thought initially. For example, I believed interns needed to engage in identity development to become anti-racist educators (Luehmann, 2007). What I did not realize is how important shame and ambivalence was in the process of practicing to be anti-racist. The same went for self-advocacy/agency (Matias & Mackey, 2016). I was not prepared or aware how central navigating, practicing, acting with shame and ambivalence would be to self-advocacy/agency. Storytelling as method gave me permission to move beyond what was said because often, the shame and ambivalence I described were things I *interpreted* or *felt* in what the interns said (Mazzei & Jackson, 2012). Conjecture mapping and coding failed to help me “represent” what happened.

Knowing what I know now, one suggestion I might offer those who engage in conjecture mapping and DBR more broadly, is to embrace telling more stories. For conjecture mapping, perhaps telling the story about why particular decisions were made in the map or telling a preliminary story of how the learning environment will be created or what will happen with students in the learning environment will enable us to begin to see the nuance within the design. For example, I used racialized storytelling (Johnson, 2017) to describe my position in this project and allude to why I decided to make the learning environment I did. Additionally, by using storytelling as method in DBR, we may be able to make learning more complicated because learning is complicated. If learning were easy, we would not have the myriad of camps and ideas

we do in education. By telling stories we can begin to admit that learning is complicated and dynamic. Stories can help us show, highlight, or experience the multitude of differences present in learning contexts without policing or repressing it (Lather, 2008). By using storytelling as method I think DBR can help us further understand the world because story is central to being human (T. Barone, 2007; Farrant, 2014; Lewis, 2011).

Implications for practice

Critical whiteness pedagogy

Critical whiteness pedagogy is a form of teaching grounded in supporting people, especially White people, in grappling with whiteness and white supremacy. Critical whiteness pedagogy places itself in opposition to white privilege pedagogy (Lensmire et al., 2013; Levine-Rasky, 2000a; Tanner, 2018c). The main features of critical whiteness pedagogy revolve around having people “play” (Miller & Tanner, 2019; Tanner, 2018b), be confused (Tanner, 2017), and take on the burden of race (Matias & Mackey, 2016). Critical whiteness also avoids the use of “race work” for White people consisting of confessionals and *only* acknowledging our privilege (Lensmire et al., 2013; Levine-Rasky, 2000a). This study extends what critical whiteness pedagogy can and should do to enable anti-racist action on the part of White people.

Throughout the story I told about Boaz and the other White interns, they said problematic things, racist things, and unintelligible things. As their instructor, I assumed they had perfectly thought-out reasons for stating such ideas, and rather than assume they did not know why they said what they said and seek to lecture at them, I choose to inquire deeper. Additionally, most of the statements I considered problematic, were couched in ambivalence. For example, they said things like “I’m not racist, but” (Bonilla-Silva, 2002). Again, rather than see these statements as

purely racist, I saw them as ambivalent. Taking a lesson from Lensmire and Snaza (2010), I positioned the White interns in terms of, “longing, terror, perplexity, shame, and magnanimity” (p. 421). In other words, as complicated.

By treating the White interns as complicated, I positioned the White interns as *experts* on their own White identities and race. Too often are White people positioned as “not knowing” or “ignorant” about their own identities and race. In fact, Mills (1997), Baldwin (1962), and others, believe that society is structured in a way that White people are, “unable to understand the world they themselves have made” (Mills, 1997, p. 12). For Mills (1997), this makes up an epistemology of ignorance. I am not here to disagree with Mills (1997), Baldwin (1962), or others who clearly demonstrate the shortcomings of White people in relation to race. We have a long way to go. However, as Thandeka (1999) teaches us, White people are taught to repress any thought or action in relation to race that goes against what Mills (1997) would describe as the racial contract. Taking Thandeka (1999) seriously, White people need the opportunity to break their conditioning and show what they do actually know. In truth, drawing upon students’ prior knowledge, treating their ideas as valuable, and positioning students as knowers are foundational to all asset-based and critical pedagogies. Therefore, we must extend the same grace and opportunity to White people when talking about race. This is part of critical whiteness pedagogy.

Teacher education is a site a site of hegemonic struggle among White people (Lensmire & Snaza, 2010). This means teacher education often, as I said previously, positions White people as being racist or anti-racist, usually in a strict binary, perhaps with good reason most of the time. Still, the resistance often pegged as racism on the part of the White people may also be them defending their self-respect because of bad and insulting pedagogy (Lensmire & Snaza, 2010). The hegemonic struggle also takes place as teacher educators force White interns to “be” a certain kind of White person. By positioning White people as experts, we as teacher educators can avoid enacting pedagogy we would abhor if our own interns enacted in classrooms with students. We

can avoid trying to enact a type of policing, similar to the kind Thandeka (1999) describes, albeit in opposite directions, in an effort to “make” a new, narrower version of White people because, I ask, who is that type of pedagogy for? Lensmire (2017a) might argue it is to signal belonging at the expense of other White people. Personally, I would agree with this sentiment.

When teacher educators enact a pedagogy positioning White people as experts on race, new possibilities and dangers emerge. Chief among the possibilities is anti-racism for White people is not constrained to the imaginations and opinions of the educator. For example, Boaz was able to be both a conservative Christian and anti-racist. Yes, contradictions existed for Boaz, at points, he was a hypocrite, but he was also able to justify his positions to himself and, I believe, constantly on a journey towards being increasingly more anti-racist. By positioning White people as experts, we also avoid enacting pedagogies of harm. In short, I was able to capitalize on the ideas the White interns shared that were valuable rather than worry about the ideas that weren't. Additionally, I could treat the ideas I did not find valuable from a stance of curiosity and wonder because I assumed the White intern had good reason for saying what they said. This allowed me to engage them in constant conversation rather than evoking the resistance that is all too commonly described when engaging White people around race, racism, and white supremacy. The dangers? Well, the most obvious one is White people may, in our arrogance, believe we have all the answers and our perspective on the world is the “right” one. However, I contest, as Kumashiro (2000) argues, all people, including White people, are always “becoming.” Therefore, by having White people participate in new experiences centered on “play,” be confusion, taking on the burden, and being experts on their own identity and race, we can use critical whiteness pedagogy to support White people in “becoming” something else. Too long have we defined “good” White people as merely consisting of acknowledging privilege, instead, we can start to let White people “become” the complicated, distorted, distinct, contradictory, insightful people we are in relation to race.

Teacher Education

Findings from my dissertation suggest teacher education needs to simultaneously embrace practice-based teacher education and critical forms of teacher education. Both are necessary to support teachers in being anti-racist educators. For example, critical teacher education provided the focus on power, white supremacy, and provided language for interns to adopt when talking about anti-racist teaching. Practice-based teacher education provided interns with chances to actually try and be anti-racist. The social and emotional justice project most clearly had both elements at play within it during the 2020-2021 iteration. In the social and emotional justice project, interns were required to *do* something in relation to justice. Therefore, the interns needed to draw upon what they learned in class to engage in a justice-oriented praxis outside of class. Completing the project required interns to combine features of practice-based teacher education and critical teacher education because the project was grounded in practice, focused on power, and was intended to have the interns create a more racially just world, even in small ways.

By combining practice-based teacher education with critical teacher education, teacher educators can and should focus more on what teachers do rather than what they know. By focusing on what teachers do, we as teacher educators and researchers can take the guesswork out of our jobs. For example, I *never* lectured about any content. The most I did was provide the interns, after much negotiation, a definition for white supremacy. I *never* told them about white privilege! For many courses focused on justice, this may sound like a radical notion. However, by focusing on what the interns did, I was able to meet them where they were at and treat them as experts, let them “play,” be confused, and take on the burden of race. These are requirements for critical whiteness pedagogy, which I argue, is practice-based. By focusing on what interns did, I was able to stay attuned to moments when they were actually taking on practices we were co-

constructing in class. I did not worry with whether they had “good” intentions, were “performing” for the class, or “knew” all the concepts we spoke about along the way “perfectly.” I didn’t worry because even in their resistance, in their hesitance, in their ambivalence, they took up various practices in different capacities. No matter how ambivalence the interns were, they continued to “become” anti-racist some way, even if it was small.

A focus on practice allowed me to create more opportunities for the interns to “play” with ideas and create their own way of thinking about course concepts. Windschitl et al. (2012), when discussing the potential of AST to change practice, noted the most influential learning happened when interns adapted and created tools/language to meet their needs. This held true for the interns. For instance, Boaz described fear around losing his White community, later he was able to articulate that fear explicitly, then finally was able to find ways to navigate the fear, although it never went away entirely for Boaz. While I do not know what Boaz knows, I do know he spoke and acted differently by the end of his time in the program and his articulation of fear met his needs as he worked towards “being” anti-racist.

With all this said, engaging in practice is not enough. The practice interns engage in must be grounded in social justice. It must focus on power. Therefore, when constructing representations, decompositions, and approximations of practice, teacher educators need to infuse social justice. To do this, teacher educators can draw from the deep and robust descriptions of more critical teacher education scholarship. For me, I was used critical whiteness pedagogy. The reason for this was it provided a way to embed the improvisational aspects critical scholars say is necessary for interns to engage in (Philip, 2019). Critical teacher education also helped me think about “what” I wanted to frame discussions and activities around. Without critical teacher education scholarship, I may have fallen into the trap of thinking that having interns learn power and race-evasive science teaching would achieve equity, when in fact, it would not.

Science teaching

Although this dissertation is about science teacher education, I do think it holds one lesson for science teaching. Mainly, that anti-racist science teaching is less about what is taught and is more about how it is taught. In this claim, I lean heavily on the interns' ideas. Initially, the interns sought to change “what” was taught in science teaching. They looked to identify “anti-racist” phenomena for their rehearsals. They did the same when thinking about the COVID-19 unit for Upward Bound. After analyzing their teaching, and later, as they critiqued AST, the interns argued anti-racist science teaching was less about what was taught and more about how science as taught. For example, the interns realized they should have conversations about race, power, and white supremacy in science, but at some point, they needed to teach topics that were less obviously racialized like photosynthesis, atomic structure, and potential energy. Knowing this, the interns realized it would be in how they taught science that would make the difference. Boaz even noted that a lesson that was intended to be anti-racist because of the phenomenon's relevance to students, bees landing on flowers, could still be “not racist” or “racist” if it were taught in a particular way. This give credence to the fact that science education should focus more on how science is taught than what is taught.

Choosing more relevant phenomena is a way to be more anti-racist in science teaching. It makes little sense to pick a phenomenon students have no connection with, but as some of the interns said, if anti-racist science teaching is about power, if no student has a connection to a phenomenon, perhaps that is a way to avoid inequitable power relations. Admittedly, I am not sure how I feel or what I think about that idea. Perhaps it is a way to get out of choosing a relevant phenomenon? Still, it adds to the argument that anti-racist science teaching is in how science is taught because there are numerous ways to view the what of science. So numerous it can become like checking a box. For example, interns said they wanted to teach about diverse

scientists, but as Sheth (2019) shows, that can be fraught if done wrong. The same holds true for phenomena that are deemed relevant (Sheth, 2019). So, I believe the interns are right, science education needs to pay attention to how science is taught rather than focusing on what is taught in order for us to achieve equity.

Theoretical Implications

Whiteness and science (teacher) education

Science education has grappled minimally with whiteness and white supremacy (Le & Matais, 2019; Ridgeway, 2019). Outside of a few studies, science education as failed to directly examine white supremacy. Therefore, drawing from calls to use critical theories to frame the study of race and make science education more equitable (Parsons, 2014), this study provides an example of why it is important for science education to embrace and integrate critical whiteness studies into our theoretical repertoire. The reason for this is that critical whiteness studies has theories necessary to deal with the disease rather than the symptoms of inequity in science education (Le & Matias, 2019). For example, Mensah & Jackson (2018) used Harris' (1993) conceptualization of whiteness as property to describe science as white property, and McCausland (2020) drew upon Thandeka's (1999) theorization of white shame to articulate how pedagogies of whiteness supported their learning of whiteness in science labs they participated in. In both studies, the authors were able to address the root of inequities in science learning contexts rather than make no mention of a causal mechanism to racialized inequity or attribute inequities to racism, a symptom of white supremacy.

Science education faces a number of dilemmas to address inequity. Most obvious, is the overwhelming number of White science teachers (NCES, 2020). This trend is not unique to

science education, but it has led to a multitude of calls to address this problem by recruiting more teachers of Color (Andrews, Brown, Castillo, Jackson, & Vellanki, 2019; Carver-Thomas, 2018; Haddix, 2017). Unfortunately, while White teachers certainly have a lot of learning to do in terms of anti-racist and justice-oriented teaching, teachers of Color also struggle to enact socially just pedagogies for many different reasons that include white supremacy and their own lack of experience or expertise (K. D. Brown, 2014; Mensah, 2019; Philip, Rocha, & Olivares-Pasillas, 2017; Philip & Zavala, 2016). This indicates merely recruiting teachers of Color will not, in and of itself, solve the problem for science education and other disciplines. Beyond this fact, science education must deal with a history of marginalizing students of Color (Carlone et al., 2014; Nasir & Vakil, 2017; Parsons, 2014; Sheth, 2019). While this could be, again, attributed to the overwhelming number of White teachers, as Sheth (2019) argues, racism is foundational to science education, meaning, changing the identities of teachers will not necessarily solve our problem. Lastly, science education is a field whose sole purpose is to teach science, a discipline that is laden with racism and has an almost devote relationship with white supremacy (Marks, 2017; Roberts, 2011; Saini, 2019; Takaki, 1990; Watkins, 2001). Nothing short of addressing and dealing with these truths will solve our problems.

I believe critical whiteness studies is a theoretical toolbox to deal with our dilemmas. For example, critical whiteness studies will allow us to deal with how the historical relationship of white supremacy and science is playing out in contemporary learning contexts (McCausland, 2020). Using Thandeka's (1999) conceptualization of white shame, McCausland (2020) demonstrated how the pedagogy used in science labs they experienced were rooted in practices that emerged alongside race science. Sammel (2009) and Le and Matias (2019) used a focus on white supremacy to outline how white supremacy shapes the ways we educate students in science education by drawing upon history and theory that renders whiteness and white supremacy visible and dynamic. While neither drew extensively upon science education literature, their work shows

the possibilities in using critical whiteness studies in science education. This dissertation shows what is possible in science teacher education when using critical whiteness studies to understand the learning of interns. What I showed in this project is science interns can and do become more anti-racist when they are allowed to deal with their white shame and ambivalence in relation to whiteness, white supremacy, science, and science education.

If science education embeds critical whiteness studies into our theoretical repertoire, we can continue to identify, interrogate, and dismantle the whiteness that is inherent in our field. Rather than fix symptoms, we can fix the disease. Critical whiteness studies provides a way to see nuance in learning by attending to whiteness and white supremacy in and around emotions (Matias, 2016; Thandeka, 1999), practices (Yoon, 2012), contexts (Berchini, 2016), and more. It will also allow us to go beyond the idea that hiring more teachers of Color will solve our problem because it is silly to think that it is the job of people of Color to teach White people how to be anti-racist (Berchini, 2017), that people of Color are “perfect” anti-racist educators, that people of Color cannot choose to embrace white supremacy (Leonardo, 2004), and that the inherent whiteness and white supremacy of science, education, and science education will not simply disregard, dissolve, or destroy any person of Color who decides to resist it. By embracing critical whiteness studies, we can begin to find complicated solutions to an even more complicated problem, whiteness and white supremacy in science education.

White identity: Shame and ambivalence

During his time in the program, Boaz changed how he spoke about and engaged in discussions about race and teaching as well as in his teaching practice. I have no idea if what I taught the interns is impacting their teaching today, but I do know it impacted them while in the program. This is exemplified by the moments of anti-racist teaching I saw as the interns taught

the Upward Bound students and in their field placements. However, what remained throughout and was central to Boaz's and other interns' journey, was white shame and ambivalence.

White shame and ambivalence have been explored by critical whiteness scholars (for examples see, Lensmire, 2017; Tanner, 2018; Matias, 2016; & Crowley, 2019). Lensmire (2010) argues white shame and ambivalence are central to White identities. What this study extends is how the entanglement of white shame and ambivalence create sites for opportunity for anti-racist action for White people even if they never "go away."

The relationship between white shame and white ambivalence is that White identities are ambivalent, not because of our fear of people of Color, but because of our fear of our own White community (Lensmire, 2010; Lensmire & Snaza, 2010). What this means is that dealing with white shame and white ambivalence has less to do with making sure White people "understand" communities of Color more fully, but is more about White people understanding our own community, which includes learning about whiteness and white supremacy. This reads to me like something fairly radical, but throughout Boaz's journey, as well as other White interns' journeys, this was certainly true. I never taught "about" communities of Color, and when making sense of what it meant to "be" anti-racist or making sense of whiteness and white supremacy, the White interns would reflect and talk about *themselves*. Take Boaz. Boaz became enamored over the course of a year with whiteness and white supremacy. Boaz theorized White identity. Boaz wrote extensively about his white shame and ambivalence, albeit in indirect ways most of the time. Still, the interns were able to be thoughtful about what and how they taught. This is evidenced by the semester-long construction of a unit about COVID-19 for Upward Bound students, most of whom were students of Color. This indicates that, potentially, White people need to spend time examining ourselves, our White community, and understanding our white shame and ambivalence more than we need to talk about communities of Color.

I say White people need to understand ourselves more than talk about communities of Color hesitantly. Yes, White people do need to learn about other communities. Yet, as Baldwin (1962), eloquently outlines, if White people learned how to accept and love ourselves and each other, white supremacy would no longer be needed. Part of loving and accepting ourselves as White people is accepting and loving our white shame and white ambivalence. This project shows how it is possible accept one's white shame and ambivalence. This is visible in how Boaz constantly waffles and doubts himself, but all the while, remaining committed to doing and being better in relation to race. For example, when Boaz tells a story about feeling as if a hot tub was "dirty" because Black people were in it, he admits the racism involved. He also says, even today, if he was in the same situation, he may have a similar thought, although fleeting. What is different, is Boaz would recognize the thought as animating from his enculturation into white supremacy and *act* different. Rather than avoid the hot tub, he would still go enjoy himself. Providing an example of what he discusses, Boaz describes having fear when visiting a Black part of Newark, New Jersey and when smelling something "unfamiliar" on the bus. In both instances, Boaz describes the initial, racist, but fleeting thought and how he was able to act and think differently. In other words, Boaz learned to accept his white shame and ambivalence as parts of himself, rather than rejecting them outright. Through this acceptance, Boaz no longer needed the trappings of white supremacy, and instead was able to engage with the fear and uncertainty of each situation as his, "truer" self in my opinion.

Accepting white shame and white ambivalence provide opportunities for White people to be anti-racist. By noticing our white shame and white ambivalence we can work against it, as Boaz showed, and open ourselves up to new possible futures. For example, Lensmire (2017a) describes how a White woman, identifying as a White anti-racist, engaged in scapegoating (Ellison, 1995), another White woman during a presentation in order to signal their belonging in a critical community at the expense of the "less" critical White woman presenting. I extend

Lensmire's (2017a) theorization in that I believe the White woman who engaged in scapegoating had not accepted their own white shame and white ambivalence. I say this because, as Boaz shows, a White person who has accepted their white shame and white ambivalence realizes we are all on the same team. There are no "good" and "bad" White people because we all carry white shame and white ambivalence. There are just White people who choose to act against it and White people who don't whether by choice or because they are "unaware" they even have a choice. By scapegoating the other White woman, I believe the scapegoating White woman is attempting to position herself as "not White." I do not mean she is trying to be a person of Color, instead I mean she is trying to "become" something, someone, other than a White woman. This is no different than my use of the n-word. By using the n-word, I was working to be someone other than the White man I knew I was. In my case, I was ashamed, I had not accepted my white shame and white ambivalence, so I still "needed" white supremacy. In my case, I used the n-word. In the scapegoating White woman's case, they leveraged a tactic all too familiar to White people, albeit in a different direction, policing of white and non-white zones (Thandeka, 1999).

Thandeka (1999) argues White people lose our core sense of self as a result of white shame. What I believe this work shows, is that it is possible to begin to recover one's core sense of self, but it is impossible to "lose" one's White shame. This means any attempt at trying to "fix" White people is doomed to fail. For example, white privilege pedagogy attempts to "fix" White people by making us confess and acknowledge our privilege, almost at nauseum. In many ways, this type of pedagogy is not dissimilar to the policing White people already experience at the hands of our White caregivers because we are given a stimulus (race) and then told how to react to it (confess and acknowledge our privilege). In the case of our upbringing, we are given a stimulus (race) and are expected to shut it down, look the other way, or be racist. White privilege pedagogy is literally asking White people to go against years of socialization by engaging us in behaviorist driven learning (O'Donnell, 1985). This contradictory learning environment is bound

to create resistance because that is exactly what we are taught as White people to do when encountering race, that is until we are “broken” yet again. Even then, however, White people are not taught to accept or love our white shame and white ambivalence, therefore, we still need white supremacy.

White shame and white ambivalence reveal how tenuously white supremacy is held. White shame indicates that White people do not actually fear people of Color, we fear our own White community (Thandeka, 1999). White ambivalence reveals White people have a desire for a more free, more democratic society even as we need scapegoating to justify the inequitable aspects for our current society (Ellison, 1995). By embracing white shame and white ambivalence as features of White identities that do reveal the weaknesses in white supremacy’s hold on White identities, we can begin to help White people accept those parts of themselves too. Rather than prescribe how White people should act in relation to race, we should simply have White people figure it out for ourselves because our white shame and ambivalence are not disappearing, but we can begin to act against it, live with it, and begin to love even the darkest, most painful parts of ourselves in order to no longer need white supremacy.

Basement culture, high culture, and the space in between

When describing “basement culture,” Lensmire (2014) highlights how it is a “low space” where racist, bombastic comments are acceptable, making it distinct from “high spaces” where discourse is politically correct. My dissertation contributes to an understanding of basement culture because, I would argue, SCIED 411W and SCIED 412 were low-high spaces. By this I mean, interns were able to “try out” ideas, no matter how bombastic or potentially racist, in order to “take the heat” and be “a little bit braver” moving forward (Lensmire, 2014). For example, interns asked tough questions, demonstrated doubt, and said things that I considered racist.

However, all of the ideas were shared in attempt to understand and eventually resist whiteness and white supremacy.

In low spaces, White people can say almost anything because the main rule is the Vegas Rule, what happens in the low space stays in the low space (Lensmire, 2014). Disagreement is subtle in the low space and never outright confrontational. On the flip side, high spaces have right and wrong answers. Political correctness, the discourse and culture of high spaces can and will be used to put a racist, non-racist, or less-racist person “in their place” (Lensmire, 2014, p. 111). It is also a space grounded in white privilege pedagogy causing it to privilege confessionals on the part of White people. These confessionals may only work to provoke resistance and white shame for White people, making it an ineffective practice if we want a more socially just society (Lensmire et al., 2013). What makes a political basement culture or low-high spaces different is that almost anything goes, disagreement is prized and necessary, but nobody, and I mean nobody, is “put in their place.” The reason for this is to create a space of honesty and trust, two things missing from both low and high spaces (Lensmire, 2014).

What political basement culture creates is the synergy necessary for White people to explore, dissect, and accept our white shame and white ambivalence. By asking tough questions, like those I was asked by Boaz and Anita, for example, but receiving responses that were equally as honest, although challenging and implicitly disagreeing, we can figure our white shame and white ambivalence. In low-high spaces, pecking order is not determined by knowledge, but is determined by honesty and engagement in the space. For example, Lensmire (2014) suggests that race-evasive talk in high spaces may be because of desire to maintain worth and standing. In low spaces, the bombastic, the most explicit, or dare I say race candid comments are privileged. In low-high spaces or political basement culture, being race candid is valued, however, unlike in basement culture, any comment is up for critique, even if it will not change your standing in the community itself. This causes the frequent confessionals we see in white privilege pedagogy to

become stories of reconciliation. Different from confession, reconciliation is not an admission of guilt and privilege, it is instead about restoring relations. Confession is about punishment; reconciliation is about forgiveness and compatibility. By positioning the stories White people can begin to accept ourselves more fully, admit our faults, and find ways to renew our relations with our White communities, communities of Color, and the world more broadly. This is what a low-high space can create because White interns, like Boaz told stories that could be viewed as confessions, but in reality were ways for them to make sense of their place in the world. Take Lester, he lied about his first memory of race. The lie was that he didn't do anything racist when in fact he did. By telling me about this lie, Lester did not confess. Instead, he worked to understand the lie, his actions in the moment, and restore his relationship with himself. Lester, I know, did not think of himself as a racist or a liar, but he was, at different times both. The act of telling me his story gave him a chance to align his beliefs about himself with the reality and be in better relations with himself, in my opinion. Therefore, this study shows how elements of "basement culture" may be sites for White people to figure out how we think about race, and by merging basement culture with elements of high spaces that prize critique of ideas, White people can and do learn about whiteness, white supremacy, and anti-racist action.

Moving forward

This study only focused, primarily on one White secondary science intern, Boaz. Yes, I provided narratives around other interns, but they were not featured. Boaz was an interesting case and provided a lot to think about for me. That is why I chose him as the central participant. This study presents five future directions for research.

Empirically, I believe more work should be done around articulating *what* critical whiteness pedagogy is and *how* it is carried out. In essence, core practices for critical whiteness

pedagogy. This will serve two purposes. First, it will help teacher educators articulate their pedagogy so that it can be refined and extended. Critical whiteness pedagogy is not defined and this would be a step in accomplishing that goal. Second, it will help teachers integrate critical whiteness pedagogy into their classrooms. One of the critiques of core practices is that they decenter justice (Philip, 2019; Philip et al., 2019). By articulating a set of core practices that explicitly center justice could help address this critique directly.

The White interns from these cohorts should also be followed up with in a longitudinal study. This is difficult to do and there are a few examples of research that followed up with interns who learned AST (for an example see, Stroupe et al., 2021). However, by following up with these interns, we could examine if the intended design for the K-12 environments as a result of the program's overall design came to fruition. This would give more insight into the affordances and constraints of CWPBTE.

One of the shortcomings of this study was the lack of politicization (Curnow et al. 2019; Curnow & Veal, 2020) seen within the study. This may have been due to the shifts in contexts due to COVID-19. Many of the ways the design would build community were not implemented due to the pandemic. However, I view this as a weak response to this concern. Another possibility for not noticing politicization may have something to do with the method of inquiry (“plugging in”) and how the data was presented (narrative of engagement) because politicization is a community level process. The focus of my narrative on Boaz probably prevented me from picking up on politicization analytically. Therefore, work should be done to examine if and how politicization occurred. This has important implications as politicization results in epistemological, activity, and identity shifts (Curnow et al., 2019). Each of these elements has serious implications for the future of science education, especially as science becomes increasingly politicized in regards to climate change and vaccinations, to name a few. Having a teacher community that is equipped

and ready to handle this environment will be centrally important to shaping not only science education, but the future of our societies.

Theoretically, I believe work needs to be done to articulate the affordances and constraints of various White communities and practices. This study highlights how “low-spaces” or “basement culture” (Lensmire, 2014; 2017) can be reimagined to produce anti-racist learning and action. It also describes how ambivalence and shame, emotions and practices that are rooted in trauma, present opportunities for engagement around race and anti-racism for White people. By extending how we frame theoretical constructs like shame and ambivalence to include their affordances, not just how they harm people of Color and White people, we may find new understandings about White identities we did not notice before.

Lastly, I think work needs to be done around how critical teacher education is framed. I allude to the fact that white privilege pedagogy is aligned, in my opinion with cognitive at best but behaviorist at worst, theories of learning. However, I also wonder if learning is often taken-for-granted in most critical teacher education research, lending itself to taking up common scripts about learning. In this dissertation, I explicitly and often mention learning from the sociocultural perspective. Therefore, I believe it is important for us as a critical teacher education community to understand the ways we frame learning and how that inevitably positions the teachers we work with.

Conclusion

As promised, I will now return to the story I told at the outset of this dissertation. If you do not remember the story after around 250 pages, let me refresh your memory. I attended a conference where I felt my work was chastised and critiqued in ways I thought were inappropriate. It almost caused me to leave graduate school, but I remained because of a few folks

who, secretly, told me they thought my work held value. My interest in their reaction and my own reaction to what transpired was of interest to me and informed the work I eventually did. I followed my first narration of this story with common critiques of my work. Critiques I addressed immediately. I will not rehash those critiques now, but instead, will demonstrate why the work I do is important.

Three years removed from the conference experience, I can now say part of my reaction was white fragility (DiAngelo, 2011). However, to say my entire reaction was white fragility would be a disingenuous and erase all the complexity within my reaction. The other parts of my reaction were reactions to white privilege pedagogy that stoked my white shame and white ambivalence. For example, many of the critics of my work told me what I should do instead. They told me I “should” or “needed” to do particular things. I now believe what was occurring was a form of white racial abuse (Thandeka, 1999), many responses to my presentation were about as policing me to be in non-white zones as determined by the people at the conference. I now think of them as “white non-white zones” because I was being forced, policed, and shamed into the zone. For the White people who engaged in this practice, they were, signaling their belonging in the anti-racist community of the conference. For the people of Color, they were probably just proactively protecting themselves from another, potentially overly confident White guy. In retrospect, I wasn’t upset with the people of Color, disappointed, sure, but my rage, my vitriol, was reserved for the White people. Ironically, for entering what I think is a non-white zone (wanting to talk in nuanced ways about White identity), I was abandoned by most of the White community at the conference. I say most because of two White teachers affirmed me, in private, on the last night. While the White people did not police me into a traditional white zone, they did police me into a white non-white zone. The white non-white zone was a place where I should not treat White identity with nuance, talk about white supremacy directly, but instead acknowledge my privilege, read, and do little else.

The policing and abandonment I felt stoked my ambivalence. I wanted to do good work, but thought about quitting and “going back” to my former life. A life where I have a community that loves me. As much as I wanted to “go back,” it was my desire to keep community that kept me in graduate school. I say I wanted to understand different reactions more, this wasn’t and isn’t a lie, but I knew if I quit my work, my “former life” would also not accept me. I was in graduate school because of them. Quitting would only, potentially ostracize me more. So, really, I was stuck. I was stuck between wanting a better world, knowing the world around me was not racially just, and realizing no matter what I decided, I would lose or not be accepted by a community.

This realization is what saved me. I realized I would never be rid of white shame or white ambivalence. I had to learn to accept them as parts of me. In working with my therapist, mentors, friends, and the interns in this study, I finally accepted white shame and white ambivalence as parts of me. In this way, I no longer needed white supremacy, as much. I say as much because I am still working to accept white shame and white ambivalence as a part of me. It is a never-ending journey. However, in this dissertation, I described creating a learning environment where I did not tell White interns who to be. I did not tell them how to be anti-racist, I tried to let them figure it out for themselves as best I could. I also told stories of me using the n-word. That alone could get me canceled, but I do not need my status as a “good” White person to know who I am. Sure, it would be shitty to get canceled or looked over because of that knowledge being public, but I also believe noticing and revealing the nuances as well as the racism in such instances is more important. I also believe our society demands White people keep the darkest parts of ourselves hidden, in the shadows. Regardless of how much we may work to hide it, our white shame, our white ambivalence, our racism, is still there. No matter how “good” I try to appear, I have still done and might still do things that support white supremacy. Therefore, I do not need to signal my belonging by appearing better than I am or by engaging in self-flagellating confessions

of my white privilege; all of which leverages white shame and white ambivalence. I don't need white supremacy, as much.

As I reflect on the conference, what I needed critical whiteness pedagogy to be used. I was "playing," being confused, and taking on the burden of race. I was trying to be an expert, or demonstrate my expertise. I needed the low-high space critical whiteness pedagogy could provide. I needed a space that gave me credit for saying what I thought vulnerably and in the rawest way I knew how. I needed a space that would honor my ideas while engaging them in honest critique and disagreement. I am positive many of the people at the conference would say this is what happened. However, while I know some did, for example the scholars I thanked at the conclusion of my presentation directly, the abandonment I felt tells me most did not use a stance similar to critical whiteness pedagogy. I am White. I have been conditioned to know what it feels like to lose a community for entering a non-white zone (Thandeka, 1999), and that, unequivocally is what I felt. I needed a space that accepted and loved my white shame and white ambivalence because those were the keys to unlocking new possibilities.

My white shame and white ambivalence are why I chose to focus my dissertation on what I did, science teacher education. Amongst the worries that my dissertation wasn't "sciency" enough, I was able to recognize my white shame and white ambivalence, and choose to do differently. This dissertation is about science education. It is about science education because it was about science interns. It was also about science education because science education does have a whiteness problem. I chose to center whiteness, not science, in science education. I am choosing to enter a non-white zone by talking directly about white supremacy and my doubts spawned from my enculturation into white supremacy. I chose to do differently because science is white property (Mensah & Jackson, 2018) and whiteness has gone unexamined in science education for way too long (Le & Matias, 2019; Ridgeway, 2019). Therefore, by looking at how White secondary science teachers learned about whiteness and white supremacy as they worked

towards being anti-racist science educators, I believe this study has laid some of the groundwork for “*looking beyond* what it is we teach and learn” (Kumashiro, 2001, p. 6) in science teacher education and has helped science teacher education “*imagine living elsewhere*” (Gordon, 1997/, p. 4) so that maybe, just maybe we can live there.

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society”: Critical whiteness pedagogy in a dialogue course. *Journal of Diversity in Higher Education*, 6(1), 17–32. <https://doi.org/10.1037/a0031632>

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VITA

Jonathan (JD) McCausland

EDUCATION

Pennsylvania State University: (August 2017 – Present)
Ph.D. in Curriculum and Instruction emphasizing in Science Education

Brooklyn College Graduate School of Education: (June 2015 – June 2017)
Master of Arts in Middle Childhood Education, Certification in Biology 5-9 from New York State

Pennsylvania State University: (August 2011 – May 2015)
Bachelor of Science in Environmental Resource Management with distinction and interdisciplinary honors in Environmental Resource Management and Secondary Education

PEER-REVIEWED JOURNAL ARTICLES (Selected)

Wray, K., **McCausland, J.**, McDonald, S., Pallant, A., & Hee-Sun, L. (accepted). Using summary tables to support students' use of data-based models to explain science. *Science Teacher*.

Sharp, S., **McCausland, J.**, Cate, L., Woodruff-White, C., & Kelly, G. (2021). An ecosystem of equity in the era of COVID-19: Considerations for creating inclusive teaching and learning environments. *Authorea*.

McCausland, J. (2020). Learning “real” science: Storying whiteness in university science labs. *Journal of Curriculum and Pedagogy*.

BOOK CHAPTERS

McDonald, S., Bateman, K., & **McCausland, J.** (2020). Practice-embedded science teaching methods. In D. Stroupe, K. Hammerness, & S. McDonald (Eds.), *Preparing science teachers through practice-based teacher education*. Cambridge: Harvard Education Press.

CONFERENCE PROPOSALS (Selected)

McCausland, J. (2020). *Good teaching vs. good science teaching: Consequences of white supremacy*. Paper presentation at the national meeting of Curriculum and Pedagogy. McAllen, TX [online].

McCausland, J. & Scott McDonald. (2020) *Understanding self-ethnography as a pedagogical tool to combat whiteness in science education*. Proceedings of the International Conference of the Learning Sciences (ICLS). Nashville, TN.

McCausland, J. (2020) *The policing presence of whiteness in science*. Paper presentation for the annual meeting of the National Association of Research in Science Teaching (NARST). Portland, OR. (Conference canceled due to COVID-19)

GRANTS AND AWARDS (Selected)

Penn State College of Education Equity Fund Grant (2021): \$5,000

Dean's Graduate Assistantship for Engaged Scholarship & Research in Education (2017-2019)

Robert Graham Endowed Graduate Fellowship (2017): \$3,420

Segal AmeriCorps Education Award (2015): \$5,730