PREPARING TEACHERS TO ENGAGE IN CIVIC PARTICIPATION THROUGH COMPUTING

By

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ABSTRACT

Scholars like Ruha Benjamin have cautioned how hegemonic technologies can reinforce White supremacy and deepen racism against Black and Brown folks due to racial biases in"neutral/normative" Artificial Intelligence and over-surveillance of Black folks. K-12 education can also contribute to this hegemony. Culturally Responsive Computing (CRC) is an approach that works with students to challenge these hegemonic narratives and construct better anti-racist dynamics in the society while using various technologies.

Unfortunately, there exist several problems in fully realizing this. The K-12 Computer Science (CS) space, like much of CS, is dominated primarily by White folks which increasesmany hegemonic and racist issues. There are implications both in the CS field and in the world, through racially-biased technologies like facial recognition software that do not accurately identify dark-skinned folks. White K-12 teachers in CS have shown to be often race-evasive, which further exacerbates addressing these problems. CS teachers have also often separated the socio-political from the technical aspects in CS, which reduces the possibility of students addressing the racist issues in the field and through applications of CS. In this dissertation, first gap in the literature that I address is about how White CS teachers "attend to their own racial identities" in the context of teaching CS. The second gap in literature that I address is about teachers attending to socio/technical dichotomies in CS. I conducted workshops and case studies to see how three White high-school CS teachers 1) explore their racial identities, White privilege, and racism in the context of CS, and 2) How these teachers implement a lesson that encourages their students to be involvedin civic engagement through CS and technology. I found that having targeted opportunitiesto discuss White identities and privilege in a group allowed teachers to 1) complicate and unpack their White identities instead of shying away from it,

2) debate White privilege, 3) start reconciling with the tensions and guilt they experience while exploring these topics. I also found that using a specific computing tool that focuses on school desegregation helpedteacher think concretely about socio-political aspects of technology use. For instance, the three teachers were able to implement lessons that encouraged students to think about the implications and precautions of using technologies. The strategies introduced in this dissertation have implications for future research and practice and advancing the ways in which we approach integrating CRC in formal learning contexts like K-12.

For my loving parents

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INTRODUCTION

> Once whiteness is made familiar, then it must be made strange. No longer able to disguise itself as normative, whiteness becomes peculiar once it is located." —Dr. Zeus Leonardo (Leonardo, 2013, p. 85)

Anti-racist frameworks and pedagogical practices have a long histories in K-12 education (Hooks, 1996; Ladson-Billings, 1995; Woodson, 1933). With less temporal significance thisis also true for Computer Science (CS) education where there is increasing recognition thathegemonic CS needs to be disrupted. I use the Gramscian notion of hegemonic formation in societies, "where one subject (such as White folks) category's moral and intellectual leadership is another subject category's (such as Black folks) coercion and domination" (Kurtz, 1996, p. 106). In such a dialectic relationship, the dominant subject's cultural, moral, ethical, and intellectual leadership is considered the norm and as "common sense" (Hall, 1986). Scholars like Benjamin (2019) have cautioned how hegemonic CS can reinforce White supremacy and deepen racism against Black folks due to racial biases embedded in "neutral/normative" (i.e. White hegemonic intellect) technologies and over-surveillance (i.e. White hegemonic morality). Consistently ignoring the role of existingsocial hierarchies and racism in the design of such technologies has only worsened the demarcation of experiences that White folks and Black, Brown, Indigenous, and other people of color (BIPOC) have, something Benjamin refers to as the "New Jim Code".

Researchers believe that disrupting hegemonic CS will not only challenge White supremacyand racism in CS and increase the participation of BIPOC students, but also that computing can be channeled for BIPOC community and personal goals, youth civic participation, community activism, wealth generation, and self-advocacy (Eglash et al.,

2013b; Lachney, 2017; Sandoval, 2019; Scott & White, 2013). One strategy for teachers to challenge hegemonic CS in schools is culturally responsive computing (CRC). CRC has its roots in culturally responsive teaching (CRT) (Gay, 2018), culturally relevant pedagogy (CRP) (Ladson-Billings, 1995), and culturally sustaining/revitalizing pedagogy (CSP) (McCarty & Lee, 2014; Paris & Alim, 2014). It considers the backgrounds, communities, experiences, motivations, and perspectives of students of color as assets that can be centered in computing learning experiences (Scott et al., 2015). CRC is about more than just broadening participation in computing. It challenges the notion of "who endures socially and culturally irrelevant curriculum" (Scott et al., 2015, p. 427), that is who endures hegemonic CS. Instead, it encourages students to become technosocial change agents (Ashcraft et al., 2017), who challenge hegemonic narratives and construct better anti-racist dynamics in the society while using various technologies. Finally, CRC approaches acknowledge that technologies have the power to both amplify and disrupt racism and White supremacy (Scott et al., 2015). So, these approaches promote BIPOC students to draw from their own identities and experiences while working towards social justice and disruption of racism through CS.

So far, CRC research has mostly focused on out-of-school contexts. Within these context, CRC has shown promise in improving students' STEM knowledge and cultural connections(Eglash et al., 2013a; Scott & White, 2013), including in the area of computational thinking (Lachney et al., 2020; Lachney, Green, et al., 2021). But these out-of-school experiences are also limiting because not all Black, Brown, Indigenous, and other students of color have access to such computing workshops. We need to ensure that all students–including majority students–can have access to CRC approaches. Turning to K-12 public education is one possible solution. Recently, researchers and practitioners have

been promoting CRC practices in formal learning contexts and engaging K-12 teachers to use culturally responsive and sustaining approaches within their CS instruction (Davis et al., 2019; Goode et al., 2021; Goode et al., 2020; Lachney, Bennett, et al., 2021; Lachney& Yadav, 2020; Leonard et al., 2018) There are several lessons and implications that have emerged from this prior work on how to support K-12 CS teachers to implement CRC. I outline them in turn below.

First, White teachers often use color-evasive discourses when engaging with issues of race and racism, and resort to individualistic, evasive, and deflective discourses when talking about CRC and their non-White students (Goode et al., 2020). Goode and colleagues proposed that such teachers can benefit from professional development programs and experiences to be better equipped to discuss race and racism. Similarly, Leonard et al. (2018) cautioned that teachers exhibited some hesitation and apprehension when facilitating culturally responsive lessons in a classroom with students of a different race than theirs. Davis et al. (2019, p. 1171) argued that a proper CRC implementation is extremely important for teachers. Unless teachers do so, they cannot explain the social and racial implications of using CS and various technologies. The researchers encouraged their teacher participants to use culturally situated design tools (CSDTs), a computing tool that allows students to "translate between indigenous or vernacular (computing) knowledge in cultural context(s), and equivalent (computing) concepts in the classroom". Unfortunately, Davis and colleagues found that although the teachers used powerful, sophisticated, culture-based tools to support CRC, they did not allow for students' self-exploration, effectively communicate the social dimensions of the tools, or explore the artificially created social/technical dichotomy in computing. Due to this, the students failed to truly engage with the lessons and failed to see the relationship between culture, race, and computing.

These studies and prior work have highlighted two issues that need to be addressed. My dissertation will address these two issues through a two-paper dissertation. The first issue I will address is for White teachers to attend to their own and their students' racial identities. Specifically, we need more attention on how White teachers can shift away from color avoidance frameworks and toward race-conscious literacies. If they are not able to recognize the significance of their own identities in race relations, then navigating CRC, supporting positive images of their BIPOC students' racial identities, and working with their students' cultural capital will be inauthentic. I believe that White CS teachers, who form the majority of the K-12 teaching CS force (Barnes & Brooks, 2018), should be given opportunities to explore their identities, address White privilege and racism, and challenge whiteness in CS. Matias et al. (2014, p.69) defined Whiteness as "a social construction that embraces white culture, ideology, racialization, expressions and experiences, epistemologies, emotions and behaviors". Further, Picower (2009) had said that Whiteness is an ideology and a way of being in the world that maintains White supremacy and racial hierarchy.

Matias (2013) maintained that if White teachers do not interrogate their Whiteness and only focus on learning about the racial 'Other', then their cultural responsivity cannot be genuine. They will fail to understand the implications of White supremacy and hence cannot appropriately address it. To facilitate this teacher learning, the first study was a teacher identity exploration study via a Zoom professional development workshop. It was a single case study with three teachers who identify as White.

The second issue is for teachers to explore the social and racial implications of the role of CS in design of technologies As mentioned earlier, in hegemonic CS, White-centric data and knowledge is considered the norm and is privileged. So, White teachers are often not used to exploring the socio-political harms of technologies on Black, Brown,

Indigenous, and other people of color, which creates and maintains an artificial social/technical dichotomy in CS. The first issue that I mentioned in the previous paragraph affects the second issue in many ways, as without challenging whiteness as a whole, it will be difficultfor teachers to challenge hegemonic whiteness within CS, which reinforces the socio-political/technical dichotomies. To address this gap, in the second study, the teacherscritiqued and developed strategies towards dismantling White hegemony in their classrooms. The topic they explored in particular was school district desegregation, as this issue also relates to Whiteness and racism. The teachers worked to understand the social and political aspects of using computing, thereby exploring the minimization of the socio-political/technical dichotomy in hegemonic CS. These explorations were also done via another Zoom workshop.

The computing tool was created on https://processing.org/ and helped teachers exploreschool desegregation/integration in a visual format. I chose to use a tool that enabled socio-political critique of racism and ways to think about dismantling them, as these are important components of CRC. Eglash et al. (2013b) mentioned that CRC should enable students to (a) improve their STEM learning experiences; (b) empower them for social critique, and bring these two aspects together to reduce social/technical gaps. Scott et al. (2015, p. 428) also added that CRC should enable students to "appropriate the technical and research skills to dismantle the system with groundbreaking technologies that empowersocio-historically disadvantaged spaces". They also added that students need social supportfor such skills, including encouragement from K-12 teachers. Through these two studies, I answered the following research questions in this dissertation.

1. How do high school CS teachers reflect on their own racial/ethnic White identity?

2. How do these teachers discuss the ways in which they envision and negotiate Whiteprivilege?
3. How do these teachers discuss the ways in which they see the connections betweenCS, race, and racism?
    (a) What are some ways in which they address their thoughts on CS, race, andracism in their CS classrooms?
4. How do CS teachers speak about the implications of socio-political elements of technology use?
5. How do CS teachers talk about race and racism when exploring a computing toolthat explores school desegregation?
6. How do these teachers implement a lesson using the computing tool meant to exploreschool desegregation?

Here, the first question is to explore how White teachers reconcile with their racial identities at an individual level, especially in the context of teaching CS. The second question explores how teachers think about Whiteness at a systemic level and more specifically about White privilege at an individual and collective level. Finally, the third question(s) addresses how then the teachers address race and racism in CS contexts, given their prior exploration of race relations, systemic privileges, and identity reflection. These questions address the first gap in the literature on how White CS teachers "attend to their own racial identities" in the context of teaching CS.

The fourth question relates to how teachers talk about socio-political implications of technology use in CS contexts. It specifically attends to if and how teachers enmesh the socio-political and the technical as concepts that are to be considered together. The fifth question relates to how teachers explore school segregation, a context entrenched in racism,

using computing technologies. The sixth questions will examine how the teachers actually implement CS lessons regarding the social and racial implications of school (de)segregation. These three questions address the second gap in literature of teachers attending to socio/technical dichotomies in CS.

Dissertation Structure

The introduction section of this dissertation provides the introduction and motivation behind both the studies. The first chapter will cover the first study, regarding White hegemony, Whiteness in CS, and teacher White identity reflection. Then, the second chapter will cover the second study regarding teacher exploration of the computing tool and their lesson planning with the tool. I will finally discuss my positionality, the limitations and delimitations of this dissertation, the implications of the two studies, andmy conclusions drawn from both the studies in chapter three.

CHAPTER 1. TEACHER IDENTITY EXPLORATION AND NAVIGATING WHITENESS

In the 2017-2018 school year, 79% of teachers who taught in public schools were White (NCES). In CS, the percentage of White teachers is similar, with 82% of the teachers who disclosed their racial information in Code.org's CS Principles Professional Learning Program identified as White (Barnes & Brooks, 2018). While the teaching force in the US is overwhelmingly White, the student demographics are quite different. The Non-Hispanic White student population decreased from 58% in 2008 to 52% in 2018 across K-12 (NCES, 2019). Thus, there is an overwhelming and disproportionate representation of White peoplenot just in the teaching force, but also in CS.

Whiteness does not directly equate to White people. For instance, scholars have highlighted the prevalence of anti-Asian crimes with the rise of the COVID pandemic across the world, even those places that perhaps do not have White people. Nakayama (2020, p. 200) said,

> "[Whiteness is a] cultural logic of scapegoating, racism, and blame that makes 'sense' within a particular way of viewing the world. *Whiteness is not contained*. Its cultural logic is expressed and performed around the world in ways that are not unexpected. Whiteness is not a national phenomenon but aninternational one. Racial logics are not contained within borders. Building walls will not prevent the spreading of toxic racial logics that have material consequences on racial/ethnic groups." (emphasis added)

Although Whiteness may not know race, Whiteness is still thought to operate more freely with While people and in White communities due to White supremacy (Leonardo, 2013; Matias & Grosland, 2016). Thus, the increased number of White people in a certain

context could influence the extent of Whiteness present within it. Indeed, Picower (2009) highlighted that "the sheer number" of White teachers who teach in a system entrenched in racial inequities needs to be examined further. In this study, I plan to examine how teachers explore and critique Whiteness and its role within hegemonic CS.

Literature Review

First, I will explore the concept of hegemonic Whiteness. Next, I will explore how White teachers in the past have unpacked and navigated their racial identities, Whiteness, Whiteprivilege, and racism. After that, I will examine ways in which researchers have worked with White teachers to navigate and challenge whiteness in education. Finally, I will relatethese findings to CRC and how my study addresses the needs of White teachers in CS education.

Hegemonic Whiteness

I refer to the Gramscian notion of hegemonic formation in societies in this study. So, by hegemony, I mean a dialectic relationship "where one subject (such as White folks) category's moral and intellectual leadership is another subject category's (such as Black folks) coercion and domination" (Kurtz, 1996, p. 106). In such a relationship, the dominant subject's cultural, moral, ethical, and intellectual leadership is considered the norm and as "common sense" (Hall, 1986). In the US, race is one of the organizing principles of hegemonic domination (Ladson-Billings, 1995). Researchers have argued that one of the ways in which Whiteness gets operationalized is when White folks are unaware of their position in the racial domination system or hierarchies and they continue to maintain those systems Picower (2009). So according to Picower, Whiteness is an ideology and a way of being in the world that maintains White supremacy. As Matias et al. (2014, p. 69) also mentioned, Whiteness is "*a social construction* that embraces white culture,

ideology, racialization, expressions and experiences, epistemologies, emotions and behaviors" (emphasis added).

Researchers have also positioned Whiteness as a property historically protected by law (Harris, 1993, p. 1709); not a physical property, but anything which was valued by Whitefolks. She argued, "whiteness became the basis of racialized privilege - a type of status in which white racial identity provided the basis for allocating societal benefits both private and public in character. These arrangements were ratified and legitimated in law as a type of status property. Even as legal segregation wasoverturned, whiteness as property continued to serve as a barrier to effective change as the system of racial classification operated to protect entrenched power.

These include even abstract concepts of time, creativity, and the benefits of education. Forinstance, historically, being White allowed people to conduct genocide over Indigenous folks, allowed them to exclude Black and Indigenous from accessing education and lawful justice, and be a “free citizen” instead of a slave (Ladson-Billings, 1995). It becomes more evident that Whiteness is a property when we consider that Black, Brown, Indegenous, andother people of color get excluded from the benefits that only White people can reap.

Annamma (2015) particularly focused on Whiteness as a property in public education. This relates to who benefits from Whiteness and White ideologies (White people), who (Black, Brown, Indigenous, and other people of color) gets excluded, how school districtsmaintain inequitable distribution of resources between White and Black, Brown, Indigenous, and other people of color, and who (White people) wield power over educational policy decisions.

It is clear that White folks have historically benefited from Whiteness and that there are many historic privileges to being White. Unfortunately, not all White folks, in particular White teachers, are aware of these systems of hegemony, domination, power, and privilege.Researchers have argued that “White, middle-class prospective teachers have little to no understanding of their own culture. Notions of Whiteness are taken for granted. They rarely are interrogated. But being White is not merely about biology. It is about choosing a system of privilege and power” (Ladson-Billings, 2004, p. 81, emphasis added). If teachers continue to be unaware of Whiteness and their position in the racial and societal system as being privileged, then they cannot disrupt the White supremacy and hegemony.

Teacher educators and researchers have been researching various methods through whichteachers can begin to understand Whiteness and White privilege.

White Teachers Navigating Race, Racism and Whiteness

One of the primary ways in which researchers have worked with White teacher identity studies is to use “color-evasive frameworks” or "race-evasive" frameworks (Annamma et al.,2017). According to Jupp et al. (2019, p. 2), “Race-evasive White teacher identity studies, by definition, refer to the subset of White teacher identity studies that deploys the framework of colorblind racism in analyzing White preservice and in-service teachers’ White race-evasion, White privilege, and whiteness”. A literature review of twenty-five years of race-evasive White teacher identity studies revealed several different themes acrossthe 47 studies that were analyzed. There were five themes in total, which were: (a) racialized silence and invisibility, (b) resistance and active reconstruction of White privilege, (c) Whiteness in institutional and social contexts, (d) fertile paradoxes in new research, and (e) reflexive Whiteness pedagogies (Jupp et al., 2019, p. 16)

I elaborate some of the relevant themes in turn. The first two themes, racialized silence and invisibility and resistance and active reconstruction of White privilege, relate to how researchers have found that White teachers adopt a color avoidance ideology, where they do not "see" race or racial differences and refuse to recognize and reconcile with their Whiteprivilege (Sleeter, 1993). Leonardo (2013) mentioned that this ignorance should be problematized, such that we don't consider White teachers as racists, but instead understand and promote their full participation in race relations. Researchers have also explored nuanced ways through which White teachers perceive race and racism. McIntyre (1997) found that White teachers coded race explicitly as Black. Similarly, in a study by Johnson (2002), the earliest memories of the teachers related to race focused on identifying a racial "Other" and not perceiving themselves as racial beings. Further, the teachers failed to see the structural aspects of White privilege, challenge White privilege, and locate themselves in the hierarchy of racial privilege.

When it comes to Whiteness in institutional and social contexts, teachers often see races along individualistic lines. McIntyre (2002) emphasized that unless properly educated, White teachers have a tendency to see themselves as different from the "bad whites" and consider racism in individualistic terms instead of in systemic ways. Levine-Rasky (2000) discovered that some teacher candidates perceived themselves as unfavorable candidates forhiring and were anxious about how others viewed them as privileged beings. Thus they referred to the notion of systemic elements like hiring, but it was to resort to White defensiveness and stating that they experienced "reverse discrimination" in education.

Picower (2009) found that many teacher participants used religious discrimination to divertthe conversation from their racial privilege. They also spoke about their family's

Euro-centric immigration experiences and alluded to how they thrived in the American meritocracy despite not knowing to write and speak English initially. In addition, their racial focus was primarily on Black individuals and was extremely negative. Finally, these teachers also perceived themselves as "White victims" who did not want to be "made to feelguilty" about their racial privilege, especially as they thought they had done no harm as individuals. Why might White teachers be resorting to such harmful tendencies? The thirdtheme, Whiteness in institutional and social contexts, might offer some insights to this question. Locke (2005) and Denis and Schick (2003) mentioned that liberal race-evasive pedagogies could have acted as fuels for teachers to separate themselves from institutionalized racism and see themselves as 'innocent' White liberals.

Given White teachers form the majority of the teaching profession, it is important that they have opportunities to educate themselves on how to authentically challenge Whitenessand racism in their classrooms. There has been some work with White teachers to address the color-evasive ideology and explore their own racial identity which I explore in the next section.

White Teachers Challenging Whiteness in Education

Jupp et al. (2019) explored the fifth and final theme, reflexive Whiteness pedagogies, as away for the field of Critical Whiteness Studies (CWS) to move forward. That is, they proposed that it was important to find "compelling ways of talking about racial identity, racial prejudice, racial privilege, and racial discomfort" (Kincheloe, 1999, p. 179). Jupp et al. (2019, p. 38, emphasis added) called reflexive Whiteness pedagogies the "*pedagogy ofpossibilit[ies]* adher[ing] to imagining alternative institutional and identity outcomes from those that simply re-inscribe racism."

Some researchers have explored the “intellectually compelling ways” of racial discourse thatJupp and colleagues advocated for. Johnson (2002) used an autobiographical narrative approach with her teacher participants, in which they explored their life stories through a racial lens. She asked the teachers questions about how they grew up, their parents’ attitudes towards race and racism, their experiences in school and teacher preparation programs, and how they perceived their White identities and privilege. Johnson found thatalthough the teachers were not able to challenge White privilege, they found the exercise oftracing the source of their racial identities and ideologies useful for acknowledging systemicprivilege.

In another study, McIntyre (2002) requested her majority White (>90%) student-teachers to create collages that represent whiteness. They used photographs, symbols, phrases, andadvertisements from the different magazines they read to create the collages. Mcintyre found that student-teachers were beginning to acknowledge their White privilege and wanted to further explore their identities and privilege. But, although the teachers acknowledged their privilege, they still did not view whiteness as oppressive and denied individual responsibility. Mcintyre mentioned that teachers should be provided with opportunities to center Whiteness, view themselves as a collective racial group, and critique Whiteness both individually and collectively.

Matias and Grosland (2016, (p. 161)) emphasized that "the real disease is White supremacy and [it is] maintained by enactments of Whiteness". They proposed that Whiteness must be challenged and disrupted in all teaching and anti-racist education.They used digital storytelling as a mechanism for their White teacher candidates to talk about their Whiteness while negotiating with their emotions. That is, they wanted teachers to engage with their emotions and understand that sentimental fears of being perceived

negatively as a White person should not be elevated over the tangible, realistic fears that BIPOC have of injustice. They proposed digital storytelling as a way for White teachers to self-reflect and decolonize their mindsets. They found through the student teachers' digital stories that they could (a) end emotional distancing from racial issues, (b)debunk their color blindness, (c) engage with emotions such as defensiveness and fear of exploring race and racism, and (d) wished to share the burden of addressing hegemonic whiteness. Existing work has engaged teachers in self-reflection with opportunities for discussion and reading various materials relating to whiteness (Matias & Grosland, 2016; McIntyre, 2002). These approaches have proved to be somewhat effective for the teachers to engage with White privilege and racism.

Even as we explore teachers challenging White privilege and racism, it is important to keepin mind some insights that Jupp et al. (2019, p. 40), fourth theme, fertile paradoxes, can provide. They mention that "educational institutions have historically functioned as both the vanguards of racial stratification (Gillborn, 2008; Leonardo, 2013) as well as the arenas of democratic social transformation (Freire, 1970; Gutmann, 1999)". The tensions of exploring race-consciousness workshops within inherently racist structures of educational institutions (e.g., hierarchies in academic institutions, standardized testing, segregated schools, rigid school curricula) will, unfortunately, play a role in full realization of teachers exploring racial identities and thinking about their role in disrupting Whiteness in CS classrooms. It still is important, as many researchers have pointed, to continue engaging within these tensions (Brown, 2013; Jupp et al., 2019; Segall & Garrett, 2013).

Frameworks for Studying Teachers Navigating Whiteness

Helms (1990, 1995)'s White racial identity model has been widely used to study teachers'White identities. The model includes six stages of White identity development

that describe how White people can work towards a positive White anti-racist identity and reconcile with being both White and anti-racist simultaneously. The six stages in the model are as follows:

1. Contact: People may be colorblind and not aware of their racial identity
2. Disintegration: People become aware of White privilege but resort to denial, shame,or guilt to navigate their privilege
3. Reintegration: People are still trying to reconcile with their racial identity and privilege but may end by blaming people of color
4. Pseudo-independence: People are not able to reconcile that they can be both Whiteand anti-racist. They look to people of color to understand race and racism.
5. Immersion/emersion: People start to understand what it means to be a White anti-racist person. They may self-reflect and start talking to other anti-racist Whitepeople to better understand White privilege
6. Autonomy: People internalize a positive racial identity and continue to be open to new information and self-reflection. They realize this identity development will be on-going and non-static

But, some researchers have also problematized Helms' framework. Among other things, Rowe et al. (1994) felt that the developmental implications of the model i.e., looking at it as a progression through different stages was wrong. There were also concerns that apart from the immersion/emersion stage, the Helms' model does not pay much attention to howWhite people connect with the White racial group (Leach et al., 2002).

Other scholarships have envisioned various lenses to analyze White identity, some providingalternatives to a developmental model. Based on Bhabha (2012)'s conceptual framework ofthe "third space", Leonardo (2013) suggested that White folks can actively engage within that space to be reflexive about their identities. Specifically, "third space" involves "(forging) a third space for neo-abolitionist whites as neither enemy nor ally but a concretesubject of struggle" (Leonardo, 2013, p. 186) implying a non-static non-developmental nature of White identity development. He also mentioned that the notion of third space implies that the "history (of White people) is not determined by the originary sin of racismbut rather a complex web of contradictions that make up what it means to be white in anygiven context" (Leonardo, 2013, p. 95).

Utt and Tochluk (2020) proposed six ways through which White teachers could navigatethis third space. These were:

1. Understanding oneself
    (a) Analyzing privilege and microaggressive behavior
    (b) Exploring ethnic and cultural identities
    (c) Engaging with the history of White anti-racists and multiracial struggles forjustice
    (d) Developing intersectional identity
2. Accountable action in the community
    (a) Building White anti-racist community
    (b) Demonstrating accountability across race

Using Leonardo (2013)'s lens compels researchers to focus on tensions or struggles teachersexperience while exploring and negotiating with their White identity, instead of simply confining a teacher to a certain racial identity development "level". Further, Utt

and Tochluk (2020) proposal of observing White teachers' interactions at a community and systemic level addresses Leach et al. (2002)'s concerns of ensuring we study White racial group identity in addition to individual identity. Together, these scholarships provide me a way to analyze ways in which teachers explore their identities and connect those findings with prior literature.

Whiteness and Cultural Responsiveness in CS

Researchers have long focused on how whiteness can impact cultural responsivity and anti-racist education in the field of teacher education. Matias (2013) highlighted that unless teachers challenge White supremacy, they will remain complicit in its maintenance. According to her, if White teachers do not interrogate their whiteness and only focus on learning about the racial "Other", their cultural responsivity cannot be genuine. Matias and Grosland (2016, (p. 207)) also said "white teacher candidates and white liberal teacher educators (should) undergo the painful therapy of understanding their Whiteness, of asking why they feel uncomfortable talking about racism. Absent this process, they will not be well-equipped to engage in a process of antiracism." Utt and Tochluk (2020) proposed that White teachers should engage in understanding one's White self and perform accountable anti-racist acts in the community to truly engage in culturally responsive teaching.

In CS education, CRC approaches have been long used to challenge White hegemony in CS(Eglash et al., 2013a; Lachney, 2017; Sandoval, 2019; Scott et al., 2015). But researchers have only recently started focusing on White teachers in CS . I will first elaborate on ways CRC principles challenge whiteness. Then, I will elaborate on why we need more research on working with K-12 teachers to challenge whiteness in CS. As mentioned earlier, CRC considers the backgrounds, communities, experiences, motivations, and perspectives of students of color as assets that can be channeled to learn computing

(Eglash et al., 2013a; Scott et al., 2015). CRC is about more than just broadening participation in computing.

Scott et al. (2015, p. 420) proposed five tenets of CRC.

1. All students are capable of digital innovation.
2. The learning context supports the transformational use of technology.
3. Learning about one's self along various intersecting sociocultural lines allows fortechnical innovation.
4. Technology should be a vehicle by which students reflect and demonstrate an understanding of their intersectional identities.
5. Barometers for technological success should consider who creates, for whom, and towhat ends rather than who endures socially and culturally irrelevant curriculum.

The fifth tenet in particular alludes to a hegemonic "socially and culturally irrelevant curriculum" that students should not be subjected to. Researchers who have used CRC approaches have attempted to address these five tenets in various ways. For instance, Culturally Situated Design Tools (CSDTs) have been used to translate traditional knowledge present in Black hair-braiding, Appalachian, Anishinaabe, and Afrofuturist Quilting, Ghanaian Adinkra geometry, etc., in computing tools (Eglash et al., 2017; Eglash et al., 2006). This attends to the five tenets, as students who used CSDTs can not only explore various parts of their identities and the cultures of diverse communities around the globe,, but also they can challenge what is considered "common-sense" White hegemonic CS. Other researchers have focused more on civic participation through computing technologies, critiquing the Whiteness and racism in the society that does not consider

Black, Brown, Indigenous, and other women of color valuable, especially in STEM fields (Ashcraft et al., 2017; Scott & Garcia, 2016).

The majority of the work on CRC has focused on out-of-school or after-school contexts. Unfortunately, not all students, especially BIPOC, have access to computing resources outside of public school. Researchers have tried creative ways to address this issue and work with people in the K-12 space. For example, Lachney, Bennett, et al. (2021) highlighted an important case study where a White K-12 teacher worked closely with a Black cosmetologist and they both implemented coding lessons through CSDTs' "Cornrow Curves", a block-based programming tool used to explore mathematical concepts embedded in Black hair braiding. The study explored ways in which expertise was considered distributed, and not just a property of the White CS teacher, thus challengingwhiteness and hegemony. They proposed an "open village" concept where implementing CRC requires not just traditional educational stakeholders but also local cultural experts and other community members.

Other researchers have also worked with K-12 CS teachers and explored their thoughts around race and racism. Some have highlighted that the majority White CS teachers felt that the lack of student racial diversity happened because of students' misconceptions about CS (Gretter et al., 2019). Researchers have also focused more exclusively on teachers' race in their studies. In a CRC professional development workshop, (Goode et al.,2020) found that white CS teachers had color-evasive discourses when speaking about students' race and ethnicities). Goode and colleagues highlighted that the teachers often used terms like "my population", "that population", "anyone", "they", "them", "those people", and "urban students" without specifying the race of their students. Although the researchers did not use the lens of whiteness, they hypothesized

that one of the reasons for White teachers' discomfort could be a lack of familiarity with talking about race. (Goode et al., 2021) advocated for more professional developments in CS that explicitly center on race and equity. Although researchers are beginning to work with teachers in CS, especiallythe majority White teachers, there is still a dearth of exploring whiteness and White teacher identity in CS. For instance, there still remain questions about how CS teachers can feel prepared to fully explore race and racism in CS and be welcoming to things like the "open village" concept.

Study Purpose: Understanding how to Prepare Cs Teachers to Challenge Whiteness so that they are Prepared for CRC Implementation

Given the findings from prior literature, I believe that it is important for CS teachers to first reflect on their identities and whiteness before engaging with CRC. So far, no one hasexplicitly focused on whiteness and White identity exploration in CS education. I conducted a study where teachers will engage and explore whiteness and their identities.

This study addresses the following research question.

1. How do high school CS teachers reflect on their own racial/ethnic White identity?
2. How do these teachers discuss the ways in which they envision and negotiate White privilege?
3. How do these teachers discuss the ways in which they see the connections between CS, race, and racism?
    (a) What are some ways in which they address their thoughts on CS, race, and racism in their CS classrooms?

Methods

Participants

Over the course of my PhD, I had the chance to interact with a group of about fifteen high-school CS teachers. These teachers taught AP CS Principle, a course specifically designed to broaden participation in CS. All of them happened to be White and attendedthree Zoom workshop sessions on CRC during the summer of 2020. They had been recruited through a local chapter of Computer Science Teachers Association (CSTA) mailing list. During the workshop, teachers had opportunities to think about Whiteness and reflect on their own identities by completing identity wheels before and after the workshop.

From this group, I recruited three teachers based on their interest and high commitment levels towards exploration of CRC. I gauged the interest levels based on previous quick responses to emails, completion of activities in prior workshop, and willingness to speak andengage in discussions during prior workshop. I offered these three teachers a compensation of $500 each to participate in the entire study, which was conducted over Zoom in late Fall2021. Table 1 includes a short description of each teacher to help contextualize the background and potential epistemological perspectives they would bring in.

Important Additional Context

This study took place in Fall 2021 and early Winter 2022. During this time the teachers in my study were facing many challenges due to the state of the world. First, there was a school shooting in an area near them. This caused their high-schools to be closed for a couple of days and a general emotional distress amongst the community. During this period, I reached out to the teachers through an email expressing my support, a personal gift of $6 Starbucks gift card each, and time off from their required workshop

activities for about one and a half months. I also rescheduled (the second time) the last part of the workshop as one of the teachers was unwell, and all were overburdened, during the omicronvariant uptick of the COVID pandemic. I am extremely grateful for the teachers continuedparticipation despite all the physical and mental stressors they were facing.

Table 1. Teacher Details

Teacher Pseudonym	Demographic Details	Context and Background
Carl	Man, White, Middle-Class, Age range: 30-40	Carl teaches Cybersecurity and Web Design. He believes his school is racially and ethnically diverse as many of his students are from recent immigrant families. His CS classrooms are around 60% White, 20% Asian, and 10% Black. He is interested in exploring anti-racist topics in his CS classrooms as he believes "technology can go either way, depending on the human who is programming it." Additionally, he thinks these topics are important for the global society and will help him become a better educator.
Fiona	Woman, White, Middle-Class, Age range: 30-40	Fiona teaches Advanced Placement CS A (AP CSA) and Java programming. Most of her CS classes have boys and they are White or Asian. She has very few Black or Brown girls in the classroom. She wants to learn more about technology's rolein amplifying "institutional racism" and how she can help address it. She feels that engaging in this work will help her become a better mom and a better teacher. She also feels like she has a moral obligation to do the work.
Ray	Man, White, Middle-Class, Age range: 30-40	Ray teaches AP CS courses (though not in the current year), Intro to CS courses, and some Python programming. His school is over 90% White and his CS classes reflect that. His classes also tended to have a majority of boys. Ray wants to do anti-racist workin his CS courses as he thinks it's a very prominent issue, especially in the current climate.

Structure and Composition of the Workshop

This study relates to the first part of the workshop, in which the teachers pictorially reflected on their identity by using pictures to self-describe various parts of their identity, read articles on Whiteness, and had a group discussion about the articles and their identity reflection. The workshop had asynchronous and synchronous components. First, I had a brief interview and conversation session with me, the researcher. I refer to this as "Individual introductory conversation/interview with researcher". Please refer to Appendix A for an overview of the questions I asked. After this session and before attending the synchronous part, the teachers worked by themselves on an asynchronous module that included two short non-academic articles for them to read. The two articles were.

1. Why talk about Whiteness? (We can't talk about racism without it) In addition to whiteness, this article also has a section on White privilege and touches briefly on White supremacy.
2. A black professor offers advice 'For White Folks Who Teach in the Hood' (by Prof. Chris Emdin)

I had several reasons for choosing these articles. First, I believed that the non-academic nature of the articles will be more approachable to teachers. Second, I valued the sources. The first article is by the organization Learning for Justice founded by the Southern Poverty Law Center (SPLC) and its mission is, "To be a catalyst for racial justice in the South and beyond, working in partnership with communities to dismantle White supremacy, strengthen intersectional movements, and advance the human rights of all people". The second article is by Prof Chris Emdin, who is a scholar with a focus on passionate about hip-hop education, STEM education, politics, race, class, diversity, and youth empowerment. Finally, I believed that given the focus of these two articles on

understanding Whiteness, White privilege, and racism, they would help White CS teachers explore whiteness.

After reading the articles, the teachers filled an identity wheel created on Google Slides (See Figure 1) with pictures and phrases. There were four slides in the identity wheel, withthe following titles 1) Race, 2) Ethnicity, 3) Gender, and 4) Class. After filling the identitywheel, they answered the following questions, also asynchronously.

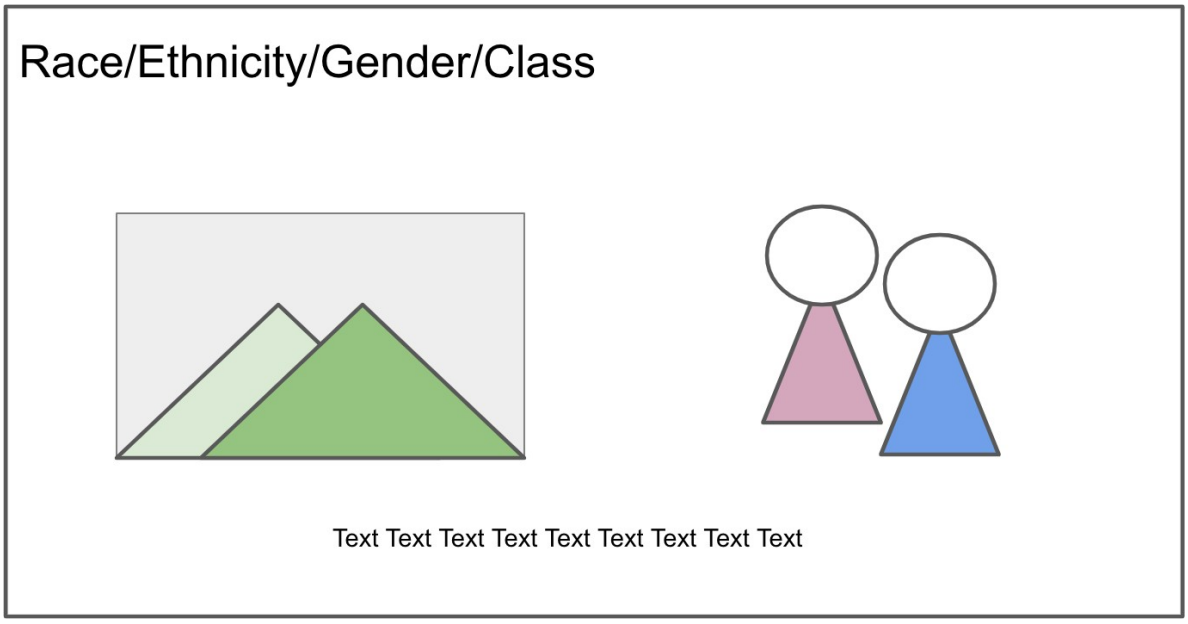
1. What are your identities you think about most often?
2. What are your identities you think about least often?
3. What are your own identities you would like to learn more about?
4. What are the identities that have the strongest effect on how you perceive yourself?
5. What are the identities that have the greatest effect on how others perceive you?

I used the four categories based on University of Michigan's Social Identity Wheel developed for inclusive teaching at their College of Literature, Science, and the Arts (LSA). I used a condensed version of the full identity wheel in which teachers only reflected on their race, ethnicity, gender, and socioeconomic status, excluding categories like religion.

Utt and Tochluk (2020) mentioned that one way White teachers can explore their full identities is by understanding their intersectional identities. They said it would help teachers who prioritize their gender or class-based disadvantages be required to explore their race-based advantages simultaneously. Further, I believed separating 'race' and 'ethnicity' would be helpful for teachers to reflect separately on their race and (if present) their European ancestry. Unfortunately, having too many identity categories to reflect on may also be a disadvantage, as in the past teachers have used religious discrimination and

European non-English language ancestry to deflect talking about race (Picower, 2009). To fill the identity wheel, the teachers used pictures that describe various aspects of their identity, like race, gender, and class. Prior research has shown that pictorial representation and digital storytelling has helped teachers to be more explicit in the presentation and reflection of their racial identities (Matias & Grosland, 2016; McIntyre, 2002). I hoped that in using pictures of their own selection, the teachers in my study would become more explicit and reflective. To aid their reflection, they could also write any other thoughts about their identity in addition to the pictures in one or two sentences.

Figure 1. Identity Wheel Representation



After the asynchronous activity, the teachers joined me for a synchronous Zoom session. The synchronous part of the workshop engaged teachers in collective reflection, which increases the possibilities for the teachers to see themselves as a racial group (McIntyre, 2002). First, we introduced ourselves and had an ice-breaker discussion which mostly consisted of introductions and checking in with people's schedules, their work in

schools, and how they were navigating the COVID pandemic (15 min). In the next part of the session (30 min), we discussed each article as a group using discussion prompts . In the third part (45 min), each teacher presented and described their pictorial identity wheel. We then discussed their thoughts on the activity (with the help of some prompts), specifically their thoughts on explicating their racial identities. In the final part of the session (30 min), I asked some questions about whiteness and White hegemony present within CS and CS curriculum. I used examples like racial biases in technologies to facilitate a brief group discussion about the topic. Please see Appendix A for the various prompts used during the synchronous session. I have listed below all the activities in the synchronous workshop in order.

1. Ice-breaker (15 min)
2. Group discussion on articles (30 min)
3. BREAK (10 min)
4. Presenting identity wheel and following group discussion (45 min)
5. BREAK (10 min)
6. Discussion on White hegemony in CS (30 min)

Data Collection

I primarily had two sources of data in this study. The first source of data was the completed identity wheels, which had pictures and text. The second source of data was the recorded Zoom session, which were transcribed using https://otter.ai/. The software was able to recognize and transcribe multiple people speaking. I also saved the video of the session to ensure I correctly capture who spoke when. As there are different aspects to the data, listed below is how I separated them for analysis.

1. Individual introductory conversation/interview with researcher

2. Individual identity wheel data
    (a) Teachers' identity wheel data (asynchronously filled identity wheel)
    (b) Data from the individual explanation of the identity wheels in the workshop
3. Data from the group discussion on Whiteness and White hegemony
    (a) Group discussion on identity wheel
    (b) Group discussion of the articles
    (c) Group discussion on White hegemony in CS

Context of Data Analysis: Embedded Single-Case Study

My study is an embedded single-case design, with multiple embedded units of analysis (Yin, 2009) (see Fig 2). I wish to highlight here that Yazan (2015) mentioned that there isyet to be a full consensus of case study as a methodology in the field of education. But, they underlined three approaches by scholars Yin, Merriam, and Stake and advocated thatscholars use a "combined perspective which best serves their research purpose" (p. 134).

So, although I use Yin's model of an embedded single-case design, my definition of a case and case study approaches, my epistemology, and my analytical approaches align more closely with Stake (1995) and Merriam (1998). For instance, I too think of a case study as "an intensive, holistic description and analysis of a *bounded* phenomenon such as a program, an institution, a person, a process, or a social unit" ((Merriam, 1998, p. xiii, emphasis added). In my particular situation, the "unit/phenomenon" or is the culturally responsive computing workshop the teachers attended. Further, Yin was more of a positivist which differs significantly from my epistemology. Stake and Merriam were more constructivist, which too is slightly different from the critical perspectives I bring to this work. Further, Merriam's suggestions of analytical strategies include ethnographic analysis,

narrative analysis, phenomenological analysis, constant comparative method, content analysis, and analytic induction. Stake, however, suggested a more expansive notion and said that "Each researcher needs, through experience and reflection, to find the forms of analysis that work for him or her". So of all three scholars (Yin, Merriam, and Stake) my analytical approach is probably closest to Stake's suggested techniques as I used a discourse analysis technique to analyze my case study.

Case Study's Embedded Units of Analysis

There were three elements that formed the case (i.e., the CRC workshop). In each of thethree elements, I explored with the teachers the concepts of White identity reflection, White privilege, and teaching CS as a White teacher. These three elements form the different embedded units of analysis in my case study. See Figure 2 for a visual representation of my case and context.

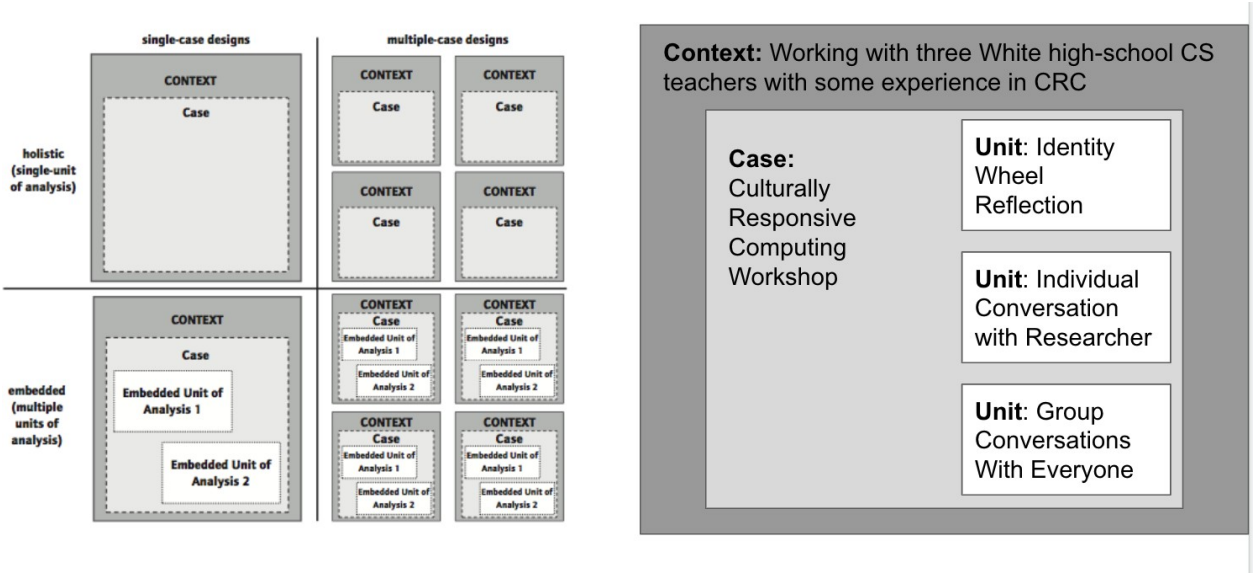
The three elements of the workshop were captured through several ways

1. Individual conversations of the researcher with each of the three teachers (audio transcribed to text, accompanying video)
2. Identity reflection from each of the three teachers had the following elements:
   (a) Google Slides with images and phrases for identity representation (text, image)
   (b) Teachers' explanation of the Google Slides (audio transcribed to text, accompanying video)
3. Group conversations together with all teachers (audio transcribed to text, accompanying video)

Thus across these three elements, I had 1)Textual data from audio/video transcription, 2)Images, and 3) Video data. I used the textual data as my primary data sources, with theimages and video data as a way to bolster and triangulate findings from

the textual data.For instance, the textual data from the "teachers' explanation of the Google Slides" was my primary source of data analysis. The images used in the Google slides helped bolster the themes found from analyzing the textual data.

Figure 2. Description of single-embedded case study



Discourse Analysis: Analysis of the Textual Data

To analyze the conversations that were text-based, I used Discourse Analysis. According to Gee (2004), "Essentially a discourse analysis involves asking questions about how language,at a given time and place, is used to engage in the seven building tasks [which are: 1.

Significance, 2. Practices, 3. Identities, 4. Relationships, 5. Politics, 6. Connections, 7. Sign Systems and Knowledge]" (p. 140). Also, according to Gee, words, language, or discourse, is used to build things around us, especially the seven different items mentioned above. Specifically, he said "Whenever we speak or write, we often (and often simultaneously) construct or build seven things or seven areas of "reality". Let's call these seven things the "seven building tasks" of language." (p. 32). In Table 2, I have listed how Gee envisions the way language shapes the building of the seven tasks.

Table 2. Gee's Building Tasks

Gee's Building Task	Meaning of the Building Task
Significance	We need to use language to render [something] significant or to lessen their significance, to signal to others how we view their significance.
Practices	We use language to get recognized as engaging in a certainsort of practice or activity. A practice is a socially recognized and institutionally or culturally supported endeavor that usually involves sequencing or combining actions in certain specified ways
Identities	We often enact our identities by speaking or writing in such a way to attribute a certain identity to others, an identity that we explicitlyor implicitly compare or contrast to our own
Relationships	We use language to signal what sort of relationship we have, want to have, or are trying to have with our listener(s), reader(s), or other people, groups, or institutions about whom we are communicating
Politics (the distribution of social goods)	We use language to convey a perspective on the nature of the distribution of social goods, that is, to build a perspective on social goods
Connections	We use language to render certain things connected or relevant (or not) to other things, that is, to build connections or relevance.
Sign Systems and Knowledge	We can use language to make certain sign systems and certain forms of knowledge and belief relevant or privileged, or not, in given situations; that is, we can use language to build privilege or prestige for one sign system or way of knowing over another.

First, I narrowed the list of seven building tasks down to five as my research questions relate especially to five of these building tasks, 1) Identity, 2) Politics, 3) Practices (Activities), 4) Relationships, and 5) Sign Systems and Knowledge. As a

reminder, theseare my research questions. The brackets depict how they relate to each building task.

1. How do high school CS teachers reflect on their own racial/ethnic White identity? **[Identity]**
2. How do these teachers discuss the ways in which they envision and negotiate Whiteprivilege? **[Politics, Relationships]**
3. How do these teachers discuss the ways in which they see the connections betweenCS, race, and racism? **[Politics]**
    a. What are some ways in which they address their thoughts on CS, race, and racism in their CS classrooms? **[Practices, Sign Systems and Knowledge]**

After narrowing down the five building tasks, I created directing questions as I analyzedmy data for conversational motifs or themes around identity, politics, relationships, and practices. These directing questions related to both the building task and the research questions. The directing questions are listed in column 2 of Table 3.

Once I had my directing questions, I read all the data sources line by line, especially looking for conversations that related to these five building tasks, the directing questions, and how teachers' words shaped their understanding and building of these four tasks. Dueto this line by line reading, four motifs emerged as they related to teachers' identities. I used NVivo to categorize conversation segments that built and created each of these four motifs. I also had used NVivo to color-code the motifs, as this helped me see how the teachers went back and forth to a thread of conversation around a certain motif. For instance, the teachers often went back to the "tensions are required" motif/conversational thread during the group conversation session. In the results section, I used these conversational threads to help describe the richness of each motif.

I give here an example of how I arrived at the motif, "Teachers debated about White privilege: Is this different from other forms of privilege? How can teachers use their White privilege?" The specific building task that helped me arrive at this motif was related to politics (see Table 3): how people use words to 'create, distribute, or withhold social goodsor to construe particular distributions of social goods as "good" or "acceptable". Given this explanation of politics and distribution of goods, I felt this relates to the notion of Whiteness as a property and how privilege and benefits are distributed or withheld becauseof Whiteness. Thus, I narrowed the following as my "direction question" or what I had to keep in mind as I read the transcripts: "Distribution/withholding of social goods is akin to the concept of "Whiteness as a property" (Annamma, 2015). Who gets the benefit of Whiteness as a social good? Why? How do they benefit from it?". As I did a line by line analysis, I focused on when teachers spoke about certain forms of privilege due to Whiteness. For instance, Ray spoke about four generations of his family living in the same neighborhood due to property rights. I gathered such instances of speech and grouped such quotes and examples under one motif and I tiled this motif "Teachers debated about White privilege…" as the contents of this motif related the most to White privilege and Whiteness. Through such a process, I found four motifs overall. These were:

1. Teachers complicated White Identity: sometimes a monolith but at times more nuanced
2. Teachers debated about White privilege: Is this different from other forms of Privilege? How can teachers use their White Privilege?
3. Teachers agreed that tensions and discomfort they feel is required: They said although uncomfortable, it was ultimately helpful for their growth

4. Teachers shared their intentional approaches to begin discussing race in CS classrooms: Practices included setting the tone of the classrooms, projects, and classroom material

Figure 3. Data analysis procedure

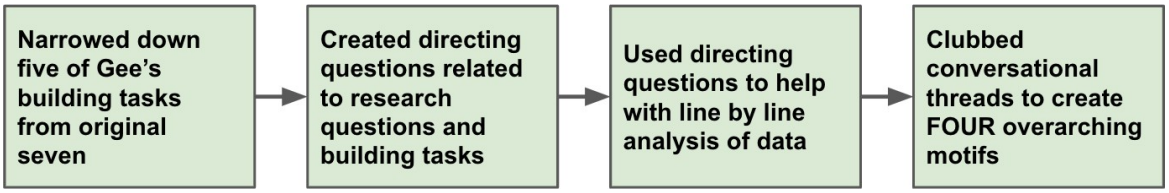


Figure 3 gives a pictorial breakdown of my data analysis procedure. Table 3 gives a comprehensive overview of the relationship between Gee's building tasks, how these tasks relate to my research (i.e., the guiding question for my analysis), the data sources I used (the embedded units of analysis), and the overarching motifs (themes) I found across the data sources.

Analysis of the Images and Video Data

As I mentioned earlier, I used images and video data as a way to bolster and triangulatefindings from the textual data. For instance, one teacher, Ray, specified that he felt his White identity felt like a part of a monolith. To support this statement, he used an image of a "White Wonder Bread" on his Google Slides identity reflection to describe his identity.Thus, in this case, I used the image to refine the motif of "Teachers' complicated White Identity: sometimes a monolith but at times more nuanced".

I used the video data to help me with different facial expressions and pauses as they related to teacher comments. For instance, Ray spoke about redlining benefiting White folks, Fiona agreed with him by nodding her head. These instances also helped me refine my motifs and add these details when I share teachers' quotes in the results section.

Table 3. Overarching motifs across data sources

Gee's Building Tasks	Gee's Building Tasks as they relate to this research (directing questions)	Data Sources (embedded units of analysis)	Overarching motifs across data sources
Politics: How are situated meanings, social languages, figured worlds, intertextuality, Discourses, and Conversations being used to create, distribute, or withholdsocial goods or to construe particular distributions of social goods as "good" or"acceptable"or not?	Distribution/withholding of social goods is akin to the concept of "Whiteness as a property" (Anamma, 2013). Who gets the benefit of 'Whiteness' as a social good? Why? How do they benefit from it? How does it shape White privilege?	Teacher's Identity Wheels Teacher's Individual Conversations With Researcher Teacher's Group Conversations	Teachers debated about White privilege: Is this different from other forms of privilege? How can teachers use their White privilege?
Relationships: How are situated meanings, social languages, figured worlds, intertextuality, Discourses, and Conversations being used to build and sustain (or change or destroy) social relationships?	Leonardo's (2013) conception of the Third Space, emphasizes the presence of tensions that neo-liberal White folks may experience while exploring conceptions anti-racism. What tensions do the teachers feel about the relationship with themselves, other White folks, or BIPOC?	Teacher's Group Conversations	Teachers agreed that tensions and discomfort they feel is required: They said although uncomfortable, it was ultimately helpful for their growth

Table 3. (cont'd)

Gee's Building Tasks	Gee's Building Tasks as they relate to this research (directing questions)	Data Sources (embedded units of analysis)	Overarching motifs across data sources
Practices (Activities): How are situated meanings, social languages, figured worlds, intertextuality, Discourses, and Conversations being used to enact practices or activities in context?. Sign Systems and Knowledge: How are situated meanings... Conversations being used to privilege or disprivilege different sign systems (e.g., languages) and ways of knowing?	How do teachers reflect on their classroom practices and activities as they explore racism and CS? How do they explore their practices as a White CS teacher? What activities or forms of knowledge/belief do the teachers privilege over others?	Teacher's Individual Conversations With Researcher Teacher's Group Conversations	Teachers shared their intentional approaches to begin discussing race in CS classrooms: Practices included setting the tone of the classrooms, projects, and classroom material

Analysis of Individual vs Group Dynamics

I kept track of individual comments that contributed to each motif and group conversations that contributed. In the results section, I elaborate on how each conversation type contributed to each motif. For instance, at an individual level Ray indicated a more monolith White identity by his words and also by sharing an image of a "White Wonder Bread". But Carl indicated by speech his understanding of a White identity that is broad and nuanced and by sharing his own image, instead of any stock image from the internet, in the individual level Google Slides activity. In group conversations, they further empathized their differences in views through conversation and debate. Together, both these sources: individual level and group level, helped me refine the refine the motif of "Teachers complicated White Identity: sometimes a monolith but at times more nuanced"

Results

In this section, I discuss my findings related to the four motifs mentioned previously. I elaborate on the motifs using the teacher conversations. I will be indicating the source of the conversation (individual or group). I have added emphasis on certain phrases that theteachers kept revisiting in their conversations.

Teachers Complicated White Identity: Sometimes a Monolith But at Times More Nuanced

We began discussing White identity together as a group when we discussed the article,"Why talk about Whiteness? (We can't talk about racism without it)".

Carl opened his thoughts on his article by sharing how he conceptualized Whiteness andWhite identity and how he was still working through its nuances. He said,

> When you say someone's White, White means a lot of different things. I mean,a lot of Arabic people consider themselves as white. I'm part Greek. I mean, you know, that's still part…you know, they're still Middle

> Eastern. And, you know, I mean, I consider myself White too. But when you say someone's White,what do we get? What do you define as White? What does that mean?. I mean, White is just a very, it's like a paintbrush. (Group conversation)

The conversation then side-stepped to privilege, but then came back to how they defined White identity when Fiona said the following, "I can't remember exactly what I was gonnasay. But I was just gonna piggyback up also, I meant to mention that I agree with Carl's initial remarks about it being such a, you know, such a broad paintbrush, and, you know, where do you identify in that in that large group of Whiteness?" (Group conversation)

To add to this narrative of a 'complicated' White identity, in their individual identity reflections, both Carl and Fiona alluded to their ethnic identity (their country of origin) inaddition to their racial identity. Further, while depicting their identity wheels, they used their own pictures to describe their identity.

For instance, Carl said, when talking about his identity, said "My ethnicity [is partly] Greekand English. So my mother was from Greece and my father is a third generation from England. Gender, male, and socioeconomic status. I would say I would consider myself upper middle class I guess." (Individual sharing of identity wheel). Later, when reflecting on his identity wheel activity, he said "And also, we are all immigrants here. I mean, none of us are 100% [American]. " (Group conversation).

Fiona, talking about her own racial and ethnic identity said,

> As far as a race goes, I am White. And ethnicity is interesting, because I am Italian and Finnish. My dad was Finnish and my mom's side is Italian. Now, Igrew up with a single mom, my dad passed away when we were little.

> So that kind of just naturally we spent more time with my mom's side of the family, which is Italian. And so culturally, even though I'm more biologically Finnishthan I am Italian, um, that was really a huge part of the culture growing up, especially the food, and then I actually married my husband [is] 100% Italian. So that has continued on. the Finnish genes I think are strong because our two kids are blond haired, blue eyed kids, but I think more culturally growing up [have] identified with the Italian side. (Individual sharingof identity wheel)

Thus, Fiona felt that although she looked phenotypically Finnish, she felt more in touch with her Italian heritage internally. For her, this complicated the meaning of a White identity because of a mismatch in the way her family looked outwardly and the cultural practices they actually partook in. According to her, her White identity was more nuancebeyond the external looks.

Ray had a slightly different take on his White identity. Although he also alluded to his ethnicity and country of origin, he felt that, "Just thought of transition from that first slideto like our race to our ethnicity, the race, the ethnicity is all kind of. . . streamlined into a single race. (Group discussion)"

Figure 4. Ray's self description of his racial identity

He mentioned he felt conflicted about his ethnic identity because of the several generations of family living in Michigan. He said,

> Because that whole broad [paintbrush] of Whiteness, I think I am pretty muchthat broad brush. Like everybody kind of brushed us out. They're like, "Hey, here's your Whiteness culture". That pretty much defines me. So like for my race, like pretty much standard White bread..Caucasian. Not much diversity inmy background unless you go generations and generations back. My ethnicity there is Swiss, if you go far enough back, but really, it's…. it's Michigan for like, four generations back on both sides of the family. They all grew up in the sametown in Michigan, they all lived within like 15 miles of each other. For at least four generations back. I mean, there [are] 95 year olds still get together for breakfast who all were born in the same town in

> Michigan… So yes, it's one of those like, yeah, I have Swiss culture. I mean, but not really. (Individualsharing of identity wheel)

Unlike Carl and Fiona who shared their individual pictures in their identity wheels, Ray shared a picture of a White Wonder Bread to emphasize the "broad brush" stroke of Whiteness he thought he fell under. Thus, together, the teachers discussed the different ways in which they conceptualized their own identities. In part, their conceptualization of their racial identities affected ways in which they thought about White privilege. For instance, conversations of White privilege often can get side-stepped due to comparing certain White immigrant experiences. On the other hand, the realization that generational continuation of White folks living in the same land/area can contribute to realization of White privilege. We see effects of such instances in the next motif.

Teachers Debated About White Privilege: Is This Different from Other Forms of Privilege?

When we as a group "Why talk about Whiteness? (We can't talk about racism without it)", apart from discussing the meaning of White identity, the teachers also discussed White privilege. As mentioned earlier, both Carl and Fiona were examining White privilege and identity through multiple lenses, which also included the lens of early Whiteimmigrant experiences. In the next following conversational excerpt, you can see how Fiona thinks of certain White immigrant experiences as not always privileged but also much more privileged than what Black folks experienced. Fiona said,

> I think sometimes there's this notion that they're like immigrants, as Carl was saying, like, you know, there was influx of like, Irish immigrants and Italian immigrants that faced a lot of discrimination during that time period, like, you know, early European immigration. And so I think sometimes White ethnic people like White Italians or something like that will say, well,

> you'll get we pulled ourselves up by our bootstraps we were also discriminated against, and look where we are now or something..[But there were also] like this huge influxof like programs to help people and you know, and help get rid of that discrimination, and then help with job opportunities and stuff like that. And those same things weren't like afforded to Black people who were experiencing those same things as they migrated [to the] north from the south. (Group conversation)

Apart from the immigration perspective, Fiona also shared the following

> [Some people are] White, but they wouldn't consider themselves privileged. Maybe they had a disability. Maybe socio economically they weren't advantaged or privileged at all. And I think that's where sometimes that… word defensiveness comes in, because you look at a White privilege and like, wait, I didn't have any privilege. But just again, if you take everything away, the colorof your skin gives that privilege even though you struggle with other things. I thought that was [a] really nuanced point. That was important. Yeah. (Group conversation)

[Interviewer thanks her and speaks about intersectionality and oppression along various dimensions and asks teachers' thoughts about systematic privilege. Fiona continues her thoughts]

> …denying that the country sort of founded and still works in a sort of a white supremacist are based on like White supremacist principles like for sure foundedin that way. And then obviously those continue on, even to today in a lot of really real ways. And denying that is really harmful. So, you know, it's not enough to just say, "Well, I'm not racist, and I would never do

> anything harmful to another person". Also, not recognizing that the society that you live in is doing that, and that you are benefiting from it by, you know, simply having the color and skin that you do. So I think that's an important acknowledgement. (Group conversation)

Here you can see that Fiona was thinking about migration, socio-economic status, and (dis)abilities at the same time as other forms of benefits that White folks have had. She did not specifically allude to the transatlantic slave trade, slavery in the Americas, or theJim crow laws, but did acknowledge the lack of privilege of Black folks during The GreatMigration. Overall, she was trying to wrestle with and understand how White identity affords people privilege.

When Fiona mentioned programs that benefited White immigrants and not Black folks, Ray nodded in affirmation, added his own thoughts, and said,

> But not only were like.. the systems there to pick [White] people up, there wasn't a system in place to keep White people down. . . So maybe there wasn't aprogram for you individually, your family individually, to bring you up, but there wasn't a program that was intentionally there to kind of keep you down… You were afforded maybe the job interview, because your name looked like a White name, right? Instead of a Black name or a [non-White] migrant name or something like that. So not only were [there programs to benefit Whiteimmigrants to] lift us up, but there was no inherent bias generationally, and legally, to keep us down either. (Group conversation)

He attributed this aspect, that nothing systematically has kept White people "down" to a form of privilege that was afforded to White folks, but not others like Black folks or non-White migrants. Ray was also thinking of his ancestral benefits as he

navigated thenotion of White privilege and alluded specifically to racist laws. For instance, he said,

> …because I'm White, right. So my ancestors have been able to get different mortgages or as a White culture, they don't do that. The White culture has put Jim Crow laws, to, maybe not individual identity, but that system was in place to give a leg up. And that leg up, we're seeing generations beyond much more now. Because there is that gap created between generational wealth between being able to buy houses and being able to pass those down… So even if I don't see those individual benefits every single day, those benefits are therethroughout the societal itself, society itself. (Group conversation)

Apart from acknowledging his privilege, Ray also spoke about how he could use his privilege to an advantage. To give some context, in the political climate when this study took place in 2021/2022, politicians, the media, and many members of school boards across the nation were censoring topics related to anti-racism and the tenets of critical race theory. This phenomena also influenced parents who were critical of teachers who wanted to speak about anti-racism. Despite this opposition, Ray said that he felt comfortable having conversations related to anti-racism, despite "squeaky wheel parents" who may object and complain. Here, we see Ray talk about using certain benefits, like the vast number of jobs in the CS field, as his leverage.

> If they fire me, they're not going to be able to find someone to replace me. So at this point in time, like I feel pretty safe having those conversations. Talk to me 10 years ago, I probably wouldn't. [10 years ago] I know that there was somebody in mind to take my job as soon as I was leaving. So we didn't have that leverage. Now, in the economic situation that we have, for our field,

> I feel much more secure that even if I did [lose my job], I'll probably go down thestreet, find a new job. (Group conversation)

This quote also highlights how Ray is using his privilege, not only as a CS teacher in high demand, but also as a white teacher to challenge White parentswho may be critical of anti-racism within his classrooms. Ray and Fiona shaped much of the discourse around privilege. Carl did not actively take part in these discussions around White privilege. It is not clear why he chose to not take as much of an active role. In the next section, we see how the teachers mentioned specifically about the tensions teachers felt.

Teachers Mentioned that Tension and Discomfort They Feel Around Anti-Racism is Required For Their Growth

The mention of tensions and discomforts first arose when the teachers started discussing the article "A black professor offers advice 'For White Folks Who Teach in the Hood' (by Prof. Chris Emdin)" The teachers spoke about navigating anti-racist topics as a White CSteacher. Fiona started the conversation around what the article said in its final paragraph:

> "What you do is understand that the tension that you're feeling is not a negative thing," (Prof. Emdin) said. "Anything that helps us collectively growwill at some point make us feel uncomfortable. I think tension is actually the seedbed for growth." (Group conversation)

[She continued her thoughts after the interviewer asked a few more questionsabout her perceptions of tensions]

> I'm looking at just basically the last sentence of the article about understandingthat the tension or maybe the discomfort that you feel is good, it kind of meansthat you're working towards progress, and it shows growth.

> Because a lot of times, I think, you know, and I can speak from personal experience, sometimes you don't engage in conversations like this, because it does start to make you uncomfortable or make you have a sense of guilt or shame or something like that. And, and…. it was a good reminder that any kind of tension that you feelor discomfort is actually good, it means you're doing the work, it means you're kind of talking about things that need to be surfaced. So I thought that was a good reminder at the end of the article. (Group conversation)

Ray agreed with this general sentiment by nodding and by affirming Fiona verbally. I as aninterviewer, then, asked the teachers if they had always felt this positively about tensions. Fiona, then, added her thoughts on how she used to be actively discouraged to broach certain topics, especially in terms of societal expectations and relationships as she grew up.She said,

> Years ago, sort of the adage of like, "Don't talk about politics or religion or whatever." You know, there's a couple sort of "off" topics. . . things. And I thinkthat by making those "off" topics and making those things that we didn't talk about, probably continued the system as part of like, keeping up the system that works more towards you know, White people than it does towards other people by saying, "We don't talk about this. We don't bring up these things." And so I think people maybe. . . , me included, fell in line with that, because there is that sense of discomfort when it comes to that and recognizing, you know, your own biases that you have, recognizing, you know, things that you, you know, you gain privilege from and things like that. (Group conversation)

Here, one can see Fiona reflecting on whether her privilege helped generate the narrativeabout not talking about "off topics" like race and racism. She, then, spoke about how it was fair for folks with privilege to be uncomfortable. She further mentioned how it was important for teachers to be uncomfortable as well. Specifically, she said,

> And I think that's a fair exchange, like you should it, you know, exchange your level of comfort and like, just the kind of surface level conversation that you know, that you'd have at these family things or, or other gatherings and stuff like that, for, you know, for that discomfort, because that means that you're making progress. . . But at schools. I think a lot of times, too, you know, us as teachers, we didn't want to have those uncomfortable conversations. And now, I think, hopefully, people are leaning more into that, because they know that that will bring about progress. But yeah, there was definitely a time where, youknow, you don't want to like. . . stir things up, or you don't want to, you know, offend anyone, or, or whatever. . . call people out. But I think there's a way to do it. Now that brings about progress. (Group conversation)

It is interesting to note how Fiona, a White CS teacher, similar to Ray could use her privilege to discuss anti-racism in her classroom. Ray also added his thoughts on having "heated conversations" and navigating tensions as a teacher with his majority White students who might be hearing stereotypes and propaganda at home, giventhe anti-critical race theory rhetoric in many communities. He said,

> [I've] become much better at not only [being] okay with the tension because I've also become more educated. . . Reading, finding other things, finding fact based arguments to counter the propaganda that some of the kids have heard

> athome… so we can steer the direction into a fact based thing rather than just propaganda argument where it just gets [into] heated tensions and everything. We can break it down, and actually have that conversation about, "This is why what you're [i.e., the students] saying is hateful. This is where that stereotype might come from, this is where it came throughout history, thisis why that is offensive." So as I've been learning and growing, too, and makes those tensions a lot easier, because we can have a conversation that is much more fact based and data based. And there's not much argument they [the students] can do with that other than, "Well, I just don't like that [i.e., a comment that challenges their mindsets]". So that allows the tensions to kind ofdie down and evolve from that. (Group conversation)

Thus, Ray was thinking about not just how and why tensions might be helpful, but also how some tense conversations can eventually lead to some desirable change he wants to seein his students. He was thinking about what tensions might lead to for his students.

Again, Ray was thinking about using his privilege to challenge his students' thinking aboutrace and racism.

Finally, Ray also talked about tensions in his mind that arose from being a group of onlyWhite teachers discussing anti-racism. He felt that this was at odds with dismantling power structures as Whiteness has the most amount of power in schools. He shared,

> I'm also brought back to the whole systematic racism that we have around because we're on a panel talking about cultural diversity in a CS classroom. And we are all like, White, upper middle class based on what we have. So that that creates that automatic divide on that difficulty. . . And that just

> systematicview of okay, the power in the building [i.e., schools] is White. Right? So we have that just ingrained into our subconscious that is built into the structure ofschools to just looking at and talking through here. So it just kind of brought me back to thinking about the systematic [racism] in the country itself. And the system we have like its present, even here as we're talking to, presenting ourvaried backgrounds, but those very backgrounds still funnel into one spot, right? They funnel into that broad brush of Whiteness and power in the school buildings. . . (Group conversation)

Carl agreed with Ray that they [all three teachers in the workshop] all share very similaramounts of power as White teachers, despite their somewhat different backgrounds. But apart from this aspect, Carl did not share much of his thoughts to build conversation around this motif of tension and discomfort around anti-racism and teaching as a White teacher. He seemed more comfortable to engage in introducing topics of biases, equity, and diversity in his CS classroom rather than explicitly discuss anti-racism.

Teachers Shared Their Intentional Approaches to Begin Discussing Race, Racism,, and Anti-Racism In CS Classrooms

The conversation around discussing race and racism in CS classrooms started when I askedthe teachers how they create opportunities for students to talk about themselves and their identities in CS classrooms. Carl began by saying,

> I think the way I do it is I show a lot of like documentaries, regarding the issue to like, for example, Coded Bias, I show that documentary. So a couple other ones about like, social media and bullying on social media, and how, you know,that whole debacle. But also in the first week of school, to

> like going back and you know. . . talking about what [we teachers do] on the first week of school, I always bring in my different experiences in teaching and teaching in different diverse communities like [redacted] and [redacted]. And by doing that, I think alot, especially the African American students, they just naturally gravitate to me, because they know, I've taught, you know, in Detroit for about four years. So I mean, I understand where they're coming from and their point of view. SoI think that's helpful. (Group conversation)

Here Carl spoke about how he tries to show documentaries on the topics he is interested inwith respect to computing, society, and broadening participation. He also spoke a bit about how he tries to forefront his own identity and experiences as a way to connect to hisstudents. In a short while, I asked the question about how explicit they are about being anti-racist in their CS classrooms. Then, Carl shared the following,

> Again, going back to the documentaries that I show a lot, I do show a lot of documentaries, and I think that helps bring, especially particularly with the females of color, it does help and bring to their forefront of their minds, the issue that you know, that they are making a difference by pursuing computer science in a few [years] while when they go on to college, pursuing Computer Science major. (Group conversation)

Although Carl looked at documentaries as an opportunity to tell young women of color that they are making a difference in the world by being involved in CS, he tied it to specifically pursuing CS majors in college. Clearly, Carl sees broadening participation of women of color into CS as an important aspect of addressing anti-racism in CS. But, one can wonder: what pressures might young women of color face, if they but are simply told

"they are making a difference" but aren't provided with the required tools and support for them to thrive in CS?

Apart from Carl, Fiona also had a few thoughts to share about addressing racism in her classrooms. Her strategies had to mostly do with setting the tone of her classrooms to beequitable. She said,

> I kind of tell them, like, I am a pretty flexible person as far as like, you know, you're you have something going on, personally, and you can't take a test, I'll give you an extension on that. I'm flexible, like, you know, the due date, or, you know, things along those lines. And then I just kind of like juxtapose that with like one inflexibility I have and sort of tell them that, like that, I just will not, you know, tolerate any I don't know how I say it or phrase it but like, I just am a believer in like equity and equality. And I just won't tolerateany, you know, poor language, or discussions that are hateful, or demeaning, or bigoted, oranything like that, and not that it comes up [often]...But just saying it and knowing it...I don't know if that is a big move but I just think it's kind of important to say that right outof the gate (Group conversation)

Fiona also followed up her classroom expectations by saying that setting an appropriate tone, especially about racial equity, was what her students really wanted. She shared an example of a survey in which her students indicated that they feel racial justice is important for their generation to address.

> We gave [my students] 16 issues that are like, you know, important, that are kind of on the forefront right now everything from like COVID-19, to climate change, to racial inequality, to cost of health care, and we have them

> ranked their priorities, because we are going to be working on one of those as our groupproject. And overwhelmingly like the numbers were staggering that the majority of kids found racial inequality to be the most important issue that their generation is facing. (Group conversation)

Apart from setting a classroom tone, she also spoke about her own internal conflicts aboutaddressing social justice issues in her CS classrooms after the AP exams, i.e., any standardized tests. She was worried about the potential negative messaging this would create; That social justice might be considered less important after thought by her students, especially compared to learning CS syntax. She also said that if someone were to criticize her for such approach, it would be fair. She reflected,

> And there's a segment in it, where it talks about, like race and, and even how, like, artificial intelligence is racist, not racist, but it is a racist, I guess it is, but it's, you know, there's racial profiling going on with that, and stuff like that. SoI usually do that after the AP exam, just because I'm restricted on time. But then, kind of having a full circle moment here on that very first article [i.e., about White privilege] that we read, if there is sort of, in a way, I'm suppressing that talk, and and maybe devaluing it, by putting it after the AP exam, it might seem like it's an afterthought, it might seem like I don't, sinceI'm not doing it throughout the school year, it might seem and it would be, it would be a fair criticism to say that I don't value that as much as the other stuff. So just reflecting on my own what I'm doing, by putting that at the endof the school year, maybe what I'm saying is that I devalue that. I mean, I, in my heart, I don't. But that's a criticism of mine that I think would be fair. So,you know, this is kind of pushing me

> to think that instead of putting those lessons at the end, after the AP exam, maybe those are, it's, it's better to put [them] throughout the school year. That way, I'm not kind of sending a message that I don't think it's important as like, "For loops", or something likethat, or as important as, you know, whatever…"Arrays". So that's something that I've been thinking about, that I probably should, you know, do a little bit more reflection on my own practice. (Group conversation)

It is important to note that Fiona while agrees with the importance of discussing racism within CS classrooms, she feels hampered by the AP curriculum itself and limited opportunity it provides for her to bring social justice issues before the AP exam. It is clear in her comments the tension she feels between preparing students for the AP exam and not just leave social justice issues as an after thought to technical aspects of learning CS.

Ray also shared some approaches he liked to implement. His thoughts included an app creating project where he wanted his students to humanize their participants and put the participants' interests before their own. Apart from this, Ray added his concerns on some of the barriers he felt come into play when integrating ant-racist approaches in his classroom. He spoke about both rigid curricula of courses like AP CSA/AP CSP and the role of parents and school administration in restricting topics surrounding anti-racism in CS. He was especially worried about the rhetoric around Toni Morrison's "The Bluest Eye" within school board meetings and parents demanding it be removed from schools. He wondered what it would mean for systemic change if only some school districts allowed for conversations around anti-racism. He shared,

> But in my [non AP CS] classes, I got a little more autonomy to kind develop what I want. So some Intro CS classes, I got the opportunity to kind of

> build those in. So it kind of depends on the course itself. But at the same time, I'mlucky in a district where administration or superintendent believe in implementing diversity into the classroom, so we get a buffer between thesqueaky wheel parents and us. But other districts don't have that quality administration. Are you a district that allows to have these conversations? Or [does your district not] allow you to have the conversations because then thekids don't have a place where they can go to have those conversations? So [the kids are] going to go home, to the echo chamber of hearing propaganda and racist ideas at home, and then they don't have an opportunity to hear any otheropinions or read. . . because books are being thrown away So even though we might be able to implement [something anti-racist in my school], it seems likeit's a drop in the bucket with the system in the nation. (Group conversation)

So, overall, the teachers were interested in discussing anti-racist ideologies in their classroom, but were grappling with many structural, personal, and communal issues that they thought would hinder anti-racist approaches. In particular, it should be noted that the CS curriculum itself can help or hinder teachers from implementing anti-racist approaches within their instruction. In particular, standardized curricula and associated tests are barriers to implementing anti-racist CS approaches.

Discussion

There were four overarching motifs that I found in the teachers' discussions. These were 1) Teachers complicated White Identity: sometimes a monolith but at times more nuanced 2) Teachers debated about White privilege: Is this different from other forms of privilege?

How can teachers use their White Privilege?, 3) Teachers agreed that tensions and discomfort they feel is required: They said although uncomfortable, it was ultimately helpful for their growth, and 4) Teachers shared their intentional approaches to begin discussing race in CS classrooms: Practices included setting the tone of the classrooms, projects, and classroom materials. In this section, I will elaborate on how these four motifs together answer my research questions.

How Do High School CS Teachers Reflect on their Own Racial/Ethnic WhiteIdentity?

The teachers, as mentioned earlier, complicated the meaning of White identity. Carl felt that White identity is a broad "paintbrush" and has many elements, such as different ethnicities and immigrant groups, associated with it. In particular Carl mentioned that "We're all immigrants here." Fiona also agreed with Carl and said that White identity is very broad and people need to find "Where do [they] identify in that in that large group ofWhiteness?" Even when using their identity wheels to describe themselves, both Carl and Fiona presented their ethnicities as very different from their race. They also used their ownphotos to describe their racial identity and made it personalized when talking about theiridentity.

On the other hand, Ray felt that his ethnicity and race almost collapsed into a single category. He felt since many generations of his ancestors have been living and benefitingfrom Whiteness, he is not able to separate race and ethnicity. He said, "the race, the ethnicity is all kind of…streamlined into a single race." Indeed, when using his identity wheel, he used a stock image of a "White Wonder Bread" to describe his race.

The differing ways in which the teachers approached exploring their racial identities is interesting. Scholars too have differed in the ways they construct the significance of race. For instance, Chike Jeffers has leaned more towards a socio-cultural way of constructing

race. “Jeffers holds that the cultural aspect of racial difference—that is, the ways in which races are groups differentiated by distinctive ways of life—is underappreciated in its importance to the past and present and is the centrally important feature when thinking about how we might continue to construct races in the future, past the end of racism.” (Glasgow et al., 2019, p. 2, emphasis added). Carl and Fiona, when talking about their racial identities, also alluded more to their cultural ways of being and doing. For instance, Fiona alluded to her Italian heritage and culture. On the other hand, Sally Haslanger’s opinion is that “races are first and foremost sociopolitical groups, marked by bodily features, that function within a dominance hierarchy.” (p. 2) In the case of the U.S., the dominance hierarchy is due to White supremacy, as mentioned earlier in the literature review. Ray perhaps felt closer to this socio-political grouping, as he alluded to generational family privilege of living in the same area for generations, without being influenced by redlining.

Overall, the teachers viewed themselves as racial White beings, but there was some variation in how they approached it. This finding is somewhat in contrast to the previous studies of White teachers exploring their identities. For example, Jupp et al. (2019) reported that White teachers in previous studies used race-evasive discourses. Specifically, prior research has found that teachers use a color avoidance ideology, where they did not "see" race or racial differences (Sleeter, 1993), coded race explicitly as Black (McIntyre, 1997), and did not think of themselves as racial beings (Johnson, 2002). Research on CS teachers has also found that they are race evasive even when discussing culturally significant topics (Goode et al., 2020). Another important facet is that in some previous studies the diversity within White identity groups (such as religious differences,

Euro-centric immigration, etc.) was used by teachers to evade thinking about collective White identity and privilege. In this study, however, Fiona unpacked Euro-centric immigration experiences to reaffirm to herself about White privilege, as we see in the next section.

How do these Teachers Discuss the Ways in which they Envision and NegotiateWhite Privilege?

Picower (2009) mentioned that some White teachers tended to use religious discrimination and Euro-centric immigration experiences to divert conversation from White privilege. In this study too, both Carl and Fiona touched upon the immigrant experience of White people **without acknowledging that Black and Brown immigrant experiences are different**. Fiona, on the other hand, mentioned that there were many benefits afforded to White immigrants that were never afforded to Black people. Ray added that apart from programs that helped White people, there were never any initiatives "that kept them down", unlike the experiences of Black people. Ray, in particular, highlighted the generational advantages that his ancestors and his family had because of property and housing rights. Both Ray and Fiona acknowledged systemic levels of privilege afforded to White people when compared to Black immigrants. In the future, perhaps conversations like this where White teachers explore their history in the country could be astarting point for them to see Whiteness as a property (Annamma, 2015;

Ladson-Billings, 1995), both in school and in out of school contexts. Indeed, we know fromJohnson (2002) that White teachers found the exercise of tracing the source of their racial identities useful for exploring systemic privilege.

Apart from the systemic levels of privilege, Fiona mentioned how "the color of [White] skingives that privilege even though you struggle with other things." Here, Fiona transitioned to speaking about White privilege at an individual level and how even people

who may have socio-economic disadvantages, for instance, still benefit from their racial privilege.

Although many researches have emphasized a need to acknowledge and unpack systemicprivileges, some have also posited the importance of teachers exploring individual responsibility (McIntyre, 1997). Future teacher preparation workshops or courses should find ways in which teachers can navigate both systemic and individual privilege and responsibilities.

Fiona and Ray also discussed the importance of the tension, guilt, and some level of discomfort was perhaps even beneficial for their growth. In some past studies, White teachers struggled with their feelings of guilt as they explored racial identities and relations (Picower, 2009). In this study's context, the teachers appreciated an article by Prof. Chris Emdin that was directed specifically towards White teachers navigating tensions they felt whilst doing anti-racist work. Perhaps future work with CS teachers should also explorethe topic of engaging with tensions and guilt directly and with intentionality.

Apart from discussing the importance of tensions and guilt, Fiona felt that she was almost primed to shy away from difficult conversations around race and racism while growing up. She mentioned that she now thinks investing in the difficult conversations was a 'fair exchange' for the potential positive outcomes from such conversations. In many ways this demonstrates a level of "accountable action in the community" that Utt and Tochluk (2020) alluded to as a strategy to engage in the 'Third Space'. Scholars have emphasized that White teachers must engage intentionally in the 'Third Space' where they see themselves as a 'subject' of struggle investing in racial justice while fully exploring their racialized selves using non-White discourses (Leonardo, 2013), address any fixed or problematic conception of how they view allyship, and invest in the "tension of consistent

work toward anti-racism and against complicity in racist systems" (Utt & Tochluk, 2020, p. 128). I discuss some ways in which the teachers thought about doing or taking action in CS contexts in the next few sections.

How Do These Teachers Discuss the Ways in Which They See the Connections Between CS, Race, and Racism?

The teachers did not fully invest time or build deep conversations around the connections between CS, race, and racism. But they shared a few thoughts that shine light on their conceptions of anti-racism within CS. Both Fiona and Carl briefly mentioned the problematic issues regarding biases in CS and in Artificial Intelligence systems, and ways they bring up the issues in the classroom. Scholars have emphasized the importance of communities fully exploring and disrupting the ways in which CS and other technologies reinforce White supremacy and racism (Benjamin, 2019). Future workshops can perhaps explicitly focus on the role of CS in the design and deployment of technologiesthat maintain White supremacy. Yadav and Heath (2022) as well as highlight examples of these technologies, such as showing the biases in the criminal justice system. Conversations around the responsibility of CS educators towards first recognizing, and then disrupting, such mechanisms can then be discussed.

In the current study, however, for most part the teachers focused on the practices they follow within their CS classrooms to address societal issues they thought were important. Ielaborate these in the next section.

What are Some Ways in which they Address their Thoughts on CS, Race, and Racism in their CS Classrooms?

Carl mentioned documentaries he showed, such as Coded Bias, to let his students know about problematic aspects in CS that need to be addressed. He mentioned that Dr.

Joy Buolamwini, who fights for justice in artificial intelligence, as the central character of the movie could act as an inspiration for young women of color in his classroom. He further talked about how he told the young women of color in his CS classrooms that they were "making a difference", even by pursuing a CS major in college. Specifically, Carl believed that getting more women of color into CS would help address the algorithmic biases into CS without the need to challenge the technologies themselves and change spaces that support women of color. Some scholar activistshave challenged this narrative of stopping at a neo-liberal perspective of almost imbuing women of color into mainstream hegemonic CS. Instead, they argue for spaces where women of color can also become "techno-social change agents". They called techno-social activism as "a form of activism that trains girls of color to recognize the affordances and limitations of technology and to have a critical perspective on how technology can be used for social change" (Scott & Garcia, 2016, p. 67). In the future, teacher educators can thinkof combining specific examples of Brown or Black women who are currently techno-social change agents, like CS scholar activists Dr. Joy Buolamwini or Dr. Ruha Benjamin, which can lead to targeted conversations around CS, politics, activism, and civic engagement.

This could help teachers progress from thinking only about broadening participation of women of color in CS to imagining the possibilities of what CS could become in the future by having techno-social activists.

Fiona's strategies were primarily focused on setting her CS classroom environment as a space which does not tolerate bigotry. Although this may seem like a generic practice, this strategy could indeed be extremely effective for students who may feel disenfranchised within CS contexts. A recent Pew Research Study found that many Black Americans in STEM fields cited concern about workplace discrimination, actual experiences of racial

discrimination, and hostility from coworkers that affected their success, like promotion (Cary & Parker, 2018). Apart from specific strategies required for teaching CS, teacher educators could promote discussion around setting intentional and clear expectations in the classrooms. Then, hopefully, CS teachers could start creating and modeling anti-racist environments that could one day translate into STEM workplaces too.

Both Fiona and Ray spoke about structural barriers to doing anti-racist work in their CS classrooms. Fiona wrestled with the idea that she tends to talk about racism in Artificial Intelligence as a topic only after the final AP exams. She questioned herself about the kindof message she was sending her students and that the students would see the work beingdevalued. Ray also mentioned that the non-AP curricula offers him more flexibility. Thesign and knowledge systems that have been traditionally privileged in schools focus a lot onstandardized testing and rigid curricula, but these have only worsened racial inequalities (Au, 2016). An important concept to bring back here is the tensions or the "fertile paradoxes" (Jupp et al., 2019). These refer to the tensions of trying to do anti-racist work within systems, such as exams and curricula that shut out justice oriented learning and that actually worsen racial inequities. Fiona and Ray alluded to these tensions frequently.

The issues they brought up can make one wonder about how to start navigating these tensions within our systems, but I will highlight a few possibilities here. First, do teachers consider anti-racist or culturally responsive approaches to be a "topic" rather than a paradigm? Sleeter (2012) argued that if one treated culturally responsive pedagogy as a setof steps to tick off, then we trivialize it. Instead, she emphasized that it should be a paradigm that guides all of one's teaching. CS teacher educators could center this idea from

Sleeter and could help CS teachers navigate about the meaning of using an anti-racist lens in all their teaching versus presenting "stand-alone" lessons that explores race and racism.

The second aspect that I wish to highlight is the apparent constrictions due to syllabi andcourse curricula. Once again, centering (Sleeter, 2012)'s emphasis on culturally responsivepedagogy as a paradigm, one could argue for revamping high-school CS curricula like AP CSP and AP CSA. If the contents of a formal school curricula are of value, especially according to teachers like Fiona, what message are we sending students if we do not use anti-racist perspectives to guide the design and content of the curricula they use in schools? Yadav and Heath (2022) explicated this problem by using the framework of informal asymmetry. They mentioned, "When CS curriculum developers prioritize the needs of the industry, rather than interrogating how computing is used as a tool for oppression, it creates an *information asymmetry* between curriculum developers and teachers/learners" (Yadav & Heath, 2022, p. 452).

Finally, Ray's major concern was that if only a few teachers do anti-racist work, and many school districts end up banning books that talk about race, racism, and anti-racism, then the work feels like a "drop in the bucket" Sleeter (2012) spoke extensively about this problem and the marginalization of culturally responsive pedagogy. She posited that the reasons this happens is because of three main points, "(a) a persistence of faulty and simplistic conceptions of what culturally responsive pedagogy is, (b) too little research connecting its use with student achievement, and (c) elite and White fear of losing national and global hegemony" (Sleeter, 2012, p. 568). The current political backlash around Critical Race Theory, in particular, points to how these three reasons might be affecting people's intolerance of any anti-racist work in schools. Future research should contend with and address the political backlash, and the importance of anti-racist work, especially in CS

contexts. Teacher educators can also help teachers engage in conversations about how to deal with political backlash. For instance, if Ray talks about anti-racist work and gets backlash, his privilege as a White CS teacher affords him to continue to do so even at the risk of losing his job. What might using teacher privilege look like for others and how could they leverage it to do anti-racist work in their classrooms? As teacher educators it is important that we don't intentionally or unintentionally place our teachers in harm's way, but having conversations around the use of privilege, even in small ways, can be an important starting point.

Implications and Future Directions

There are several avenues I believe that are important for both research and practice, based on the results of this study. I outline the implications for both research and practicein turn below.

Implications and Future Directions for Practice

I have a few suggestions for future teacher professional development workshops based on my experience. First, talking about their racial identities and privilege, especially in a group setting, seemed to have benefited the teachers. Future teacher preparation initiativesshould continue working on this aspect and see if there are other ways that benefit teachersmore. For instance, this workshop purposefully targeted non-academic articles that spoke of race, Whiteness, and race relations due to time constraints. What might happen if teachers had more time to read more academically oriented articles that helped them unpack biological, socio-cultural, and socio-political realities of race, racism and Whiteness? (Glasgow et al., 2019).

What might a more prolonged workshop experience, say over a period of one year, look likefor teachers? What might such a workshop look like for pre-service teachers, if

embedded within their certification requirements? These are just some possible avenues that practitioners can explore in the future. Finally, a topic that the teachers in this study spokeabout briefly was the presence of biases in AI, which is fortunately now in popular discoursedue to scholar activists like Dr. Ruha Benjamin and Dr. Joy Buolamwini. Opportunities for teachers to fully explore racial inequities in CS and socio-politics that affect technologies, such as over surveillance of Black and Brown folks, might also be beneficial.In addition, some of the systemic constraints to use CRC or speak about anti-racist topic that the teachers highlighted were 1) rigid curricula, especially AP CSA and AP CSP, 2) standarized testing and constraints on "finishing" certain topics before the exams, 3) "Squeaky wheel parents" who may oppose anti-racist initiaves, and 4) District bans on teaching topics related to CRT and banning books by Black authors. The first two pointsrelate to the notion of informational asymmetry in CS curricula as Yadav and Heath (2022) highlighted. Villegas and Lucas (2002) proposed some curricular ideas for revamping the field of teacher education to prepare culturally responsive teachers.

Similarly, CS education as a field needs to also think about changing CS curricula for botheducator preparation and for our K-12 students. We have some scholars foregrounding this work already. Vakil (2018), in his paper on justice-centered approaches to computing, mentioned the need for the shift away from dominant approaches to justice-centered approaches in CS curricula. See Table 4 for details on his proposed approaches (p. 37)

Table 4. Vakil's proposal of justice-centered approaches in CS or Technology Education

Dominant approach	Justice-centered approach
Technology and computing have social implications.	Technology and computing have social and political implications.
Learning activities focus on individual and student choices (e.g., piracy, cyberbullying, obeying copyright laws, responsible social media use).	Learning activities focus on individual rights and freedoms, and corporate and government responsibilities
Students are encouraged to beresponsible digital citizens	Students engage in critique of unethical abuses of technological power (e.g., US surveillance state and privacy vs. security debates) and explore the roletechnology can play in reaching social justice goals.

Similarly, Yadav and Heath (2022) highlighted that the standards for CS curricula acrossP-16 need to be revamped using a critical citizenship approach.

For the third and fourth points, it is important to look to scholars like Sleeter (2012) who alluded to "backlash politics" as historically oppressed groups try to make gains in society. She had multiple recommendations to address these issues. First, she suggested that studies should look at large-scale academic achievement in addition to other outcomes, in particular how culturally responsive pedagogy benefits all students, including White students. Second, she suggested that collaborations with large institutions like the Southern Poverty Law Center will help help reach out to larger audiences of teachers, parents, and education leaders of the importance of anti-racist work. Finally, she called for re-framing the deficiency lens around minoritized groups and being intentional about the public debate around the importance of anti-racist and culturally responsive work.

Lachney, Bennett, et al. (2021) spoke about an open village of multiple stakeholders who together create CRC learning experiences for students. To truly achieve the open

village, we might need to try applying Sleeter's suggestions of collaborations with non-profits and create authentic public debate around anti-racist work, particularly in CS classrooms.

Implications and Future Directions for Research

Theoretically, this paper brings together conversation about race-evasive White teacherstudies from two fields: teacher education (Jupp et al., 2019; Matias, 2013) and CS education (Goode et al., 2020). It also continues the conversation and adds to the narrative of these two fields. For instance, in this study one can see practical instances of how CS teachers were grappling with trying to do anti-racist work given rigid curricula and school district mandates against Critical Race Theory (i.e., what Jupp et al. (2019) called "Fertile Paradoxes"). One can also see practical application of trying to critique Whiteness and White privilege through intentional group discussions, as was proposed theoretically by McIntyre (2002). Finally, we see an example or a case of how CS teachers, who as a group were shown to be race-evasive in multiple prior instances (Goode et al., 2021; Goode et al., 2020), can be involved and engaged in intentional conversations about race.

In the future, apart from exploring teachers' thoughts about their racial identities, it is alsoimportant to see how they enact practices in their classrooms. For instance, one of the tenets of CRC is "Technology should be a vehicle by which students reflect and demonstratean understanding of their intersectional identities." (Scott et al., 2015). How do White CS teachers, who go through a process of unpacking and trying to understand their own racial identities, help enact this tenet? How do they help their students achieve this tenet?

Another area that researchers can explore is how White teachers, who have explored theiridentities, navigate exploring the cultural capital of their Black, Brown,

Indigenous, and other students of color. Matias (2013), for instance, mentioned that a focus solely on learning about the racial "Other" can be detrimental if White teachers do not have space to self-reflect. Given the previous finding of race-evasive White CS teachers Goode et al. (2020) when learning about corn-row hair braiding, it could be beneficial to know if self identity reflection can help in such contexts.

Finally, I conducted this White identity research as a woman of color. This may have impacted the comfort levels of both me as a researcher to push on certain concepts, and the teachers to feel free to speak in their minds. In the future, White researchers can also explore the notion of Critical Whiteness Studies (CWS) in CS contexts. Given how deeplyentrenched CS is in Whiteness, it would be truly beneficial to the community to explore this topic and issues further.

CHAPTER 2. TEACHERS EXPLORE CIVIC PARTICIPATION THROUGH CS TECHNOLOGIES

Eglash et al. (2013a, p. 632) cautioned that "STEM education's failure to incorporate the social dimensions of science and technology has harmful repercussions throughout society;exclusion of under-represented youth is just one of the many bad outcomes it creates".

Another specific outcome of STEM education's failure is the White hegemony and racism in CS. Hegemonic CS can reinforce White supremacy and deepen racism against Black folks due to racial biases in "neutral/normative" Artificial Intelligence and over-surveillanceBenjamin (2019).

Researchers and practitioners working on culturally responsive computing (CRC) practiceshave been actively working on allaying this artificial demarcation between socio-political/socio-cultural and technical dimensions in CS. Indeed, CRC actively promotes using one's cultural and social capital to learn and apply various technologies.

Given below are the five tenets of CRC. The last three explicitly state how socio-political/socio-cultural dimensions are central to using technologies Scott et al. (2015,p. 420).

1. All students are capable of digital innovation.
2. The learning context supports transformational use of technology
3. Learning about one's self along various intersecting sociocultural lines allows for technical innovation.
4. Technology should be a vehicle by which students reflect and demonstrate an understanding of their intersectional identities.

5. Barometers for technological success should consider who creates, for whom, and towhat ends rather than who endures socially and culturally irrelevant curriculum

First, I will detail ways in which researchers have made the socio-political/socio-cultural aspects of CS technologies explicit. These include exploring African-American heritage and vernacular culture through technologies (Eglash et al., 2013b; Lachney, 2017), using e-textiles to engage in Native American arts (Kafai et al., 2014), and using technology for local activism and social change (Ashcraft et al., 2017; Sandoval, 2019). In this study, I amespecially interested in what teachers can do for civic engagement and local activism using CS. More specifically, the issue I am interested in is school desegregation. This requires people, especially White folks, to engage in activism while confronting systemic racism andwhiteness. I will focus on why K-12 teacher support is important for supporting youth social activism and civic engagement. Unfortunately, teachers can still struggle with breaking the technical and socio-political/socio-cultural dichotomy in CS (Davis et al., 2019) and this, in turn, will affect ways in which teachers can use CS for activism and civicengagement. The discomfort or unpreparedness of teachers to teach CS ultimately can affect ways in which students can use technologies appropriately for socio-political change. Not using technologies properly takes us back to Eglash's notion on the failure of STEM education: CS can maintain or further racism unless we actively prevent it from doing so. Iwill conclude with a proposal about what teacher educators can do to help teachers better implement lessons that make explicit the social aspects of using CS-related technologies.

Literature Review

While the harmful impact of computer science is becoming more evident, it is still less clearhow we prepare students in ways that prepare them to challenge the Hegemonic nature of CS and use CS as a tool for social-justice, personal agency, and civic engagement. The current work on CRC provides a framework for educators to implement strategies that bring justice-oriented CS into their classroom. The following sections provide a backgroundon CRC and how it could support K-12 teachers.

Addressing the Socio-Cultural and Technical Dichotomy in CS Using CRC Approaches

One of the main objectives of culturally responsive computing is to focus on diminishing the separation between culture and STEM. Some researchers have focused on using the STEM knowledge in heritage and vernacular culture to "translate" them to Western forms of STEM knowledge (Eglash et al., 2013b; Lachney, 2017). For instance, in Culturally Situated Design Tools (CSDTs), the mathematical and STEM concepts embedded in cultural practices like African-American cornrow braiding, African fractals, Anishinaabe arcs, Appalachian quilting, Graffiti, etc, are highlighted through block-based programming.Each of the CSDT tools have a background section that explains the historical, social, and political implications of the cultural practices. BIPOC students have greatly benefited from learning from these tools and feeling a sense of "cultural ownership" over the STEM concepts embedded in the tools as well as increased STEM-related knowledge (Eglash et al., 2017; Eglash et al., 2013a). However, most of the implementations of the CSDTs have been in after-school contexts or with researchers closely tied to the implementation(Lachney, Bennett, et al., 2021) and there is little understanding on whether and how teachers use them to engage students in CS.

Researchers have also focused on culturally responsive e-textiles to talk about culture in relation to computing. E-textiles are electronic fabric crafts that combine cloth and sewingwith electronic components like programmable microchips (Arduinos), conductive paint, LED lights, speakers, etc., to create interactive clothing (Searle & Kafai, 2015). (Kafai et al., 2014) implemented a summer camp where Native American youth-created collective and individual e-textile designs. The researchers wanted to provide students with a contextthat challenged the notion of what constitutes computing. They also wanted to allow themto think about connections and dissociation between Indigenous sewing practices and computing. Unfortunately, Kafai and colleagues found that the students often forgot the local Indigenous names of the plants that they were quilting. They suggested that future research and practice should work to ensure better integration of such cultural knowledgeand computing. Other researchers have also advocated blurring the boundaries between the socio-political and the technological as discussed in the next section.

Addressing the Socio-Political and Technical Dichotomy in CS Using CRC Approaches

Another aspect that CRC focuses on is to promote social critique, civic participation, and addressing social issues with respect to race and racism (Ashcraft et al., 2017; Garcia et al.,2020; Sandoval, 2019). Vakil (2018), in his paper on justice-centered approaches to computing, mentioned the need for the shift away from dominant approaches to justice-centered approaches in CS curricula. See Table 1 for details on his proposed approaches (p. 37). Note that he mentions the importance of both social and political implications. In addition, he mentions corporate and government responsibilities, critiques of unethical abuses of technological power, and the use of technology to reach social justice goals.

I use the justice-centered computing approach as a guide to detail some work that has beendone in computing education research. For instance, a great example of addressing socio-political issues and promoting social critique within CRC is Scott and Garcia (2016)concept of 'techo-social change agents'. According to them, techno-social activism is "a form of activism that trains girls of color to recognize the affordances and limitations of technology and to have a critical perspective on how technology can be used for social change" (p. 67). Ashcraft et al. (2017) implemented the concept of techno-social activism through workshops over a two-year period. They encouraged girls of color to have conversations around racial representation in gaming and technologies (i.e., corporate responsibilities), discuss the intricacies of being women of color compared to men of color, and explore what social justice really means in the context of using technologies, in particular virtual environments. One of the outcomes of the workshops was that the girls wrote to the company that created the virtual environments being used that none of the avatars were able to represent dark-skinned or curly-haired girls. Explicit attention to social justice issues made the girls be critical about considering social justice as a separate overlay on technologies. Another example of justice centered work is of Garcia et al. (2020) who explored how Black girls leveraged technology for social justice. They conducted their study through the lens of critical digital literacy, which according to them, "explicitly (examines) the power dynamics of leveraging digital technologies to explore personal identity and enact social change" (p. 348). They analyzed essays of teenage Black girls and found that many were beginning to use digital technologies like social media to advocate for social change and a just future. They advocated for future researchers and practitioners to dismantle the "binary framing" of digital and critical literacy. Similarly, Sandoval (2019) worked closely with a high-school CS teacher to implement culturally responsive Scratch

lessons and explored using Scratch to attain goals of social justice. She used the concept of "ancestral praxis", the "socio-historical processes of Indigenous people throughout the world" (p. 38), to inform her work. For instance, she encouraged the students in her study to reach out to their family elders for their knowledge of various social issues as they created different Scratch projects. Students were exposed to societal problems in their community and worked in groups to think about projects through which they could address the issues. Students, especially a junior named 'Itzel', became very attuned to the socio-political implications of computing. She often led critical discussions on when or why it was appropriate to use computing for various causes. She created a Scratch app to focus on dietary practices in the local community, which also happened to be a food desert. The high-school teacher worked with the students throughout the course of their projects. Their teacher support was crucial to the implementation and presentation of the projects. I detail the importance of such support systems in the next section.

Teacher Support to Address Social-Political/Technical Dichotomy and Support Civic Participation Using Computing

Researchers have argued that youth need their families, schools, the government, the commercial sector, and community organizations to help them engage in civic participationand attend to socio-political issues (Jagers et al., 2017; Youniss et al., 2002). Some have advocated for policies that provide schools with opportunities to tailor curricula that allow students to use ICT for getting involved in the democratic process and work towards various employment opportunities (Youniss et al., 2002). Indeed, Hope and Jagers (2014) discovered that Black students who had formal civic education, such as civics courses in high school, had higher levels of civic participation. Having a critical analysis of oppressiveinstitutions and systems was also related to civic engagement.

Further, democratic teaching practices and an equitable school environment also predicted increased civic engagement longitudinally (Jagers et al., 2017). Benjamin (2019) highlighted various oppressive systems that technologies create, such as racist and biased facial recognition software. CS teachers need to be in a position to guide students to dismantle these oppressive technologies and rebuild a more just system. A recent survey poll, from 120 colleges and universities, showed that college-level Computer Science students were the least likely to want to be global citizens and "become agents of responsible change", i.e. civic participation (Núñez et al., 2021). This makes the need for CS teachers to play a partin supporting their students to become responsible users of CS even more pressing.

As mentioned in the previous section, the support of teachers to implement CRC and civic engagement lessons has been shown to be important. In Sandoval (2019)'s research, she worked very closely with the teacher, Allan Adams, who she chose as he was White and didnot have the same background as his students. She wanted to work with someone like him to inform the majority White teaching force. They interacted frequently and Mr. Adams considered Sandoval as the "cultural expert". He began and continued to see the implications of computing for society and that it can be used for activism. He could work closely with his students to develop Scratch projects that were meant for social change, forinstance, an app that focused on promoting healthier eating habits in the local community.Sandoval believed that this was because of him working on his cultural competence throughout the school year. He did so by inviting Sandoval to share her cultural expertise through presentations in the classroom and by engaging with her feedback on the way he implemented his lessons. But, she also mentioned that Mr. Adams could not engage much in the ancestral praxis while implementing the projects. Further, it

also is important to askourselves the harms of seeing only the person of color as the cultural expert, i.e., putting the entire burden on the person of color to speak about socio-political issues. What can White teachers do to address these issues?

I believe that engaging in ancestral praxis, that is engaging with the Indigenous practices of students, would require a White teacher to focus on both their identities and their students' identities. I believe understanding their students' identities requires White teachers to also reflect on Whiteness and White hegemony. Not reflecting on the identities of students has demonstrably shown to be ineffective in the context of CRC. Davis et al. (2019) wished to examine if having a culturally responsive curriculum in a CS classroom would improve student engagement and help with their opinions on culture and computing. They found that the teacher in their study was very interested in the CSDTs that focused on vernacular and heritage culture. Unfortunately, the teacher did not go much in-depth into the historical and political aspects of the CSDTs which ultimately affected the students negatively. Perhaps one of the reasons the teacher failed to do this was because of discomfort to engage in identities and histories different from his own identity. Indeed, reflecting on Goode et al. (2020)'s work, one can see that White teachers had difficulties specifically mentioning "Black" or "African-American" even in the context of talking about the histories and politics of corn-row hair braiding in the CSDTs. If teachers do not engage with their own racial identity, it is difficult to imagine them understanding and working with their Black, Brown, Indigenous, and other students of color's identities and experiences. And without knowing the historical, cultural, and socio-political implications of technologies for their students, teachers will not be able to fully engage with the goals of CRC.

Study Purpose: How Do CS Teachers Explore the Concept of Civic Engagement in Computing Contexts

Civic engagement, social critique, and racial justice are some of the goals of CRC. Prior research confirms that schools and teachers are one of the many support systems importantfor students to have civic engagement jagers2017classroom,youniss2002youth. Further, socio-political critique and advocating for racial justice through technologies requires a blurring of the boundaries between the socio-political and the technological. Part of dismantling the dichotomy involves spending time explicitly talking about racial and historic identities. However, as evidenced in prior work, these are areas that teachers sometimes struggle with (Davis et al., 2019; Goode et al., 2020; Sandoval, 2019). I wish to answer the following questions through this study.

1. How do CS teachers speak about the implications of socio-political elements of technology use?
2. How do CS teachers talk about race and racism when exploring a computing toolthat explores school desegregation?
3. How do these teachers implement a lesson using the computing tool meant to exploreschool desegregation?

Here, the first question relates to teachers seeing the socio-political implications of technology use and misuse. The second question relates to how teachers explore school segregation, a context entrenched in racism and White supremacy, using computing technologies. The third question examines how the teachers actually implement CS lessons regarding the social and racial implications of school (de)segregation. These three questions address the second gap in literature of teachers attending tosocio-political/technical dichotomies in CS.

Methods

In this section, I detail who my participants are who participated in the study, the detailsof the workshop they attended, how I collected data from the workshop, and how I analyzed the data I collected.

Participants

The participants were three high-school CS teachers who are teaching AP CSP. Before taking part in this study, they had gone through a Whiteness workshop where they spent time reflecting on Whiteness and their racial identities. I believed that without having done such reflection, the teachers may not be able to engage with any computing tool thatrequires them to critique racist policies in society. I hoped that reflecting on Whiteness helps the teachers be better prepared to engage with CRC and civic participation. Each teacher was given a compensation of $500 for their time and efforts in the workshops.

Structure and Composition of the Workshop

This study engaged teachers in exploring school desegregation as a socio-political issue andhow they can use a computing tool to explore it. In particular, teachers read articles on school desegregation, then attended a group discussion while exploring a computing tool that allows them to desegregate school districts. The teachers were able to use the tool in two ways: 1) To think about bussing, 2) To think about redrawing district lines. I explain the reasoning behind choosing school desegregation in the next section where I discuss my motivation behind creating such a tool. I will also explain the details of the tool in the next section.

The workshop had two components, asynchronous and synchronous. Before attending thesynchronous part, the teachers worked by themselves on an asynchronous

module. In this module, they saw a short 2 min video describing the history of school integration attemptsand then read an article on ways to achieve school desegregation. Given below are the descriptions of the article and video and a link to each of them.

1. School Integration (A video from "Black History in Two Minutes or so")
2. Why Busing Didn't End School Segregation (By Audie Cornish, NPR Ed)
3. We can draw school zones to make classrooms less segregated. This is how well yourdistrict does (Is your district drawing borders to reduce or perpetuate racial segregation?)

I chose the video as it specifically talks about the history and violence related to school integration efforts. I chose the first article as it explicitly speaks about the problems related to bussing and how district boundaries play a role in school desegregation efforts. Ialso hoped it served as a good base for the third article. The third article has within it a tool that allowed teachers to look at the school district they teach in to see how segregatedit is. They could view how district boundaries have been drawn to either reduce or perpetuate neighborhood segregation.

After doing the asynchronous activities, the teachers joined me for a synchronous Zoom session. This was a group discussion. In this session, we first did a reflection on the article and the video for 15 minutes. I specifically asked questions about the notion of "school funding follows White children". I will then ask about how segregated their school districtsare, based on the article they read. Then, for 40 min, we explored the school desegregationtool created on https://openprocessing.org/ . Using this tool, the teachers were able to work on school desegregation using two approaches 1) Bussing or moving the students to different schools 2) Redrawing district lines to think about redistributing local taxes to create equitable schools. After this activity, I had a 20 min debrief of their

thoughts on thetool and the notion of school desegregation. I asked reflection questions on school desegregation and the possibility of using computing to explore the phenomena. These questions are explained in detail in Appendix B. After this online workshop, the teacherswill work on designing and implementing their lesson plans.

Computing Tool for School Desegregation: Motivation for the Tool

I chose the topic of school desegregation due to many reasons. I had initially started withthe AP CSP curriculum to find places where teachers already have an explicit curriculum-oriented chance to talk about societal issues. I found that the "DATA" unit, where students study the implications of data collection and usage, was appropriate to talk about many social and racial justice issues. Further, school segregation is yet another hallmark of White hegemony and supremacy and is a sign of Whiteness as “property” discussed in the previous study (Annamma, 2015; Harris, 1993; Ladson-Billings, 1995). Specifically, it’s a form of public property that is "ratified and legitimated" (Harris, 1993).

Many scholars have highlighted the urgency of addressing school segregation, especially as schools continue to be highly racially segregated years after the passing of Brown v Board of Education (Ladson-Billings, 1995; Thompson Dorsey, 2013). There are many reasons forthis continuing problem. Ladson-Billings (1995) discussed various ways in which the Whitecommunity has had the “absolute right to exclude” Black folks from schools. Examples included White flight i.e. White folks moving to the suburbs away from cities, public funding of private schools, and school “choice”. Thompson Dorsey mentioned that courts permitted redrawing of school attendance zones and busing after Swann v.

Charlotte-Mecklenburg Board of Education (1971). Unfortunately, in Milliken v. Bradley(1974), the courts prevented Detroit from implementing a desegregation plan that

would have allowed for students to cross urban and suburban lines, i.e. a “multidistrict remedy”(Thompson Dorsey, 2013).

Apart from such legal hurdles, the White public has also historically laid out hostile practices that actively prevent school integration. For instance, in the mid-1960s, the White parents in Boston Public Schools claimed that busing Black students into their neighborhood schools was an “infringement on the rights of taxpaying [White] families” (Delmont & Theoharis, 2017, p. 196). They participated in activities and policies that prevented bussing. gooden2014distorted urged people to not consider school segregation as separate from residential segregation and White housing privilege. Segregated neighborhoods and the ability to redraw school district lines to create even more segregation have caused much harm. The aftermath of the Milliken decision still lingers, and many states and cities have not blurred district boundaries siegel2014mitigating. But in the areas that have managed to implement district consolidation measures, the school integration has been most stable (Orfield & Lee, 2006; Siegel-Hawley, 2014). Such school integration measures would require the White public to let go of sentiments, actions, and policies that will give them the “absolute right to exclude” Black and Brown folks from accessing good quality, non-segregated education. I believe that school desegregation is an important topic for CS teachers to explore as they get involved with CRC and civic engagement. This topic also requires CS teachers to engage with White supremacy and Whiteness and to use technology in a way that dismantles White hegemony in CS.

The other reason I chose this topic of school desegregation is more personal. I used to attend a government/public school back in India. Although "top-ranked", it had a shortageof resources like an adequate number of bathrooms, running water, and well-paid janitorial staff. I only used the school bathroom only around ten times in my twelve years

of schooling. The school has unfortunately become more socio-economically segregated, whichis further deteriorating the resources. I believe this is due to more choices (akin to the U.S."school choice") that the wealthy, liberal, and formally-educated parents have; they can afford to move their children from government schools out to private or international schools for a “better experience”. Although funding for public schools is not the same in India as it is here in the U.S, the lack of "rich, educated, upper-caste" parents in PTA and other aspects related to the school’s resources is affecting the school negatively. Seeing something like this happen so close to home, made me focus on school segregation as an urgent issue to be addressed in the U.S. too (Thompson Dorsey, 2013). Among the various ways in which CRC can be used for civic participation, this topic of desegregation is important to me.

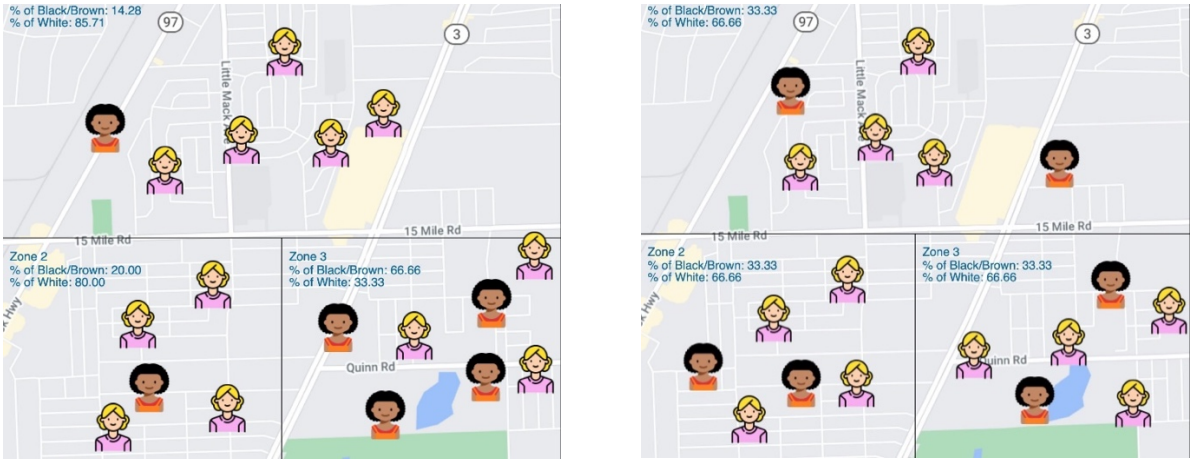
Computing Tool for School Desegregation: Creation of the Tool

This tool is not meant for the teachers or students to solve any issues of segregation, but rather to think critically about what school integration means for their locality. For instance, I hope the tool helps students consider what school desegregation or integrationtruly means for them. How would they define school segregation? What challenges may bussing or redrawing district lines bring about? Overall, I also hope they think about if and how computing can help address school desegregation.

As mentioned earlier, this tool was created on https://openprocessing.org/. It was created by a programmer with the directions and inputs that I gave. It has two components 1) An interface where people can move things around, draw things, and interact with the environment 2) A code environment that allows people to change things and add their ownadditions or deletions. Some screenshots of the tool are given in Figure 5 and 6. In the figures, one can see the segregated school district. One can also

see the attempts to desegregate schools based on either bussing or redrawing district lines, so that a teacher can reflect on school desegregation. I chose these two different techniques for school integration/desegregation because each technique has had different historical challenges and successes, as mentioned in the previous section. The teachers will have the opportunityto read about these two different techniques

Figure 5. A computing environment to reflect on bussing



(a) Before Bussing (b) After Bussing

Figure 6. A computing environment to reflect on re-drawing district lines

(a) Before Redistricting (b) After Redistricting

Finally, one can see the programming environment in Figure 7. I will be creating the environment such that teachers/students can make minor changes to the background (e.g.place a screenshot of their school district instead of the base district) to aid their desegregation efforts. They can also easily make changes to the icons or adjust the proportion of Black, Brown, and White people in various places according to their locality.

I will create a small tutorial for them to help them do these. In case teachers/students want to make more significant changes, they can also do that as the code will be completely open. They can also just view the code and reflect on the inner workings of a desktop app, in case they do not wish to make any changes at all.

This tool uses the principle of task-based programming. In task-based programming, people can use a specific computing tool to engage with a specific task, even without priorknowledge of computing. Researchers have found that such an approach has worked well with pre-service social sciences teachers who did not have experience with computing (Guzdial & Naimipour, 2019). I hope this tool helps to engage teachers and high-school students with varying degrees of programming experience.

Figure 7. Program environment of the computing tool

```
for (var i = 0; i < 1000; i++) {
  pos = randomPos(imgBrownppl.width, imgBrownppl.height);
  zone = computeZone(pos.x, pos.y)
  if (zone == "Zone1") {
    if (chkzone1ppl < zone1ppl) {
      if (chkzone1brownppl < zone1brownppl) {
        rects.push(new Rectangle(pos, imgBrownppl, "brown", zone));
        chkzone1brownppl = chkzone1brownppl + 1;
      } else {
        rects.push(new Rectangle(pos, imgWhiteppl, "white", zone));
      }
      chkzone1ppl = chkzone1ppl + 1;
    }
    if (chkzone1ppl == zone1ppl) {
      continue;
    }
  } else if (zone == "Zone2") {
    if (chkzone2ppl < zone2ppl) {
      if (chkzone2brownppl < zone2brownppl) {
        rects.push(new Rectangle(pos, imgBrownppl, "brown", zone));
        chkzone2brownppl = chkzone2brownppl + 1;
      } else {
```

Creating the Lesson Plan and Implementing It

After going through the workshop, the teachers designed a lesson plan in their own time. Igave them four weeks of time, in which they had the opportunity to ask me questions or any clarifying points. They created the lesson plan with the help of a template that I created, given in Appendix B. The template guided them to ensure they talk about the critical aspects of racial segregation and integration in school districts.

After creating the lesson plan, the teachers implemented it via Zoom. This was a mock "implementation", in which I was the only audience. The teachers implemented the plan asthough they will in their classroom and walked me through the discussions and activities that their students will have to do. They took between half and hour and an hour to complete this walkthrough of their lesson plan. I had initially planned to invite other high-school CS teachers as audience. But, unfortunately, due to the rise in COVID cases in January 2022 and the subsequent burden on school teachers, I had to change my plans.

Data collection

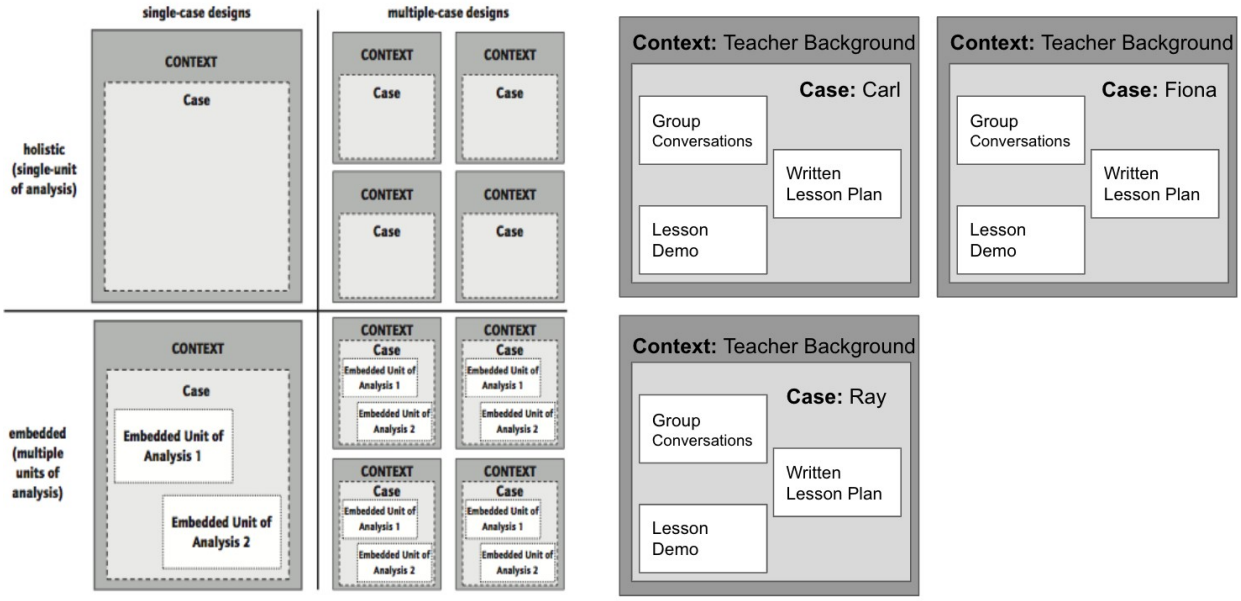
There are three sources of data in this part of the study. The first is the Zoom recordings of the workshop session where the teachers get introduced to and explore the computing tool for desegregation. The next two data sources are the lesson plan templates created byeach of the teachers and their implementation of the lesson plans. Given below is how I plan to separate the sources.

1. Data from the Zoom workshop/group discussion on the computing tool exploration. These included reflections on school funding, school segregation, and using comptuingto think about school desegregation.
2. Individual teachers' written lesson plans. These were the template-based lesson plansthe teachers filled out before their mock lesson implementation.

3. Data from the individual mock lesson implemented by the teachers. These were collected during the Zoom lesson implementation.

Context of Data Analysis: Embedded Multiple-Case Study

Figure 8. Description of Multiple-Embedded Case Study



My study is an embedded multiple-case design, each case with multiple embedded units ofanalysis (Yin, 2003). Each teacher forms a case, especially due to the highly differentiated and individualized nature of their lesson plans. Since I have three teachers, I have three cases. Each case draws from all the three data sources I listed above. First, I have data from the Zoom workshop/group discussion on the computing tool exploration which were in the form of audio transcribed to text with accompanying video. Then, I had individual teachers' written lesson plans which was primarily in the form of textual data. Finally, I had data from the individual lesson plan implemented by the teachers. This included theirexplanation and elements that accompanied their lesson implementation: such as Google Slides or visiting various websites to describe their lesson presentation.

Thus, it was in the form of audio transcribed to text with accompanying video and images. See Figure 8 for avisual representation of my case study elements.

Data Analysis: Case Descriptions and Cross-Analysis

To analyze each teachers' case, I used the general analytic technique of "developing a case description" (Yin, 2009). This strategy involves "developing a descriptive framework for organizing the case study" (Yin, 2009). My workshop had three parts to it 1) Exploring the concept of school segregation, 2) Exploring the school desegregation tool, and 3) Lessonplan creation and implementation. These three parts formed my guiding framework for case description. For each teacher, I went to the workshop, lesson plan, and lesson demo transcripts and copied chunks of text that were related to each of the three topics. I pastedthese in a separate Google Doc for each teacher. For instance, I copied all of Fiona's quotesrelated to school segregation and pasted it in a section titled "school segregation" in the Google Doc. I, then, summarized her overall thoughts on school segregation based on her quotes. After I wrote the summaries, I used her quotes to substantiate and illustrate my summaries. I used a slightly different technique for the third part of the descriptive framework, that is each teacher's lesson. I used three sources of data: 1) Zoom video of thelesson demo, 2) their written lesson plan and (if present) accompanying slideshow, and 3) the transcription of the lesson demo. The lesson plan template had space for teachers to organize their lessons into multiple sections. To help summarize each teachers' lesson, I used their lesson plan and the number of sections described in it. For instance, Fiona's lesson plan template described four sections to her lesson. I used these four sections to guide my description of her lesson demo. Thus, I wrote case descriptions of each of my three teachers. I used the Zoom video data to see what slides/webpages accompany theirverbal cues in the lesson

explanation/transcription. I then used the slides to bolster the written description/summary of the lesson plan.

I also conducted cross-case analysis. I did line by line reading of group conversations, lesson plans, and lesson demos on the software NVivo. Then, I used descriptive coding to focus only on themes or similarities that were present across all three teachers's conversations and lessons. I found two themes which were present for all three teachers: 1)Exploring cross-disciplinary lessons with CS, Civics, and History, and 2) Technology is notneutral. I summarized each of these themes and used the teachers' quotes to elaborate anddescribe each theme in the results section.

Results

In this section, I describe my three cases, Fiona, Carl, and Ray. I elaborate on how each teacher 1) Explored the concept of school segregation, 2) Explored the school desegregationtool, and 3) Implemented their lesson plan. After describing each of the three cases, I describe the two themes I found from cross-case analysis.

Fiona's Case

Fiona is a White woman, White, Middle-Class, and is middle aged. She teaches Advanced Placement CS A (AP CSA) and Java programming. Most of her CS classes have boys andthey are White or Asian. She has very few Black or Brown girls in the classroom. She wants to learn more about technology's role in amplifying "institutional racism" and how she can help address it. She feels that engaging in this work will help her become a better mom and a better teacher. She also feels like she has a moral obligation to do the work.

Thoughts on school segregation. Fiona's thoughts mostly focused on White community's backlash and racist reactions towards school integration attempts. She

mentioned that it saddened her to see people, especially White moms, actively trying to harm Black students who were being bussed to schools. A point of note is that her identity as a mom often came up when she spoke about the interest to do this work, as she thought it would help make her a better mom. Apart from the role of White moms, she mentioned that bussing often involved kids being 'removed' from their communities where they have strong ties and that may affect them negatively. She said,

> I saw a video of Toni Morrison explaining this incident, where there was this group of like White mothers who were trying to tip over a school bus with Black children on the school bus. . . it was one of the most jarring accounts I heard. And she just was talking about how, like if she tried her hardest to find,like a group of Black mothers to do that to another set of kids that she's like, "Idon't think I could find a single person", because it's just such a awful thing to like, try to harm other children on a school bus… We're speaking about this historically, busing is being removed from your safe community area (like a neighborhood network), and then being bused to this [other] area. And when you [get] there, you're being met with protests and signs and people throwing stuff at you and, you know, that sort of thing. So just the trauma of that alone before you even walk in the door is a huge problem.

During the discussion around the phrase "funding follows White students", she said,

> So even if you kind of change the equation, as far as how you get state and federal funds, um, there's, it's always really tipped in the other direction, because you have all of these just kind of like private funds going in there. Andthat "Nice White Parents" [podcast] was really interesting, because it

> took [a] very diverse school, a lot of different socio economic groups there. And these [White] parents came in and [they sent] their kids there, and then they wanted to improve it. And of course, they hosted galas and fundraisers and changed it a bit. And, you know, it did bring money to the school, but it really changed.

One can see that she used some evasive language, such as the phrase "diverse school" whenshe perhaps meant the school had many Black or Brown or immigrant students of color.

Also, she used the phrases "always really tipped in the other direction" and "it really changed", when she perhaps meant the funding only benefited the White students. But, it is important that she was exploring the notion that just funding and presence of White students alone does not mean true integration. In fact, the initiatives of White parents in such situations can actively harm Black, Brown, or immigrant students. For instance, in the case of NYC schools that the Nice White Parents podcast focused on, all new funding was directed primarily towards French language learning, but the kids of color there wouldhave benefited much more from Spanish and Arabic language integration (NYT, 2020).

Thoughts on exploring school segregation and using the desegregation tool inCS classrooms. Fiona shared that she does not spend much time in her CS classes talking about topics around race, racism, and anti-racist initiatives like the Black Lives Matter movement. She said,

> I see this [anti-racist issues] a lot in my the other elective that I teach, which is,like I told you guys, that incubator class, and they and we bring up some we, especially over the last week or so, [because] we're trying to nail down,

> like an issue that we want to support with our group project. But yeah, it's very muchan openly discussed topic. In that class. . . I mean, this is probably a bad move on my part, there's just not a ton of room in my Computer Science class that, that we talk about it, we do talk about a lot of like, tech issues and coding, and, you know, it's just very much centered on that.

Here, she mentioned that she talks about anti-racist initiatives, but more so in her "Incubator" classroom, in which she feels she has more free reign over topics. But she also mentioned that it was important to change her practice. In doing so, she was concerned about being truly authentic, if introducing topics like school integration or anti-racist initiatives in her CS classrooms. She shared,

> So there's a difference between like making a concerted effort and being you know, an advocate for more of a, you know, integrating diversity and these sortsof discussions in there versus, like, doing it just to do it, and then never talkingabout it again. Or doing a standalone lesson, and then you know, moving right on to, you know, the plan as usual, the next day. Like, they just sniff that out,and then they just won't find ownership in that either. So I think kind of, if you could find a real good balance between, yes, including this in your class making Computer Science more, you know, diverse, and talking about these issues, which they previously haven't been, but finding a really authentic way.

Again, we see some use of evasive language. Perhaps "integrating diversity" means to integrate issues around anti-racism and social justice. But again, we can see Fiona exploring what authenticity might look like if talking about justice. She felt that justice should not be a "standalone" topic but be spoken about frequently in CS classrooms.

When exploring the tool meant to explore segregation and desegregation in a local Michigan school district, she felt that the visual impact of the tool was important for students to fully understand the meaning of segregation. She also felt that one way to make it authentic would be to connect the issue of school segregation to "current events" and explore some other CS tools that already were working towards fair districts. She mentioned,

> I definitely think having the visual aspect of it is really helpful versus say, like achart that just shows, you know, percentages, or whatever. Being able to drag around [the icons] is really cool. Um, I will say that, um, yeah, I think sometimes, for them to kind of be connected to it more would be maybe centering it around. . . is there like a current, like, thing in the news that we could, you know, centered around? Or maybe if we broadened it a little bit, because I know that there's a lot of work being done right now, when now that. . . with the 2020 census data, to redistrict congressional districts. And there's some like really cool algorithms and technology that are being developedright now to make that more fair, and just applying the algorithm to figure out congressional districts to best meet people's, like political needs and things. So I'm wondering if it could be a part of the whole issue.

She also spoke about how centering it around real world problems, like segregation, also might make it easy for students to feel like they are authentically exploring how CS can solve or exacerbate a problem in the society.

> What can algorithms. . . do to help [solve a problem]? Or you can look at it from [the other direction] and here's what technology is doing to further that

> problem. I think that's a good hook with kids. Versus something where there's not quite a natural fit. . . I just feel like that might not resonate with them, or they might feel like you're just trying to kind of make a you know, like a, you know, just trying to get fit in your quota of like being, you know, culturally responsive and stuff like that you're like, "Check that box". Um, I don't, you know, they would sniff that out pretty quickly. So you centering, centering it onintegration, and districting, and stuff like that, that is a real issue, I think is important.

So overall, Fiona acknowledged she would have to change her CS classroom practices to bemore intentional and authentic about exploring social justice as it relates to CS.

Lesson Implementation: Reflecting on social justice and possible CS solutions for the society. Fiona wanted to include her lesson, titled "How can Computer Scientists be Social Justice Allies"? in the unit "Ethical and Social Implications of Computing Systems". She envisioned four parts to her lesson. In the first part, she wanted to introduce how algorithms are being used to try to reduce the negative effects of partisangerrymandering. Then, in the second part of the lesson, she wanted her students to explorehow CS could be used to address problems in the society related to social justice. See Figure 9 for a description of the four parts.

Figure 9. Overall plan of Fiona's lesson with four parts

Specifically, some examples she shared for her students to explore included racial harms in bail and sentencing, hiring decisions, and hate speech in online spaces. In particular, she highlighted to her students that the issues they were exploring were complex and they "deserve" complex solutions. She also wanted them to explore how CS solutions could evenexacerbate a problem. Figure 10 describes how she wanted to present this information to her students.

In the third part, after exploring possible CS solutions to societal problems, she wanted herstudents to share their solutions. Finally, in part four, she shared the issue of educational gerrymandering and school segregation, as shown in Figure 11. She wanted her students toread some articles that explained school segregation's history and its current presence.

Then, she wanted her students to explore the school desegregation tool and see a specific example of exploring CS solutions for a social justice related issue. She wanted

students to explore the possibilities of CS and was less concerned about her students fully engaging with the code. Specifically, she highlighted "Don't worry if you wouldn't know how to code this or completely understand the technology behind it."

Figure 10. How Fiona wanted to discuss technologies used for bail and sentencing

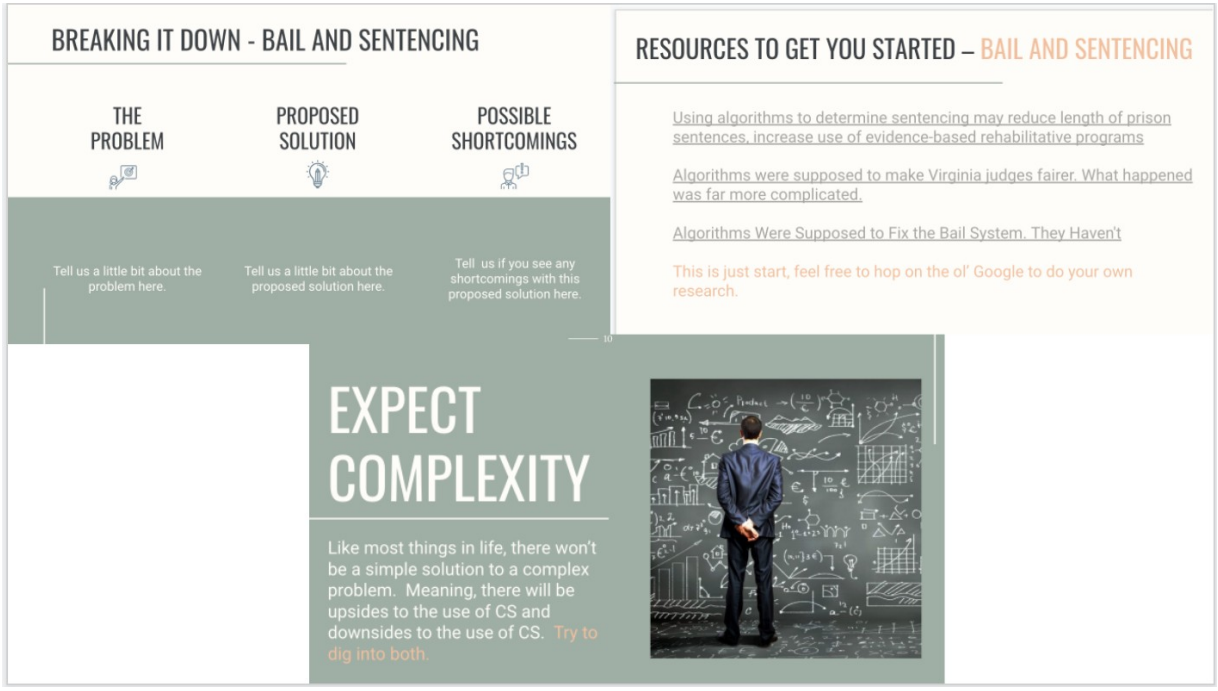
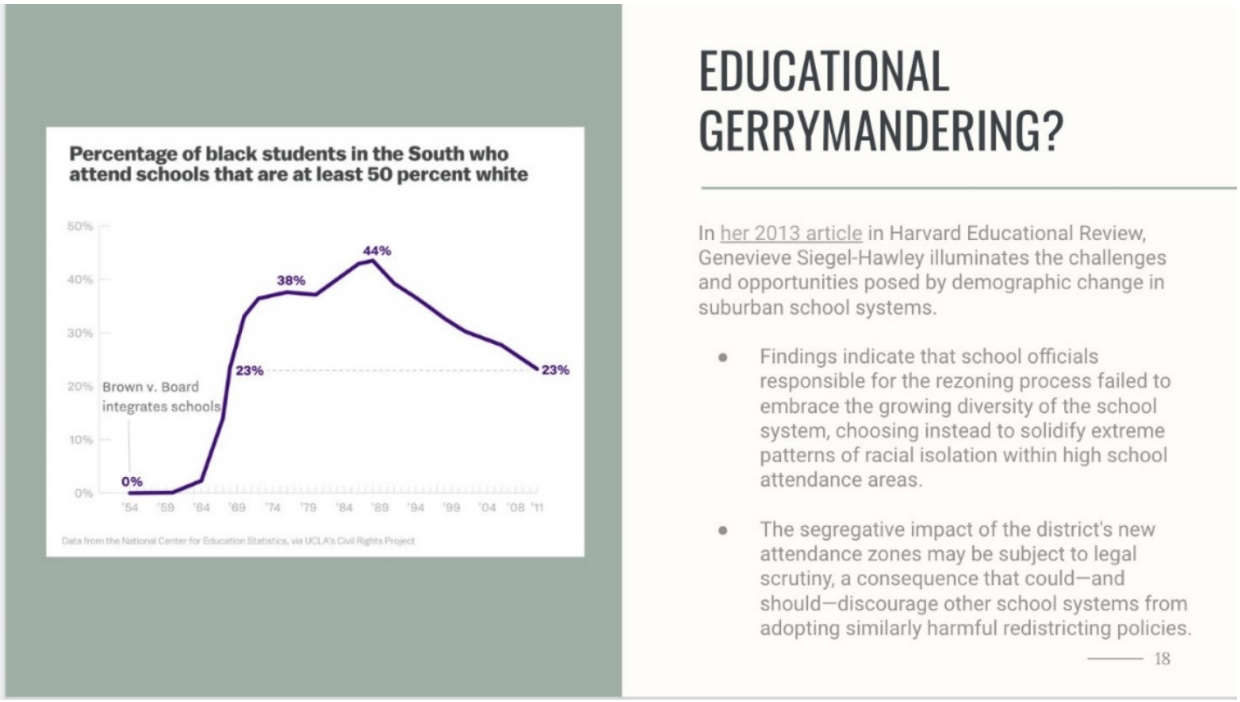


Figure 11. Fiona's plan to introduce educational gerrymandering



Instead, Fiona wanted her students to reflect on why they were using the desegregation tool in the ways they were and be critical of their actions and what they could lead to forthe community. She said,

> What I really would want them to think about and maybe even take notes onis, you know, why are you moving students to certain districts?...And I imaginethat we're going to try to make things even and equitable and, you know, makea more diverse school district as far as the elementary school and stuff. And then when I use the second tool, I would encourage them to think about, okay, why are you drawing the lines [redistricting] that you're drawing? Why are you,you know, let's shuffle them again. And which lines would you draw and kind ofask them to be a little bit conscious of the moves that they're making and conscious of what they're doing [to address segregation].

Finally, Fiona felt that such a lesson had a rightful place in her CS classes and shared strategies on how she might solidify its rightful place. This sentiment of hers also builds onthe teachers thinking about how they will navigate the potential backlash against teaching anti-racist topics. Fiona's strategy involved telling parents that everything she does, like talk about school segregation for instance, was rooted in truth and facts. She mentioned,

> I absolutely think that a lesson like this would be appropriate to do in my [CS] class, we're using a lot of the computer science standards. In fact, I pulled somefor my lesson plan, and I included them in there. We are talking about Algorithms, Supercomputers, um, Bias in coding and stuff like that. So, you know, if a parent came to me and said, like, this lesson is going on, can you? Can you show me where this is even in your curriculum? I say, "Absolutely. Here's, here's the curriculum, here's where it meets [the standards]. This is what we talked about. It's all fact based, um, you know, things like that." So my answer is absolutely, yes.

Carl's Case

Carl teaches Cybersecurity and Web Design. He believes his school is racially and ethnically diverse as many of his students are from recent immigrant families. His CS classrooms are around 60% White, 20% Asian, and 10% Black. He is interested in exploring anti-racist topics in his CS classrooms as he believes "technology can go either way, depending on the human who is programming it." Additionally, he thinks these topics are important for the global society and will help him become a better educator.

Thoughts on school segregation. Carl's thoughts on school segregation emerged when the group conversation focused on how "school choice" is sometimes presented as a way to

end or reduce segregation. He felt that school choice leads to schools that are "less diverse" as they predominantly end up having Black students, that is, they end up causing more segregation. He said,

> I kind of have a little bit of mixed feelings on [school choice]. Because if you look, for example, and a lot of these. . . a lot of the charter schools, they're all school of choice based, but they're all primarily like 98%, predominantly African American charter schools. So there's not really that, I mean, from thecharter schools that I'm aware of here, and we're, you know, in the [redacted state] area, they're actually less diverse. That's for my observation.

He further shared his negative opinion on charter schools by saying, "I mean, a lot of themyou see, get shut down within a year or two. You know, I've seen them in Detroit get shut down because there's no heat in the building. There's a couple of them that had investigations on them for how they're distributing their funds and how they're using their funds." Apart from these thoughts on charter schools, Carl did not speak much about his thoughts around school segregation

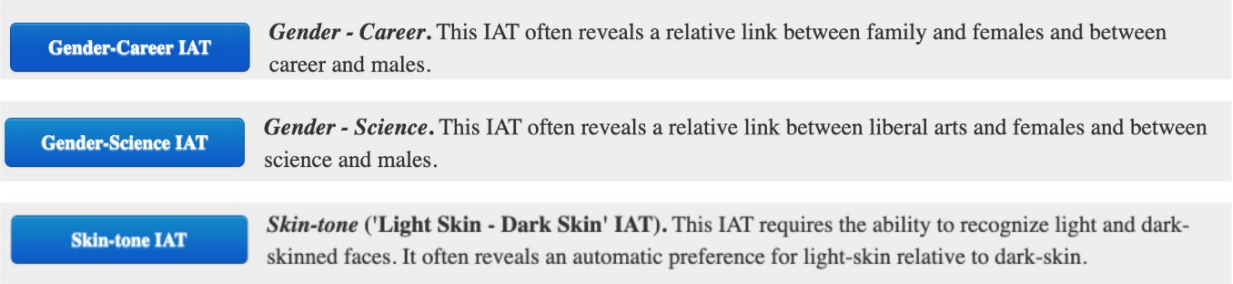
Thoughts on exploring school segregation and using the desegregation tool in CS classrooms. Carl agreed broadly with Fiona and Ray that he would like to exploretopics like school segregation and use the desegregation tool in his CS classrooms. One ofhis primary concerns was the type of language that the tool used, i.e. if it used Java or Python. He wanted to know if the platform the tool was developed on, i.e., https://openprocessing.org/ could be compatible with the CS languages he needed to teach like Java.

He also briefly mentioned that his students would be interested in topics around social justice. He also said that he would want his students to read about segregation and

desegregation efforts if they were to explore the tool. He said, “I’ll just put it on my Canvas [Learning Management System]. And then they can look at that and explore that? Yeah, I [would] definitely have to show them the article [that explains school segregation in the present times]”. He did not share other thoughts apart from these.

Lesson Implementation: Reflecting on biases within oneself in CS classrooms. Carl wanted to have a lesson in which students could reflect on implicit bias as it relates to school segregation and the desegregation tool. He wanted to start the lesson by asking the question “What does equitable computing mean to you?” and then leading an open-ended discussion around the topic.

Figure 12. The implicit bias tests that Carl wanted his students to take



After that, he wanted his students to first take three implicit bias tests, Gender-Science, Gender-Career, and Skin-Tone, as he believed they related most to the topic of the school desegregation tool, as shown in Figure 12. He then wanted his students to explore the tool, but again asked if the tool could be used in the Python language, as the tool’s language concerned him. The tool example I showed was in Java, although programs in https://openprocessing.org/ have the ability to be written in Python as well. Finally, after they explored the tool, he wanted his students to explore the website https://www.learningforjustice.org, especially the topics listed on website like race and ethnicity, religion, ability, class, immigration, gender and sexual identity, bullying and bias,and rights and activism. When I asked why

he wanted his students to explore these topics,take the implicit bias test, and what connections he would make with these topics to the desegregation tool, he said

> I guess I would focus more on again, the concept of integration, and how, how algorithms can really kind of be predictors of [integration], or they can either they could either I guess, computer algorithms in the programming. . . like with this app, how it can either really make the segregation even more enhanced.

He seems to indicate that algorithms or CS have the power to make things worse for socialjustice issues or for segregation. Perhaps he thought if students explore certain topics and are aware of their biases, they can think more critically when exploring the desegregation tool. Or perhaps he was just being skeptical of a computing tool having the power to address school segregation. As a reminder, one of his main reasons for taking part in the workshops was that "technology can go either way, depending on the human who is programming it." Finally, he said he would probably encourage his students to write a blogpost or create a tool similar to the desegregation tool as ways to further discussion around the topic. He shared,

> I think maybe like a, like an addition to this, maybe I would, you know, have the students maybe create a blog, or, like a wiki page where they could like, post, you know, their thoughts about it, or they could do maybe even create, try to create something similar to the app that you created.

Overall, Carl's lesson seemed to be slightly less structured and more open-ended. His goalthrough the lesson seemed to be to create a space for bias testing rather than explore particular topics that were pertinent to CS, like algorithmic biases and justice. For instance, he explained the crux of his lesson to me by saying, "So the actual gist of this particular lesson would revolve around your app that you had created based on

segregation. And it's an actual testing for hidden bias." In this case, the lesson perhaps could have been made stronger by explaining the connections between CS and the need for implicit bias testing and reflection.

Ray's Case

Ray teaches AP CS courses (though not the current year), Intro to CS courses, and some Python programming. His school is over 90% White and his CS classes reflect that. His classes also tended to have majority boys. Ray wants to do anti-racist work in his CS courses as he thinks it's a very prominent issue, especially in the current climate where there is censoring of topics related to antiracism. He was worried about how to approach the conversation, as some of his students tended to push back or shut down if they felt the conversation was "forced" on them. So he wanted to introduce activities that would naturally help spark conversations in his CS classrooms around social justice.

Thoughts on school segregation. Ray first shared his thoughts about bussing. He felt that bussing had many issues that it still had to contend with, including the lack of bus drivers. He shared,

> I think today, it's even more of a problem. Because there's less school bus drivers, we already got some schools that have gotten rid of busing entirely when they've had busing. So it's just based on public transit.

He also shared his thoughts on school choice and the phrase "funding follows White students". He mentioned,

> But those school choice mantra is like… "let's go ahead and let the students choose which school they go to, and then that'll increase competition. So all the schools will start doing better." But it's not going to work out that way. You can't put our capitalistic mindset on to a socialist, like, system. Like

> the whole point of our school system is that everybody has an opportunity. And once you start, like tagging that capitalist like idea into this, you start getting the the disadvantage, and you start getting that gap between the high and the low, because now you're taking the high and moving on clustering and because they can choose to go there, and they have the opportunity to go there. And then low end, low socio economic are not going to have that same opportunity to divert. . . disperse themselves in those ["high"] spots. So the whole idea of likeeverybody getting to the same spot, everybody doing better than everybody having a chance on it. It doesn't work when you say well, these are my dollars, I'm going to take them somewhere else. . . you can't, you can't attach a free market capitalistic idea to it, it just kind of breaks down the whole public school system.

He mentions the "high" and the "low" and although he only attaches socio-economic status, it is possible that he also was thinking about race as well. For instance, "inner city"is often a code word for addressing Black students. He used that phrase when he shared the following

> I've seen limited school choice where I know, we here in [redacted], we only, like 30, or 40 school choice kids per year, we're not open school choice. Um, so theyget to be very selective of which ones they bring in school choice. . . So if you're in an inner city school [that] is struggling. . . the kids that want a better experience are the ones in my school choice. Well, now you're taking those highend kids that are the high achieving kids that have parental support, and have that behind them. And then all those kids that are left behind in that school, the struggling school, are the ones that don't have

> support. So now anybody that would have been a good influence on those kids has been drawn out of thatschool into a neighboring school.

He thus was critical of the system that fails students, such as limited school choice that may exacerbate aspects of segregation. But also, unfortunately, he had deficit language usewhen thinking about the students and how certain students who are not "high end" mayhave troubles, may not have parental support or good influences, and may thus be left behind.

Thoughts on exploring school segregation and using the desegregation tool in CS classrooms. Ray teaches in a school that is predominantly White. So, he was concerned about how his students were disconnected from issues like school segregation andhow they might react to such topics. He shared that it will be good for his students to explore a tool around desegregation. He said,

> [Some kids] are so disconnected, I think this would be a good tool to connect them to other school districts and start seeing that other school districts are having this issue. That it is not [that] all schools are homogenous, like ours. Like [school districts need] to be integrated better. And this would be a tool tokind of give them some experience with it. That they don't have to have. So I think it'd be good.

He also was worried about how his students would end up using such a tool, given their limited experience and White cultural isolation. He shared that he was worried that his students would use a tool like the desegregation tool, but end just suggesting scenarios ofbussing or redistricting that worsen segregation. He mentioned,

> I mean, our district leans left politically, but there's still probably 35% that are conservative and right. But I just I'm afraid of the times where it misses

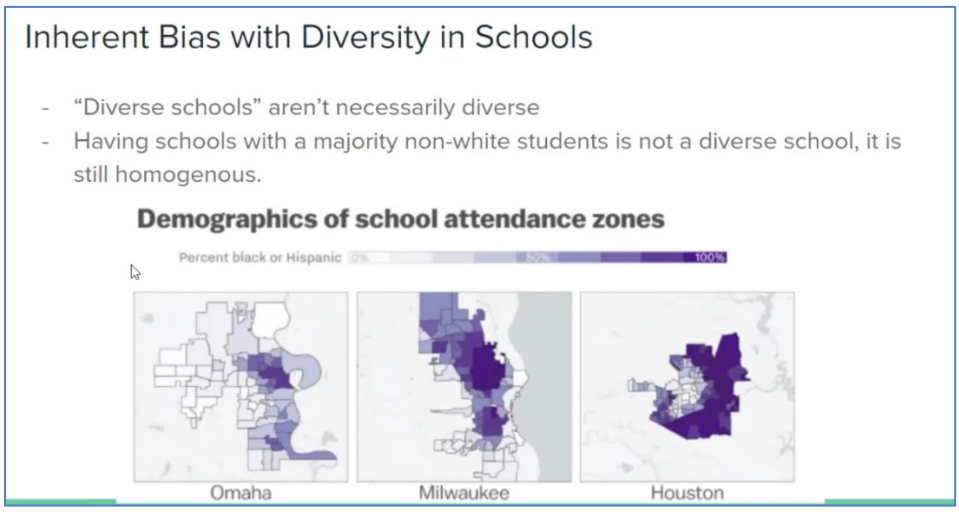
> the mark, and it lands on "segregation" is the [solution] that they made… they [thestudents in their projects] got the FOR loops, they did all those pieces [the CS syntax], they hit all the marks [with the syntax], but the ideal they were presenting was the complete opposite, right? So like, they're [the students] like, alright, let's stick with segregation. I mean, those projects are gonna come up just as much…

He wondered how he would address such an issue. Traditionally, CS classes base their assessments on the efficiency, effectiveness, and elegance of any syntax. Ray was wrestling with the idea of a racist project or product that "hits all the marks" with syntax. How would he grade it? He thought out loud, "I would hate to give an A for being racist." Although he did not completely arrive at a solution about how he would grade such racist projects, it was important that he was exploring the impact of projects in a CS classroom and not just their syntax. Unfortunately, we do see many technology products in our society that were given a clearance, or an "A", probably for having an efficient, "effective", and elegant syntax or algorithm. For instance, the kind of software that is not able to recognize faces with dark skin tones was given clearance from someone. But what would it mean to give these racist technologies an F instead of an A? Could we start this tradition of critical CS assessment right at high-schools?

Lesson Implementation: Possible CS solutions for the society and clients. Ray said that he would like to introduce this lesson plan only after the AP CS exam. He wanted to use the desegregation tool as a way for students to explore school segregation in their neighboring districts and offer possible solutions to "clients" like local politicians or the school boards. The first part of his lesson involved diving into the issue of school segregation specifically. First, he wanted to lead a discussion that dispelled the notion that

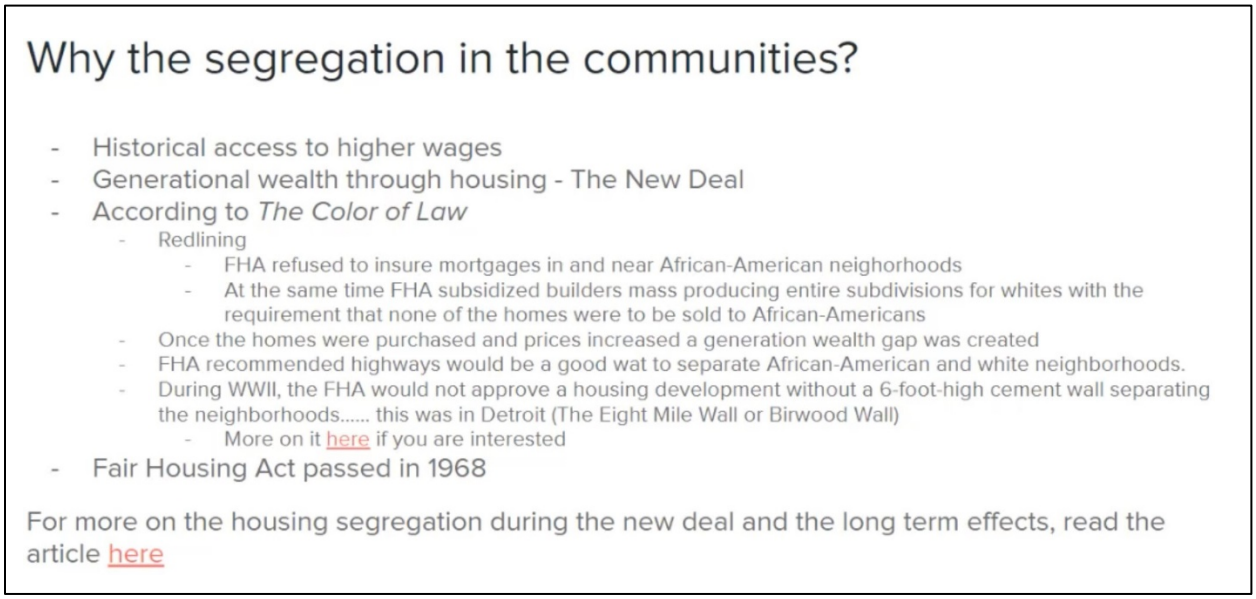
a “diverse school” does not mean a school that only has students of color, as shown in Figure 13.

Figure 13. Ray explaining the misuse of the word “diversity”



After that, he wanted to discuss the historic reasons behind neighborhood segregation andhow that also led to school segregation. He wanted to bring attention to legal ways in which segregation was promoted through redlining, building highways, and walls between White and Black communities. He spoke about how he would tell his students that the presence of highways is another way to reduce bussing between communities. Finally, he wanted his students to explore the history behind segregation by themselves by reading various articles. Figure 14 captures the some of the ways in which he wanted his students to explore the topic.

Figure 14. Ray's explanation of racially segregated communities and neighborhoods

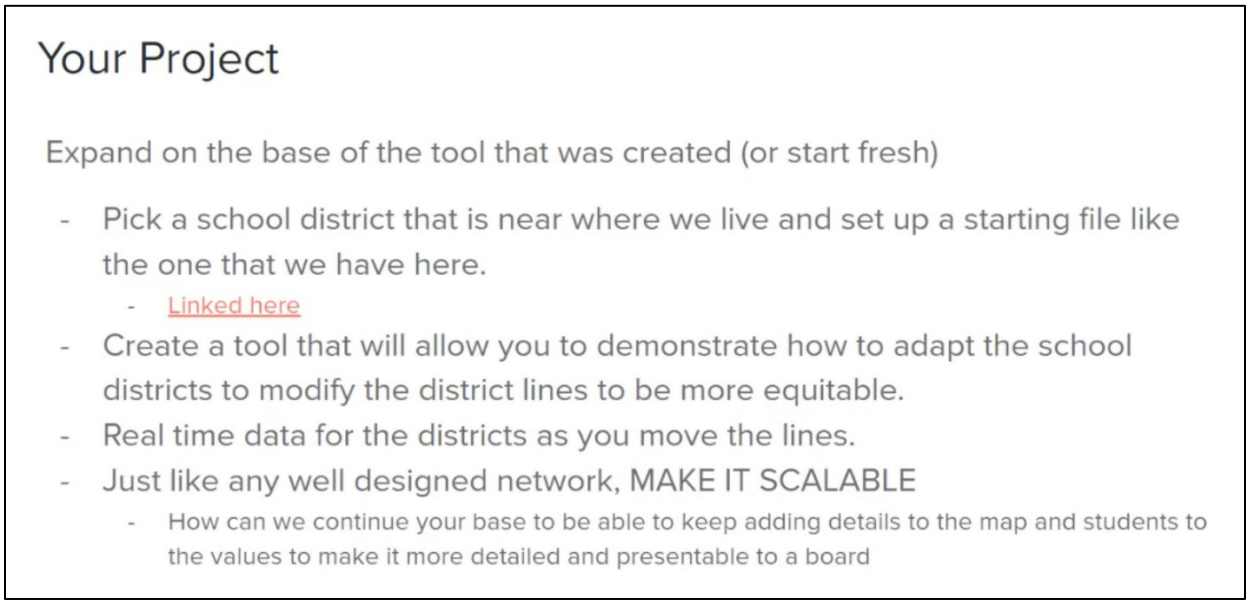


He had previously mentioned that he was worried about some of his students being okay, and even promoting, the current status quo of racial segregation. So, he wanted to lead a discussion around why it was important to reduce segregation, even though his students may argue that it costs more money or requires too much effort. He also was prepared for possible arguments from his students regarding directing funding to segregated schools, so he wanted them to listen to the Nice White Parents podcast. Finally, he wanted to explorethe question "Is the juice worth the squeeze?", (see Figure 15) i.e., should we make efforts to desegregate schools. He said, "Obviously, it's a yes, but we need to bring them to that point."

After exploring the history behind segregation, he wanted the students to do a 'project' that involved them offering various solutions to the neighborhood school segregation (see Figure 16). He had led the lesson up until this point with the statement that "Yes, we aredoing Computer Science. But we need background information" He felt this technique would help his students understand why it was important to know about the extent of theissue they were exploring CS solutions for.

Figure 15. Ray wanted his students to arrive at "yes" to the last question by themselves

Figure 16. Ray’s idea of using the school segregation tool to serve potential “clients” to show equitable school districts



Overall, Ray wanted his students to explore an issue, think of CS solutions for it, and caterthe solution for particular clients like the school board. In some ways, his approach is closeto what some folks in the field of Human-Centered Computing (HCC)

tend to use. The separation of society and technology reduces in such fields, so it is worth exploring what it may mean to integrate elements of HCC in high school CS.

Cross Case Themes

There were a couple of themes which were present across and in all three cases, Fiona, Carl, and Ray. These were 1) Engaging in cross-disciplinary lessons with CS, civic, andhistory and 2) Technology is not neutral

Exploring cross-disciplinary lessons with CS, Civics, and History. Ray and Fiona thought that a lesson on school desegregation would benefit from having inputs froma U.S. History or Civics teacher. Carl did not indicate if he agreed with the cross disciplinary idea completely, but he did mention that his lesson embraces what students might traditionally learn in a Civics course. Ray first brought this idea of cross-disciliparity to light when he shared the following in the group conversation,

> I think tying [the desegregation tool] cross curricular and making the tool for like a History or Civics class to use I think, would be a good kind of cross content ability. So then they can have that conversation with [a] History or theCivics teacher about the government in the integration [efforts through] Brown v Board and what progress [has been] made. But making a tool for another course to use, I think would have a bigger impact on it. Because then the kids in [CS] get to develop it and make it and see it. But then their impact on it is more so talking about it. But is there a way that we could tie it into a relevantlesson that's being taught in another class, and now we have created a tool for another class to have a visual demonstration, or end manipulation tool that they can use to really see and dive deeper in their

> lessons. So I think that's where I mean this, I think we'd be a good job supporting the Civics and History departments.

Thus, Ray was speaking about CS students supporting Civics and History lessons and howusing a CS tool can can a "bigger impact" on topics students learn in Civics and History courses. Fiona shared a somewhat similar sentiment when presenting her lesson plan about drawing strengths from her degree in Social Studies. Her focus, however, was more on howa History teacher can help a CS teacher with some lessons. For instance, she mentioned that she took help from her husband who is an AP U.S. History teacher. She shared,

> So my major is in Social Studies. . . And so I wanted to have a minor that was totally different, both for like marketability, because this was when it was superhard to find a teaching job. So for marketability, but then also, I was, like, you know, I'm learning all the Social Studies stuff, I'd like to learn something totally different. So my minor is in Computer Science, and then I have a teaching degree on top of that. So, um, so yeah, that provides like a really interesting lens. . . and maybe the reason why I thought it was so important to bring up the January 6 thing, or we've, or we've talked a lot in here about Black Lives Matter, or some of the social change that's going on in that realm. I think maybe just having that background, I feel a little bit more comfortabletalking about that. . . My husband's also [an] AP U.S. History teacher, so he's, like always talking about all this stuff. . . .So that helps out a lot too. And I wasable to kind of run a lot of these ideas [for the CS lesson] by him. . .

Apart from sharing the insights she gets from her Social Studies background, she also shared her concerns about how the clamping down of social justice and anti-racist topics might affect her CS classrooms, if even History classrooms face opposition in the current the climate of censoring anti-racist sentiments. She felt it was inappropriate for anti-racisttopics to be shut down and that they should in fact be taught in other areas apart from History, like CS. She shared,

> We look [at the] news currently, and they don't even. . . a lot of people don't even think a Social Studies or a US History class is an appropriate place to talkabout racism. . . If you have people out there who are saying, we can't teach this in a US history class. And people who are saying, you know, you don't want to hurt somebody's feelings, or make them feel guilty, because we're talking about slavery, or segregation, or systemic racism, and that's happening in a Social Studies class, I have to imagine if that parents child was in my [CS]class, they would have even more of a problem with it. . . But like I said, withthe current political climate when people are saying that [anti-racism] doesn't even belong, which is crazy, in my opinion, like that it doesn't even belong in aSocial Studies class. I think other people who I would staunchly disagree with would say that [anti-racism] doesn't belong in a Computer Science class.

Carl shared the following when he was asked what came to his mind as he was designinghis lesson. He said,

> [The topic] would, it would go to the fact of core values, which would be like, you know, what students would maybe learn in a Government or a Civics course. You know equality, you know, you know, our freedoms, our

> liberties, you know, every. . . every American or every citizen of the United States has a right to a public education. It should be, you know, just a granted human right.Equality.

His comments seemed to indicate that his CS lesson was addressing a fundamental right that citizens would have about public education. He also seemed to indicate that these "core values" would usually be taught in a Civics course. With all the teachers, it seemed like they had thoughts about between various ways for CS classes to interact with subjects like History and Civics. For instance, the teachers did not say the topic about desegregationshould only be covered in a Social Studies class instead of a CS class. Indeed, Ray seemed to point out that Social Studies may have already helped students understand the topic of segregation and desegregation and CS can help students further explore that topic.

Technology is not neutral. All three teachers strongly agreed that technology is never neutral. Although they did not always associate how race and racism, in particular, affect technology, they acknowledged the general misuse of technology. Ray shared the his thoughts about certain governments misusing technology and oppressing their citizenswhen talking about the potential negativity effects of technology. He stated,

> [A] natural segue we did was when my dark web and the foundation of the darkweb and creating [technologies] for suppressive governments and overreaching governments and having the people access to us, we've had that conversation. But then we also get into conversation and the dichotomy of [how technology is]a double edged sword. Because now, when you create a tool that is anonymous and good, it is also anonymous. And people use that for their other purposes. So. . . we have that conversation of how technology

> is a tool and is there and how it is used. And its intentions have very different outcomes, depending on why a tool is being used. So really, really sparking that conversation of destruction, everything we have is a tool that we have and how you use it. Andthat segues into social responsibility and internet citizenship.

Fiona's thoughts on technology's use and misuse was centered around racism in the world. She shared that the technologies we create are a part of the racist world we live in and the technological products reflect that reality. She said,

> When you teach actual coding, [there is] so much binary. I mean, obviously, everything boils down to ones and zeros. And so when you talk about things being like, involving algorithms, or technology, or coding, it's like, okay, it's either true or false. One or zero. That sort of thing. But then I'm talking about, you know, bringing up how well if all of society has a bias, and there's systemic racism in that, and the people building, you know, technology and apps and algorithms and facial recognition, stuff, are swimming within that water. Then, of course, their code can reflect that. And so looking, we will, youknow, look at issues, like fake facial recognition technology, or look at artificial intelligence, and because there's this common belief that like, "Well, if it's an algorithm that it must be, it must, must be non biased, and it must be withoutany kind of subconscious thoughts." And I mean, obviously, they don't have like, subconscious thoughts, because it's a computer, but somebody had to havecreated that [algorithm/computer]. And it's working within the system that we're all working in…

Fiona also spoke about the role of technology corporations and the importance of her students observing their practices and if they remain true to their apparent anti-racist sentiments. This seemed especially relevant in the time when this interview happened as many companies were being questioned about their genuine interests in being anti-racist. Such criticism is perhaps parallel to the concepts of greenwashing (corporations making disingenuous claims about how sustainable their company or their products are for potential monetary or other benefits) and rainbow capitalism/pinkwashing (commercialization of the LGBTQ movement, primarily for profits and appearance rather than genuine allyship). Regarding corporate involvement in anti-racist initiatives, Fiona said,

> What if you took all those statements [the anti-racist statements released during 2020 BLM movement], and then you then looked at, like their hiring practices, or who sits on their boards. Like I'm talking about big corporations now, not this, this yoga studio. Let's look at let's say, like Amazon, and so theywe could pull their if their statement, we can find that on Google ,whenever it came out in 2020. . . It's two years ago, they wrote these statements, and has, like, does their practices reflect what they said? So I thought that would be an interesting lesson, too.

Carl's lesson focused on implicit bias. He had led his introduction by saying that the people who build technologies influence the way in which the technology ends up being used. But, he did not reiterate that sentiment in the group conversation. He did share the following about how he thought social media was affecting his students negatively. He shared, "I focus on Social Media. And I'm not teaching programming this year because I have all my Cybersecurity classes. So especially in Cybersecurity, we talk about the pitfalls

of Social Media all the time, and I tell them, it's like the worst thing that happened to your guys' generation." Thus, overall, the teachers had a balanced view of technology and did not always view it in a positive light. They shared its potential to be very negative for the society and their students.

Discussion

I analyzed the cases of all three teachers separately. For each teacher, Carl, Fiona, and Ray, I described 1) their thoughts on school segregation 2) their thoughts on exploring theschool desegregation tool in their CS classrooms, and 3) their lesson plan which involves exploring the topic of school desegregation and using the desegregation tool. I also conducted cross-case analysis and found themes that spanned across all teachers' thoughts and lesson plans. These themes were 1) Exploring cross-disciplinary lessons with CS, Civics, and History and 2) Agreeing that technology is not neutral. With these findings and results in mind, I will answer my three research questions in this section.

How do CS Teachers Speak about the Socio-Political and Technical Dichotomy in CS Classrooms?

All three teachers thought that technology is not neutral and has potential negative effects,from the personal to the political. For instance, Fiona critiqued how the creators of technology are "swimming" in our world with its racial biases and so their technological products will also be affected due to it. She also spoke about observing corporate responsibility. Ray discussed the intentions of technology use, that it is sometimes purposefully used by governments to oppress people. Carl spoke about the harmful effects of social media on his students' generation, especially relating to Cybersecurity.

Vakil (2018, p. 37), in his paper on justice-centered approaches to computing, mentioned the need for the shift away from dominant approaches to justice centered

approaches in CScurricula. As a reminder, these were the three justice approaches he mentioned: 1) Technology and computing have social and political implications., 2) Learning activities focus on individual rights and freedoms, and corporate and government responsibilities, and 3) Students engage in critique of unethical abuses of technological power (e.g., US surveillance state and privacy vs. security debates) and explore the role technology can play in reaching social justice goals.

Both Ray and Fiona's thoughts on technology are slightly oriented towards the justice centered approaches. Ray's example of being critical of governments and other oppressivepower structures using technologies is related to the first and second points. Fiona too talked about analyzing any anti-racist statements released by big corporations and evaluating their actual practices. Carl's approach of focusing on cyberbullying would perhaps more dominant instead of justice centered, according to Vakil. Vakil mentioned that the "learning activities focus on individual and student choices (e.g., piracy, cyberbullying, obeying copyright laws, responsible social media use)" . That is, it focuses more on students' choices and not enough on corporate responsibility of running various social media.

Exploring the socio-political elements related to technologies would be especially importantin for the future of K-12 CS education research. Indeed, Yadav and Heath (2022, p. 452) said the following, "When CS curriculum developers prioritize the needs of the industry, rather than interrogating how computing is used as a tool for oppression, it creates an information asymmetry between curriculum developers and teachers/learners." They also promulgated the notion of critical citizenship, a framework that is centered around scholar-activists of color. Critical citizenship involves citizens dismantling

oppressivesystems (including technologies) to work towards a more justice oriented democracy.

Apart from curricula developers in CS, it is important for the CS education to also bring together scholars, educators and practitioners, and community leaders to work together towards creating a system that promotes justice-oriented social, historical, cultural, and additionally political elements of technology use (Lachney & Yadav, 2020). Working off ofteachers' current perceptions such as their grievances against the the dark web and oppressive governments (e.g., Ray), about cybersecurity and privacy concerns in social media (e.g., Carl), but to add to it corporate responsibilities and racial biases AI (e.g., Fiona) can perhaps be a good starting point to have conversations with K-12 teachers about these topics.

How do CS Teachers Talk About Race and Racism when Exploring a Computing Tool that Explores School Desegregation?

When exploring the computing tool and the topic of school segregation, the teachers addressed race and racism in different ways. Fiona spoke explicitly about the role of Whitemoms in stopping busing in violent ways. She also spoke about the podcast "Nice White Parents" and the role of White parents in directing school funding. But, she was also evasive for certain instances, such as she was not clear about how exactly the "Nice White Parents" used funding to advantage their kids more than others. Similarly, Carl and Ray were also at times race-evasive, but spoke more explicitly about race at other times. For instance, Carl mentioned that a predominantly Black school is not a diverse school. "Diverse", unfortunately, is often a code-work for Black or Brown students. So it was important that he acknowledged that common and harmful misperception. Ray mentioned that he would hate to give an "A" to a racist project, racist here referring to any project

that promotes school segregation. Ray was much more explicit in talking about race and racism in his lesson plan implementation. Unfortunately, race-evasive discourse has been an active part of White teacher identity studies. Jupp et al. (2019) analyzed twenty-five years worth of race-evasive White teacher identity studies. They found five analytical themes 1) racialized silence and invisibility, 2) resistance and reconstruction of White privilege, 3) Whiteness in institutional and social contexts, 4) fertile paradoxes, and 5) reflexive Whiteness pedagogies.

The first two themes here refer to studies that found White teachers who wanted to "look past race", who wanted to not talk about race, or used deficit and race-evasive language totalk about their students of color. Recent studies in CS education literature have found these to be a practice prevalent among K-12 CS teachers (Goode et al., 2020). The theme of "fertile paradoxes" is interesting, as some studies found that White teachers discussed race in ways that "were powerful yet power-evasive" (Haviland, 2008, p. 44). As an example something that is powerful, yet power evasive, instance, teachers have engaged in safe self-critique. That is, they might reflect on a time in the past when they realized something they did was problematic and racist, but not spend much time in discussing future plans to address things they find problematic (Haviland, 2008). Jupp et al. (2019) think fertile paradoxes occur because "educational institutions have historically functioned as both the vanguards of racial stratification (e.g., (Gillborn, 2008; Leonardo, 2013, p.40)) as well as the arenas of democratic social transformation (e.g.,(Freire, 1970; Gutmann, 1999))."

What can we do to navigate these paradoxes? Jupp et al. (2019), have some suggestions.They mentioned that the theme "reflexive Whiteness pedagogies" refers to an area of research that emphasizes "self-formation that allows [White individuals] to cross

race lines not in order to become Black but to begin to forge multiracial coalitions based on critical engagement [emphasis added]" (Giroux, 1997, p. 299). For instance, Jupp et al. (2019) mentioned that this could include an arts based curricula that would help teachers with "negotiating the multiple meanings of Whiteness" (McIntyre, 2002, p. 33). Before the teachers explored the desegregation tool, Fiona, Carl, and Ray had gone through an activity that allowed them to describe their White identities through photographs/phrases and discuss the complexity of their identities. Perhaps more such critical engagements with White identity and anti-racism might be important for CS teachers to be involved in the future. It is important for CS education to find ways for CS teachers to have repeated, prolonged, and multiple critical engagements, keeping in mind the inherent tensions that might occur in educational institutions that maintain racial stratification.

How do These Teachers Implement a Lesson Using the Computing Tool Meant to Explore School Desegregation?

The teachers implemented their lesson in different ways. Fiona focused on biases in societyand technology's role in either solving or exacerbating the problems. For instance, she wanted her students to explore the use of algorithms in bail and sentencing. Fiona also spoke about her background in Social Studies and her husband's inputs (he teaches AP U.S. History) helped her create her lesson. Carl's lesson focused on students exploring their own implicit biases related to gender, science, and skin-color. Finally, Ray wanted his students to explore the history of school segregation and design school desegregation solutions for potential clients like the school board. He thought that cross-disciplinary lessons of CS and History/Civics would be advantageous for students to explore the topic of school segregation. None of the three teachers treated their lesson's topic, i.e., school segregation, as something "non-technical" that should not be taught in CS.

Previous studies on CRC have mixed results regarding teachers implementing lessons that are explicit about mentioning social, cultural, historical, or political aspects of computing. For instance, davis2019cultural found that the teacher could not engage his students with the historical and political aspects of the Culturally Situated Design Tools like quilting.

The authors said the following, "The teacher did not explain why they were reluctant to revisit the social dimensions of the cultural material. Perhaps the fact that it was a CS course and this was what the teacher is trained in, not social studies or history, reflects a lack of cultural competencies and an uncomfortableness in talking about cultural traditionswith students in their courses." (p. 1174). Davis et al. (2019) suggested that one possible solution could be for teachers to collaborate with cultural experts, like those with quilting expertise and knowledge.

We have some examples of teachers collaborating with cultural experts. In Sandoval (2019)study, Mr. Adams, the White CS teacher, engaged with his students to develop a Scratch programming app to promote the Indigenous community's food activism. But unfortunately, he could not engage in the community's ancestral praxis. Perhaps this happened because he considered Sandoval as the sole cultural expert. Lachney, Bennett, et al. (2021) offer some guiding principles in which collaboration between cultural experts and teachers could happen in a more organic 1) Multi-directional relationship building between the different particles, such as scholars, practitioners, and cultural experts, 2) Iterative engagement with culture-computing through repeated interactions and engagements, and 3) Collaborative implementation of a hybrid lesson, that is teachers andcultural experts implementing a lesson collaboratively. Thus, we see instances of how distributed knowledge and cultural expertise could be highly advantageous for CS lessons.

In this study, however, we see some of the CS teachers relying on their own knowledge ofhistory (e.g., Ray and Fiona) and trying to integrate that knowledge in their lessons.

Although these lessons would have highly benefited from the presence of a cultural expert,like a history teacher or a community leader/activist, it might also be important for students to see their CS teacher being engaged in historical aspects of their lessons.

Perhaps this would make it easier for students to appreciate the true intent of CS teacher,cultural expert, and CS researcher collaborations: that each person is not limited to only one type of knowledge. E.g., The students need to appreciate that cultural experts can provide great insights to computing practices that perhaps others cannot. Similarly, their CS teacher need not be limited by only teaching students how to write computer programming.

The practice of "iterative engagement with culture-computing" can perhaps make teachersfeel more comfortable with navigating some of the cultural, historic, political, and social aspects of computing, instead of relying completely on the cultural expert. Iterative engagement would need repeated, multiple, engagements of collaborations between a teacher and a cultural expert. For instance, Lachney, Bennett, et al. (2021), say "culture-computing connections may not initially be obvious, once teachers and cultural experts have opportunities for iterative engagement with them it becomes possible to moredeeply explore the connections and/or identify others." (p. 17) Iterative engagements can potentially help more teachers feel that culture based and justice based computing is something they could and should take ownership of. For instance, Fiona shared about how she truly believes, and will tell students' parents, that everything wishes to teach in her CS classes, like discussing school desegregation, is a required part of CS standards. Although

this many not seem apparent given the often problematic AP curriculum, her belief in the topic perhaps made Fiona try to explain why school desegregation and anti-racism should, in fact, be discussed in CS classes.

Implications and Future Directions

There are several avenues I believe that are important for both research and practice, based on the results of this study. I outline the implications for both research and practicein turn below.

Implications and future directions for practice

According to Vakil (2018) framework of justice centered computing, there should be intentionality in students engaging with topics like attaining social justice goals through technology, critiquing tech corporations or government misuse of technology, or thinking about critical digital citizenship and freedoms in a tech world. Through my study, I found that the CS teachers were willing to engage in socio-political discussions in their computing courses. Finding ways for CS teachers to be invested and take ownership of leading socio-political topics and discussions may require a lot of intentional work from teachereducators.

Some aspects that teachers appreciated were the articles that detailed issues related to school segregation, and the desegregation computing tool. The tool helped them reflect on how they would approach teaching about the role of CS in various socio-political issues: like school segregation, sentence and bailing, and racial biases in AI. Future workshops andCS teacher education courses could consider having specific examples of socio-political issues for teachers to reflect on using computing. The specific and concrete examples couldbe narrowed down with the help of researchers or the demands of local community activist and leaders, in conjunction with students' inputs. Such workshops should take also into account the principles of critical engagements

(Jupp et al., 2019) and iterative culture-computing engagements (Lachney, Bennett, et al., 2021) mentioned earlier.

Further, one of the teachers, Ray, also mentioned that he will likely engage in a anti-racist lesson only after his AP exams are over, or in his non-AP CS class. As Yadav and Heath (2022) mentioned, it will take a lot of work of this information asymmetry to be addressed appropriately by CS curriculum developers. CS education practitioners and leaders can advocate for corporations, like Code.org, to actively work towards a justice-centered computing curricula which does not place the traditional or dominant importance on standarized tests and programming without context. Further, there is also asymmetry between the different areas of CS practice: in schools, in universities and colleges, in research settings, in government organizations, and in tech corporations. Are all places equally prepared to do justice oriented computing? Can all places be authentically involved in socio-political critique? It is important for the CS education community to think about how we can slowly become more prepared in all arenas.

Implications and future directions for research

Theoretically, researchers have proposed ways in which CS teachers and students can engage with CS and technologies in critical ways. For instance, Vakil (2018) proposed that students should be given opportunities to be involved in justice-centered computing, the tenets of CRC and the implications of CRC encourage students to be socio-political change agents (Scott & Garcia, 2016). There hasn't been as much theories or research on how we can help teachers be prepared to engage their students in such practices. This paper provides practical examples and cases of how teachers engaged in socio-political discussionsof CS and technology use. It can serve as a basis for conducting future research with teachers and to build theories around teacher preparation for CRC

I underline some avenues for future research to engage teachers in civic engagement through computing and engage with the socio-political elements of computing in the following paragraphs. In this study, I looked at how teachers discussed the socio-political topic of school desegregation, how they used a computing tool to reflect on said topic, and how they implemented a lesson plan using a computing tool to reflex on school desegregation. Unfortunately, due to the constraints of this study, I could not see how teachers actually implement the lesson in their classrooms and how students react to such a lesson. In the future, I hope to observe and analyze an authentic lesson implementation and discuss with students their opinions and thoughts after going through such a lesson.

Further, conducting workshops as an individual researcher may not be sustainable in the long run. So, I hope to try a peer model of teacher learning, where former workshop participants can co-lead a workshop for future teacher participants. The effectiveness ofsuch a workshop, and its sustainability, will be important aspects to study in future work.Finally, more research will be helpful to design specific computing tools for socio-political reflections. What topics would teachers, students, or community activist want to have acomputing reflection tool on? What specific aspects of a tool are helpful to teachers and students? What aspects are perhaps unhelpful to teachers and students? What are the implications of co-designing tools with teachers and students? What programming languages are useful for such a tool? These are some avenues I wish to research on.

CHAPTER 3. RESEARCHER POSITIONALITY, VALIDITY AND RELIABILITY, ANDDE/LIMITATIONS

In this chapter, I discuss my positionality and how it affected the implementation of the workshop and data analysis. I will also be discussing the study's limitations, validity andreliability measures I used, delimitations, and limitations.

Positionality

I am a cis-gendered woman from India. I have lived most of my life back in India and I amstill new to the U.S. I have a lot of privileges back home in India, with respect to my educational, financial, religious, and caste-based status. Some of these privileges, such as educational and to an extent ethnicity-based, have also transferred to my life in the U.S. I am always navigating the privileges I have to help me better understand race relations in the U.S. This is, and always will be, an ongoing process.

My interest in this topic of teachers challenging their Whiteness started recently. In 2019, Iwas exploring ways in which high-school CS teachers can broaden participation in computing. This initially involved interviewing some CS teachers. They all so happened tobe White, reflecting the teaching population of high-school CS. One of my professors suggested looking at the data through the lens of Whiteness. This approach made me wonder if those teachers were aware of Whiteness and were comfortable with their racial identity. At the same time, I was reading articles by Goode and colleagues (Goode et al., 2021; Goode et al., 2020) on White teachers' colorblind discourses and was witnessing the attempts at racial reckoning this past year after George Floyd's death. Now, however, I see articles on how the reckoning was much shakier than initially thought, with support for Black Lives Matter (BLM) lower than it was before the pandemic. I also see attacks on Critical Race Theory to be taught in schools. All these together made me want to pursue

the line of thought in this study but have also made me quite anxious about making sure I have navigated the study as well as possible.

Reliability and Validity Measures

The three leading scholars of case study research, Yin (2009), Merriam (1998), and Stake(1995) have all proposed various techniques for establishing validity and reliability in a study.

I used data source triangulation, described by all three scholars as a way of internal validity. For instance, I requested the teachers to both write/describe (asynchronously) and speak/verbalize (synchronously, in front of me) their 1) identities 2) lesson plans. I used these two sources of data together to arrive at the motifs and case themes during data analysis. I used of thick descriptions, an external validity technique proposed by Merriam (1998). To support and bolster these descriptions, I used ample amounts of participant quotes.

Finally, I used a researcher positionality statement, which is an internal reliability technique proposed by Merriam. I hope the statement helps readers understand where I stand and the ways in which my data analysis, and the study as a whole, will be influenced due to my positionality.

Limitations

One of the limitations of this study is that I am a non-White person who explored White racial identity with the teachers. Some initial interactions with some of the teachers (fromthe previous workshops) indicated that they were more comfortable with expressing their truest thoughts to White researchers. So depending on the race and ethnicity of the researcher, such an identity exploration study could look different.

The other limitation is that I used https://openprocessing.org/ to create the computing tool. This web app uses Java and Python as a programming language. The nature of thecomputing tool, that is to have both an interactive aspect and a object-oriented programming environment, narrowed the options I had to create the tool. Further, I also wanted teachers to be able to create a "fork" in the tool and create edits, so that they can remix the tool in any way they want to, depending on their context. So, the only feasibleoption I had was to use Openprocessing.

Openprocessing could be more challenging than block-based programming tools like Scratch, but of course, high school CS courses use Java and Python. Thus, the limitation isprimarily that it might be difficult to translate this study in earlier K-12 grades.

Delimitations

I conducted the study with only three teachers in order to have a more manageable amountof data. Having more teachers of different backgrounds or experiences can possibly paint a different holistic view. This study was also limited to teachers during the workshop and didnot include student data or classroom observations of lesson implementation, which would have required additional time and resources beyond the scope of this study.

CHAPTER 4: CONCLUSION

In this dissertation, I conducted two studies. The purpose of the first study was to understand how White CS teachers challenged Whiteness so that they are prepared for CRC implementation. More specifically, the first study examined how three White high-school CS teachers 1) reflect on their own racial/ethnic White identity, 2) discuss theways in which they envision and negotiate White privilege, 3) discuss the ways in which they see the connections between CS, race, and racism, and 4) address race and racism in their CS classrooms. Overall, there were four motifs which explained how teachers navigated these issues. First, teachers have a complicated White Identity. Secondly, the teachers debated about White privilege, whether it was different from other forms of privilege based on gender or socio-economic class. Thirdly, the teachers agreed that tensions and discomfort they feel is while thinking about racism and White privilege was required. Finally, the teachers shared their intentional approaches to begin discussing racein CS classrooms: Practices included setting an appropriate tone for their classrooms, assign projects, and introduce classroom materials like movies about equitable CS.

This study has implications for teacher professional development and teacher education. First, discussing White privilege in a group and with pictorial representation seemed to benefit teachers. Future researchers could think about ways in which CS teachers could further unpack their identities in both socio-cultural and socio-political contexts by building on some of the techniques used in this study. Future researchers could explore howa CS teacher **could use their learning about White privilege and anti-racism** might navigate **and implement** culturally responsive computing practices in the context of AP CS curricula.

The purpose of the second study was to analyze how teachers explored the concept of civic engagement in computing contexts. Specifically, the second study examined ways in which three White high-school CS teachers 1) talk about the implications of socio-political elements of technology use, 2) talk about race and racism when exploring a computing tool that addresses school desegregation, and 3) implement a lesson using the computing tool meant to explore school desegregation. The ways in which the three teachers navigated theses three aspects varied slightly. For instance, Fiona implemented a lesson which encouraged students to reflect on socio-political use of technology and CS in the society. Carl implemented a lesson which encouraged students to reflect on their own implicit biases related to race and gender. And Ray implemented a lesson which encouraged students to think of solutions to socio-political issues using technologies and CS. All three teachers, however, agreed on potential cross-disciplinary connections between CS and Social Sciences, and that technology is never neutral.

This study has implications for teacher professional development and teacher education. First, the teachers appreciated having specific examples of socio-political issues to reflect on using computing. Future practitioners could further explore the kinds of socio-political issues that could be explored intentionally in CS classrooms and curricula. Future research should look at ways in which teachers implement such lessons in their everyday classrooms,given the rigidity of school district board expectations, CS curricula, and the standardizedtesting pressures.

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APPENDIX A. ACTIVITIES USED IN STUDY I

Individual introductory conversation/interview with researcher

Questions that I asked:

1. Please tell me what subject you teach and how long you have been teaching it.
2. Could you describe your school district, in terms of
   (a) Demographics (Gender and Race)
   (b) Relationship with parents in the district
   (c) Priorities given to teacher professional development
   (d) Teacher inputs vs standardized scores
3. Can you describe your typical classroom in terms of
   (a) Race and ethnicity
   (b) Gender, with special attention to girls of color
   (c) Students' engagement levels in a typical classroom
   (d) Activities and projects they enjoy in classroom
   (e) What you do to connect students' lives with what they learn in CS
4. What are some new elements that you would like to introduce in your CS classrooms?
5. Are you interested in addressing issues of racism and social justice in CS? Why So?
6. Do you think it is possible to address issues of racism and social justice in CS?
7. What makes you interested in these workshops?
8. What do you hope to gain from these workshops and conversations?

9. What support systems do you hope to have as you explore the topics in the workshop?
10. Any other comments or lingering thoughts?

Articles and Activities for the Asynchronous Session

Articles to be read:

1. Why talk about Whiteness? (We can't talk about racism without it)
2. A black professor offers advice 'For White Folks Who Teach in the Hood' (by Prof. Chris Emdin)

Activity to be completed (on Google slides):

1. There are four pages in these slides titled 'Race', 'Ethnicity', 'Gender', 'Socio-Economic Class'. Please use two pictures and two phrases on each page to best describe yourself. You can use any image from the internet for the pictures.
2. Please answer the following questions in about 50 words each
   (a) What are your identities you think about most often and why?
   (b) What are your identities you think about least often and why?
   (c) What are your own identities you would like to learn more about and why?
   (d) What are the identities that have the strongest effect on how you perceive yourself?
   (e) What are the identities that have the greatest effect on how others perceive you?

Activities For the Synchronous Zoom session

Prompts for ice-breakers

1. How are you doing/feeling/etc?

Prompts for the article group discussion

1. Article 1:
    (a) What does whiteness and White privilege mean to you after reading the article?
    (b) Do you think White privilege exists at an individual level or at a systemic level?
    (c) The article says that "acknowledging white privilege but taking no initiative to own it or address it can be harmful and counterproductive". What are some ways in which we can address privilege?
2. Article 2:
    (a) Prof. Emdin talks positively about tensions you may face while teaching as a White teacher. How do you feel about experiencing these tensions?

Prompts for the identity wheel group discussion

1. What was the part you liked the most in this activity?
2. What was the most challenging part of this activity?
3. What thoughts do you have after hearing others present their identity wheels?

Prompts for whiteness in CS group discussion

1. The article on whiteness said that "Acknowledging white privilege must be followed with anti-racist action". Although we are somewhat restricted by the curriculum in our classrooms, there still might be space to engage in socio-political issues. Can you think of any ways to be explicitly anti-racist in your CS classes?
2. Why do you think your curriculum may be restrictive, especially if these issues are important to address?

APPENDIX B. ACTIVITIES USED IN STUDY II

Articles and Video for the Asynchronous Session

1. School Integration (A video from "Black History in Two Minutes or so")
2. We can draw school zones to make classrooms less segregated. This is how well yourdistrict does(Is your district drawing borders to reduce or perpetuate racial segregation?)

Activities For the Synchronous Zoom session

I will begin with a small explanation of why I chose the topic of school segregation. We will begin all activities after that. Prompts for the article/video group discussion are given below.

1. The video highlighted that "funding follows White children". What are your thoughtson the statement? How do you think "school choice" relates to this statement?
2. What did you find about your school district's segregation and the surrounding neighborhood's segregation?

Prompts for discussion after interacting with the tool

1. What are your thoughts on desegregation using bussing? How do you think bussing may affect students of color?
2. What are your thoughts on desegregation by redrawing district lines? How do you think redrawing district lines may affect students of color?
3. Can we use computing to reflect and think critically about school desegregation

Lesson Plan Template

Prompts for self-reflection:

1. What unit will you do this lesson in and why?

2. What language will you use to highlight the importance of this lesson?

3. What should be the key takeaways of this lesson for your students?

Table B1 Lesson Plan Template

TIME expected for each section of the lesson	**Teacher will say**	**Teacher will do**	**Students will DO (eg. watch videos, read, code, etc)**	**Students will SAY / DISCUSS / REFLECT**
Part 1 (time)				
Part 2 (time)				
Part 3 (time)				
(you can add more rows)				