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Negotiating White Science in a Racially and Ethnically Diverse United States

Patricia S. Dunac-Morgan

ACCEPTANCE

This dissertation, NEGOTIATING WHITE SCIENCE IN A RACIALLY AND ETHNICALLY DIVERSE UNITED STATES, by PATRICIA S. DUNAC-MORGAN, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the College of Education and Human Development, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chairperson, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty.

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NEGOTIATING WHITE SCIENCE IN A RACIALLY AND ETHNICALLY DIVERSE
UNITED STATES

by

Patricia S. Dunac-Morgan

Under the Direction of Kadir Demir, Ph.D.

ABSTRACT

Scholars have empirically examined, rigorously developed, and analyzed various

strategies to increase teachers' capacity to reach students of color. These instructional strategies

and philosophies include the study of multicultural education, teaching for social justice, and

theorizing the connection between school and home life. While these instructional strategies

highlight the need for a more inclusive approach, they do not center race enough. Culturally

Relevant Pedagogy (CRP) is the pedagogical, content, and cultural knowledge a teacher exhibits

(Ladson-Billings, 1995). CRP does not explicitly problematize race; yet the theory and praxis of

CRP should include a critical analysis of race and racism. As an alternative framework that

centers on race, researchers have begun to use Critical Race Theory (CRT) to explore aspects of

race and racism in the teaching and learning realm. This qualitative case study examined how

teachers make sense of their own racial selves in relation to teaching students from different racial backgrounds? (Yin, 2008). Data collection included semi-structured interviews as the primary source of data. Classroom observations and researcher memos served as secondary sources of data (Seidman, 2005; Hatch, 2002; Prior, 2003). According to critical race theorists, narratives are essential when gathering vital sources of information, in that they make the social realities of people of color, as influenced by racism, observable to the world (Wallace & Brand, 2012). As such, CRT was used to identify whether there were any influences of the students' racial identities on the teachers' development and implementation of culturally responsive practices. The analysis revealed that: (1) teachers' explicit confrontation with/of "otherness" as White female teachers and their critical awareness of societal influences on students of color presented more opportunities to be race-conscious and directly address institutional racism; and (2) teachers' critical awareness of explicit and implicit power structures and how these relationships are embedded in a "hidden curriculum" influenced their beliefs and instructional practices. These findings communicate the significance of White female teachers understanding of issues specific to urban schools, and their efforts to find ways to remedy those issues to make learning meaningful, purposeful, and authentic for students of color.

INDEX WORDS: Teacher effectiveness, Teaching methods, Teacher attitudes, Beliefs, Sociocultural patterns, Science teachers, High school science teachers, Whiteness as property, Racial factors, Critical race theory, Culturally relevant pedagogy, Science education, Qualitative research, Urban education

NEGOTIATING WHITE SCIENCE IN A RACIALLY AND ETHNICALLY DIVERSE
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A Dissertation

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DEDICATION

With malice toward none; with charity for all; with firmness in the right, as God gives us to see the right, let us strive on to finish the work we are in; to bind up the nation's wounds… and to do all which may achieve and cherish a just and lasting peace among ourselves and with all nations. (Abraham Lincoln, Second Inaugural Address, 1865)

This dissertation is dedicated to all the people of color who have lost their lives, as we continue to fight for just and lasting peace:

Oscar Grant (January 1, 2009)
Shem Walker (July 11, 2009)
Victor Steen (October 3, 2009)
Kiwane Carrington (October 9, 2009)
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Steven Eugene Washington (March 20, 2010)
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TABLE OF CONTENTS

LIST OF FIGURES

1 TOWARDS A RACE-BASED UNDERSTANDING OF CULTURALLY RELEVANT PEDAGOGY IN THE SCIENCE CLASSROOM

The racial and ethnic makeup of the United States of America is in constant flux, and racial and ethnic diversity will increase substantially over the next four decades. Whereas in 1990 the U.S. was 80.29 percent non-Hispanic White, making up the majority of the population, the U.S. Census projects that the Hispanic population will double between 2000 and 2050 and the Asian population will increase by 79 percent (U.S. Census Bureau, 1990; 2010). Additionally, it is estimated that over half of the schools in the United States do not have non-White teachers and many students will graduate high school having never had a non-White teacher (Irvine, 2003). With such drastic increases in the number of students of color, it is necessary for us to review scholarship on Whiteness, in terms of teaching and learning, paying particular attention to how this impacts students of color.

Scholars have empirically examined, rigorously developed, and analyzed various strategies to increase teachers' capacity to reach students of color. These countless approaches seek to alleviate the cultural gap between teachers and students. These instructional strategies and philosophies include the study of multicultural education (e.g., Banks & Banks, 2003; Levinson, 2009), teaching for social justice (e.g., Nieto & Bode, 2011; Macrine, McLaren, & Hill, 2009), and theorizing the connection between school and home life (e.g., Moll, Amanti, Neff, & Gonzalez, 1992). While these instructional strategies highlight the need for a more inclusive approach, they do not center race enough with teaching and learning.

One instructional strategy that has developed in the area of multicultural education is Culturally Relevant Pedagogy (CRP). CRP is the pedagogical, content, and cultural knowledge a

teacher exhibits as an instructional leader. Originally developed in the early 1990s, Ladson-Billings (1995b) defines it as "a theoretical model that not only addresses student achievement, but also helps students to accept and affirm their cultural identity while developing critical perspectives that challenge inequities that schools (and other institutions) perpetuate" (p. 469). CRP rests on three criteria or propositions: (a) students experience academic achievement; (b) students develop and/or maintain cultural competence; and (c) students develop a critical consciousness (Ladson-Billings, 1995a). For the purpose of this paper, I will utilize Ladson-Billings' (1995b) definition and frame CRP as a pedagogical method that allows students to maintain their cultural integrity, while holding the bar of excellence high for *all* students.

In more recent years, the work of CRP has extended to content specific areas of teaching and learning (Barton, 2007; Ford, Howard, & Harris, 2000; Johnson, 2011). There is a growing body of literature within the science education community that is dedicated to implementing components of CRP to assist teachers in navigating our ever increasing *color lines* (see: Du Bois, 2003).

CRP does not explicitly problematize race; yet the theory and praxis of CRP should include a critical analysis of race and racism. As an alternative framework that centers on race, researchers have begun to use Critical Race Theory (CRT) to explore aspects of race and racism in the teaching and learning realm (Basu, 2008; Ladson-Billings, 1995, and Brown-Jeffy & Copper, 2011). CRT questions "historical power structures and advocates for equity for marginalized groups" (Basu, 2008, p. 882). CRT addresses power issues that are present in social relationships, such as White teachers' interactions with their diverse students. Since its inception, CRT has evolved and now informs many fields, including education (Chadderton, 2013; Delgado, 1995; Ladson-Billings, 1995a). However, after a thorough review of academic

literature, I found that only five empirical articles studied the interconnectedness of CRT and

CRP. Of the five studies, two dealt with White social studies teachers (Martell, 2013; McBride,

2010), one with White mathematics teachers (Bidwell, 2010), and lastly, one with White teachers

in science (Yerrick & Johnson, 2011). In a review of the last study, Brown-Jeffy and Cooper

(2011) discussed the vast amount of literature on CRP, but noted the need for more research to

be systematically viewed through the lens of CRT. While many researchers continue to explore

and synthesize the effects of CRP, many do not address the race-based aspect of it.

The problem the American educational system face and will continue to face, more so in

the coming years, is attempting to recognize and respond to racism in its educational system and

creating a system to counteract that, so that educational equities are present for all students, of all

races and ethnicities. To do so, Leonardo (2009) argues for "critical engagement of race,

whiteness, and education" (p. 167). Given the fact that over 80% of teachers are White and

middle class (National Center for Education Statistics [NCES], 2009), while students of color are

increasingly present in their classrooms, race must matter and addressing it is not optional

(Howard, 1999; Irvine, 2003). While some schools may argue that day-to-day logistical issues

are more important, preparing teachers to teach students whose cultural backgrounds are

significantly different from their own is of utmost importance. Thus, it is vital that scholars look

at teachers' use of CRP to reach students of color, using a racial lens (Dixson & Dingus, 2007;

King, 1991). It would be unproductive to simply synthesize this work again; therefore, the

purpose of this literature review is to describe and critically assess how we have examined

components of race in the context of science education for students in U.S. urban schools. First, I

examine the body of literature that explores trends and challenges of science education in urban

schools (including evolution of urban schools, hegemonic practices in the science classrooms,

and race/racism, in science, school, and society), so that we can broaden the intersection of CRT and how it informs CRP in practice. Next, I explore how teachers have attempted to adapt to critical issues in the science classroom using CRP. Then, I turn to how race/racism has impacted science, schools, and society. Lastly, the paper attempts to answer W. E. B. Dubois opening line in *The Souls of Black Folks (2003)*, with the eye-opening question, "How does it feel to be a problem?" (pp. 3-4), by identifying specific influences, confines, and conflicts that exist in urban schools, as a starting point to remedy the issues of racism in science education and establish a strong theoretical rationale for its continued exploration.

Urban Schools: A Black Hole for Science Education

The U.S. Census Bureau (2012) defines urban areas as "densely developed residential, commercial and other nonresidential areas." It is estimated that urban areas now account for 80.7% of the U.S. population, an increase from the 79% reported in 2000. Barton (2001) discusses several crucial features that characterize urban areas: (1) urban areas have a large number of ethnic minorities; (2) they are home to large numbers of immigrant families; and (3) poverty is a reoccurring issue. Urban areas, with their multiplicity of cultures, act as the contexts that shape the working conditions of teachers of students of color (Atwater, Freeman, Butler, & Draper-Morris, 2010; Taylor, 2010). Research finds that urban schools with large populations of students of color and students in poverty have a distinctly different set of issues than schools that serve predominantly White and/or wealthier students, with the most pressing issues being academic achievement, limited resources, and a culture of defeat/deficit (Bogart & Cromwell, 1997; Hunter & Donahoo, 2003; Lee, Smith, Perry, & Smylie, 1999; Stairs, Donnell, and Dunn, 2011; Warren, 2012; Worthy, 2005). Harris (1992) argues, "the culture of our urban schools historically has been filled with negative and racist assumptions that guarantee failure" (p. 46).

This section specifically looks at how academic achievement, limited resources, and deficit models shape teachers' implementation of culturally responsive teaching and examines how practitioners have been able to implement these practices albeit these stark conditions.

Academic Achievement in Urban Schools

Although I recognize that students' performance can be measured in various ways, such as students' efficacy (Griggs, Rimm-Kaufman, Merritt, & Patton, 2013; Jansen, Scherer, & Schroeders, 2015) and via nontraditional assessment methods (Robinson, Dailey, Hughes, & Cotabish, 2014), academic student achievement data has implications for teacher evaluations (Berliner, 2013; Kersting, Chen, & Stigler, 2013), district funding (Niven, Holt, & Thompson, 2014; Ostrander, 2015), and public perceptions of effective teaching and learning (Popham, 1999). Therefore, for this paper, I define student achievement in terms of how students score on standardized tests.

Across the nation, we see alarming reports that urban students' achievement scores are disproportionately lower on standardized tests than their privileged counterparts (Blank, 2011; Bui, Imberman, & Craig, 2012; Grier, Blumenfeld, Marx, Krajcik, Fishman, Soloway, & Clay-Chambers, 2008; Nichols, Glass, & Berliner, 2012; O'Keefe, 2012). Although we see pockets of growth for traditionally marginalized students, these numbers are small. For example, according to the most recent reports from the National Assessment of Educational Progress (NAEP), eighth-grade students' science scores have improved two points from 2009 to 2011 (NCES, 2012). Overall, however, students from different racial/ethnic backgrounds, from lower socioeconomic status, and ELL students are improving only marginally and slowly, indicating that the science achievement gap for racially and ethnically diverse students persists.

Similarly, in the recently released Trends in the International Mathematics and Science Study (TIMSS, 2012), it is evident that the United States' science and math scores continue to ascend. The United States' average score was 544 and 525, for fourth and eighth grade science respectively, which was higher than the TIMSS scale average of 500. These scores placed the U.S. among the top 6 (out of 45 countries) for fourth grade science and among the top 10 (out of 57 countries) for eighth grade science. On the surface, the scores show great promise for U.S. schools, until data is disaggregated by race and ethnicity. It is evident that there is an academic gap between White students and students of color (see Figures 1 and 2). Though total scores indicate the U.S. is exceeding all but five other countries in fourth grade science, all but 17 nations outperform U.S. Black students, and almost half that for Hispanic students.
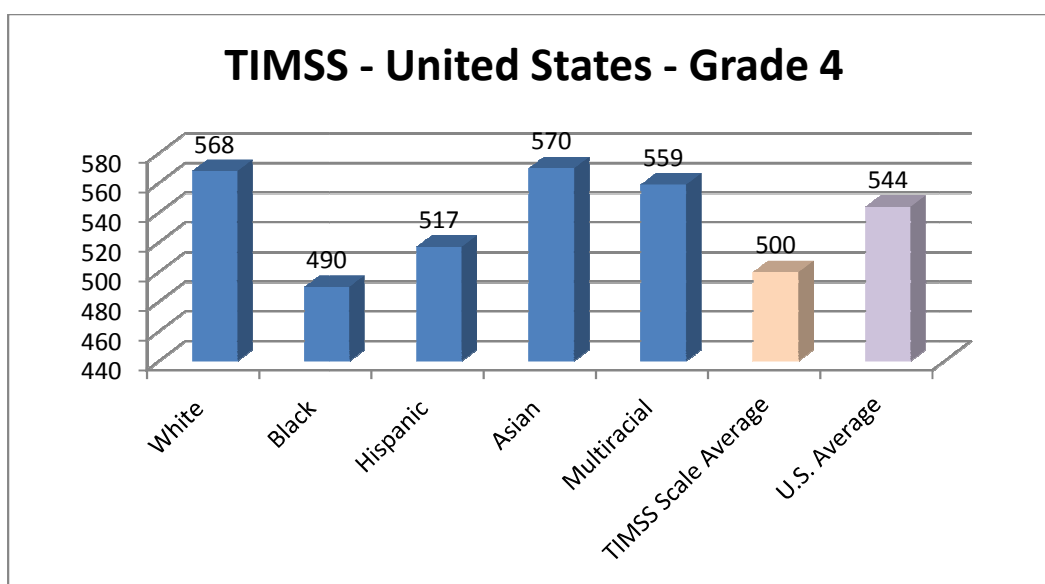
Figure 1. Average science scores of U.S. 4th grade students, by Race/ Ethnicity: 2011(Provasnik et al., 2012, p. 58)
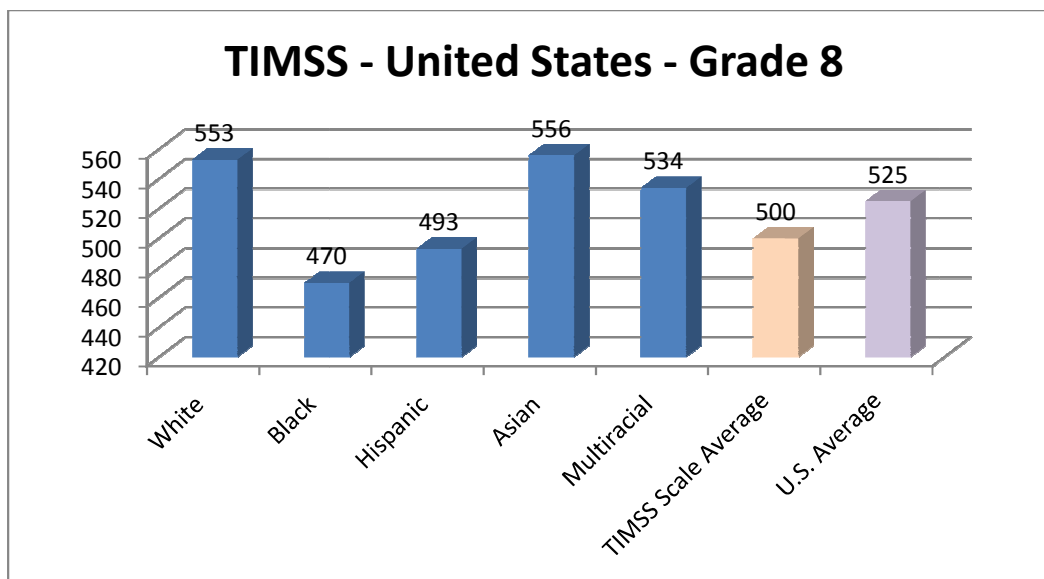
Figure 2. Average science scores of U.S. 8th grade students, by Race/ Ethnicity: 2011(Provasnik et al., 2012, p. 58)

Because research shows that most students of color reside in urban areas (Chou & Tozer, 2008), urban teachers of students of color have to balance the push for improvement in standardized test scores with what they believe is the true essence of learning science (Dunac & Demir, 2013; Li, Klahr, & Siler, 2006). It is important to note that when researchers dig deeper into the literature they find that academic achievement data reflects the Eurocentric view of learning, where meaning is fixed and others with opposing views bring little to the science curriculum (Warren, 2012). Balancing the need to reach academic excellence for all students, while simultaneously increasing achievement for traditionally marginalized students, is a constant problem for science education. As such, frameworks seeking to delve into students' personal knowledge, while making that knowledge applicable to their schooling process, are crucial. It is within these frameworks that we see how practitioners and researchers have leveraged students' diverse backgrounds to make learning meaningful and authentic.

Frameworks embracing students' diverse backgrounds and their bank of communal knowledge shows that useful information can be derived from including students' shared community practices into the learning cycle. These banks are commonly referred to as funds of knowledge. Funds of knowledge refers to those historically developed and accumulated strategies (e.g., skills, abilities, ideas, practices) or bodies of knowledge that are essential to a household's functioning and well-being (Licona, 2013; Moll, Amanti, Neff, & Gonzalez, 1992). In Moll, Amanti, Neff, and Gonzalez's (1992) study of the strategic merging of household and classroom activities in marginalized communities, they found that students had "ample cultural and cognitive resources with great potential utility for classroom instruction" (p. 134). One participant, in their research noted, "It is so important to learn how culture is expressed in students' lives, how students live their worlds. We can't make assumptions about these things. Only a part of that child is present in the classroom" (p. 136). In another example, Foster (2005) explains that teachers of African-American students need to understand that their students conceptualize their world in a *fictive kinship system* where "individuals feel and communicate a sense of collective identity that is exhibited by particular activities, behaviors, and symbols" (p. 694). Likewise, Yooso (2005) argues that students of color experience academic success when they are able to leverage their aspirational, social, linguistic, and familial capital in the classroom. Lastly, we see a strong correlation between drawing on students' funds of knowledge and culturally responsive teaching practices. These studies serve as examples of how teachers can navigate through culturally responsive teaching in light of preconceived beliefs that students of color do not traditionally do well in science, as it pertains to standardized test scores, via leveraging students' diverse backgrounds and their communal funds of knowledge to make learning meaningful.

Likewise, in Barton's (2001) qualitative study of two homeless fourth grade minority girls, Barton found that the narrow view of academic achievement based on test scores or formal grades rejects the undocumented learned material urban students experience in science class. In the study, Barton found that, although the students struck her as "bright, inquisitive, and diligent, both girls' report cards during the time of this study portrayed them as below-average students in most subject areas" (p. 904). Barton questioned the meaning of the report card in relation to what she believed they were trying to accomplish in their own way. School science had deemed them as failures; however, they renegotiated what it meant to be students of color in a White and isolated science classroom. The girls were instructed to build a planter for an agriculture project; however, they asserted their needs for a desk instead, because they were homeless and needed a place to work. Thus, the decision to build the desk instead of the planter altered what they constituted as science and what they were formally taught about science. The vast contrast between what Barton observed and what was reflected on their report cards is nothing new in urban science education. In fact, the review of literature on academic achievement on racially and ethnically diverse students highlights the discrepancies between White/formalized science and the expectation to adapt (Licona, 2013; McLaughlin & Barton, 2013). Continued research on effective instructional practices merging teachers' perceptions of students' capabilities with culturally responsive teaching practices (i.e. science learning in urban settings) needs to be explored to include the aspect of race (Barton, 2007).

Limited Resources

Not only do teachers in urban schools deal with issues of academic achievement, they also deal with limited resources. Resources can be defined as tangible materials (i.e. books, supplies, instructional materials) or human capital (i.e. qualified teachers and teacher

professional development) (Darling-Hammond & Youngs, 2002; Harris, 2012). Students of color often have limited lab supplies, antiquated textbooks, and few science-related extracurricular activities (Spillane, Diamond, Walker, Halverson, & Jita, 2001). In addition to lacking instructional materials, urban teachers are more likely to teach students who are underprepared for the cognitive demands of secondary science, because racially and ethnically diverse students have a higher probability of ending up with a teacher who is not deemed highly-qualified (Darling-Hammond & Youngs, 2002; Friedrichsen, Abell, Pareja, Brown, Lankford, & Volkmann, 2009; Ingersoll, 2001). Urban schools also offer fewer science elective options, leaving students with limited proficiencies in certain science domains (Oakes, 1990; Oakes, Gamoran, & Page, 1992). Urban teachers are constantly battling how to leverage limited resources with varying student needs.

Maulucci (2010) explores how and why teachers activated resources to resist the marginalization of science. She found that teachers activated a broader array of resources (i.e. social, symbolic, and strategic resources) when limited by tangible resources. An example from her study is one teacher who had recently moved to New York and was rudely awakened by the limited instructional time and resources at her school. The teacher was accustomed to FOSS kits (an interactive/hands-on science kit) and was forced to give her students instruction using the more traditional note-taking style. Maulucci (2010) found that limited resources could further marginalize the students in the study if teachers felt helpless in supplying their students with the distinct resources their population needed. However, in this study, teachers adapted and learned how to use their social, symbolic, and strategic resources, in lieu of economic resources (i.e. material resources, information technology, consumable supplies, non-consumable equipment, science curricula, and texts) to reach their students. In such schools, it is important that teachers

understand the possibility of limited resources and are prepared with culturally responsive strategies to meet the needs of their students regardless of the resources present.

Another form of non-material resources that can assist with implementation of culturally responsive teaching techniques is professional development for teachers. In one case of implementing CRP, Johnson and Marx (2009) examined how teachers used CRP after a series of professional development workshops. Initially the teachers were worried about the focus on activity-like projects because of state-mandated exams; however, after implementing culturally responsive teaching and inquiry-based lessons, one participant said, "'It just hit me yesterday, full face, as to why we do this type of stuff [inquiry]', she said. 'For those kids who struggle with pen and paper stuff. They can all get it with inquiry" (p. 128). The need for science teachers to move outside of their prescribed and limited resource of vocabulary instruction was essential for them to meet the needs of their students of color. In another study, Jacobs, Assaf, and Lee (2011) reviewed how teachers grew to understand their students' diverse needs when they engaged in a collective book-study about language diversity. Their study had implications for teacher education programs because they called for a more reflective practice of discussing critical issues. Not only were teachers reading about social issues pertinent to their students, they were also involved with tackling their personal beliefs. Lastly, in McCormick, Eick, and Womack's (2013) study of a university-based blended professional development model to work with in-service teachers on culturally responsive teaching, they found that teachers expressed meaningful change in teacher practices after being exposed to a book on CRP and attending small work sessions to reflect on the course's material.

The notion that teachers are confined to mandated and limited resources that hinders the implementation of CRP is present in other areas as well. For example, in Martell's (2013) study

of his own use of CRP, through a Critical Race Theory lens, he investigated the intersection of race and the multiple and conflicting accounts of social studies. As a White male teacher, he realized that he must move farther away "from the margins of the textbook to the center of [his] classrooms" (p. 81). The instructional resource his students had (i.e. textbook) gave students a limited view of their roles in society. Yet he realized that White teachers must "own White privilege and the curriculum that often institutionalizes" and work outside of that construct (p. 81). As highlighted in these various studies, teachers were only able to move toward a culturally responsive approach to teaching and learning when their teaching resources and professional development sessions were aligned to the needs of their students. Outdated and mandated curricula resources (Barton, 2007; Oakes, 1990) and limited professional development (Bidwell, 2010; Johnson, 2011) hinder teachers' abilities to enact culturally responsive teaching practices.

Cultural Deficit Model

Lastly, in a flawed attempt to rationalize the underachievement of students of color, many teachers and school entities attribute students' lack of educational achievement to issues rooted in their culture and/or communities. As such, the Cultural Deficit Model explains how teachers blame students for the institutional oppression imposed upon them (Ford & Grantham, 2003; Goon & Kirk, 1975). As such, "young Americans who are not white and middle class come to school with deficits that make their school success extremely difficult" (Oakes & Lipton, 2007, p. 55). The root causes of these deficits are attributed to stereotypes of their communities. "Teachers who believe that certain students cannot succeed in school because of particular attributes (e.g., they are Black or Hispanic, poor, or non-native English speakers) operate from a deficit perspective" (Stairs, Donnell, & Dunn, 2011, p. 6). These misconceptions also play out in science education, as there is the recurring matter of students' cultural background conflicting

with the traditional thoughts of European science (Warren, 2012). Un/knowingly, teachers perpetuate the misconception that science is hard for students who are non-White and/or who may not succeed on standardized examinations.

The Cultural Deficit Model propagates the stereotype that science is for old and White peculiar males of extraordinary intelligence (Milford & Tippett, 2013; Özel, 2012; Sharkawy, 2012). Inquiries into science teachers' images of scientists found that teachers held strong stereotypes of who could be classified as a scientist (Farland-Smith, 2012; Milford & Tippett, 2013; Özel, 2012). In Milford and Tippett's (2013) study of pre-service science teachers, for example, they found that science teachers often held strong images of what a scientist looks like (i.e. White, bearded male, glasses, pocket protector, wearing lab coats, and in a science laboratory), an image that is strikingly different than the majority of students who teachers face in urban schools. Similarly, Sharkawy's (2012) study found that students and teachers had difficulty identifying students of color as scientists without having first been exposed to a culturally responsive teaching technique where they read about diverse scientists.

Conflict arises in urban schools when students of color realize their teachers think the science curriculum is "better than" or more valued than the culture of their home, "because of concerns like poverty, language differences, and ethnic identity" (Barton, 2001, p. 905). Students are more encouraged to participate in the science curriculum when they feel they can relate to it (Bettez et al., 2011; Moll et al., 1992) and when teachers encourage different forms of expression (Xu, Coats, & Davidson, 2012). In Xu, Coats, and Davidson's (2012) study of instructional practices of science teachers, they found that, along with hands-on activities and technology, students felt invested in the lesson when they allowed for different forms of expressions to spark their natural and cultural interest in science. For example, one of the teachers in Xu et al.'s

(2012) study utilized students' cultural song preferences (i.e. a song on the skeletal system) and raps (i.e. for the solar system and the water cycle) to foster students' "interest in science as well as in understanding their students better as whole persons" (p. 144). Part of implementing CRP in the science classroom calls for an understanding of the child as a whole and finding ways for them to experience academic success (Esposito, Davis, & Swain, 2012).

In a similar case, Teel, Debruin-Parecki, and Covington's (1998) study of two cohorts of urban African American middle school students and strategies that motivated them found that appropriate teaching strategies, which aligned to their cultural background (i.e. increased responsibility, student choice, and noncompetitive grading), resulted in increased student achievement and aided in developing their connection to the curriculum. The science classroom is not just a place where students learn content; it is also a formation zone for how students form their identities as members of the science community. If teachers are conscious of their culturally relevant practices, they can nurture the identities of their students and turn the deficit model into one of self-belief (Kane, 2012). Research finds that deficit models like this cause tension in the classroom and produce higher dropout rates for students of color (Harris, 1992). If teachers implement culturally relevant pedagogy, they can reduce the deficit stereotypes that pervasively exist in urban science education.

Those who embrace the deficit model portray all students of color in urban schools with one "'at risk' brush and blame the children themselves, their families, and communities for these perceived deficits" (Kane, 2012, p. 464). When practicing science teachers internalize this deficit model, they perceive their students as less capable, less motivated, and more likely to fail, further drawing a divide between affluent and middle-class White children and students of color (Bryan & Atwater, 2002). This narrow perspective grossly simplifies the root causes of oppression by

confining the problems to perceptions of their students' cultural communities and limits teachers' use of culturally responsive teaching practices (Solorzano & Yosso, 2001). Because this model frames the problem as living within the students, their families, and their cultural communities, the solutions are limited in that they will only blame the victims.

An opposing view of the deficit model is the "Asset-Based Perspective," where teachers believe that students come with resources from their community that assists them in succeeding in school (Cramer & Wasiak, 2006). Teachers who view students as having assets upon entering a classroom "do not view their students as deficit or see their families and communities as problems" (Stairs, Donnell, & Dunn, 2011, p. 7). Another opposing view to the deficit model is Lee's (2007) Cultural Modeling Theory. Cultural Modeling Theory "highlights the generative role of cultural funds of knowledge, and the specific ways in which one set of skills can be transformed for use in another setting" (Orellana & Eksner, 2006, p. 2). With this anti-deficit mindset, teachers can begin thinking of their students as not "content knowledge poor" but "culturally rich." The rich experiences that students possess out of school can be used to acquire in school knowledge and lessen the metaphoric *black hole* that exists in science education.

In sum, it is important that science teachers of students of color understand issues specific to urban schools, including challenges related to academic achievement, resources, and a pervasive ethos of deficit modeling, and find ways to remedy those issues to make learning meaningful, purposeful, and authentic for students of color. As urban schools make up more than 80% of the U.S. population, and the majority of students of color live in urban areas, it is vital that teachers have a strong command of the issues they face in urban districts so that they can combat the inequalities that reduce students' opportunities to develop science proficiencies. This will require a cultural shift in the way teachers interact with their students of colors to shift

students' perspectives of science being old, White, and peculiar to being inclusive of what they bring to the classroom. Knowledge and possessor of said knowledge now shifts from belonging to one dominant authority figure to belonging to *all*. In the next section, I discuss how culturally Relevant Pedagogy is the way to respond to the Master Script, that science belongs to one class.

Culturally Relevant Pedagogy in the Science Classroom - Countering a White Supremacist Master Script

Master scripting silences multiple voices and perspectives, primarily legitimizing dominant, white, upper-class, male voicings as the "standard" knowledge students need to know. All other accounts and perspectives are omitted from the master script unless they can be disempowered through misrepresentation. Thus, content that does not reflect the dominant voice must be brought under control, mastered, and then reshaped before it can become a part of the master script. (Swartz, 1992, p. 341)

For urban students, "the sciences are exclusive, a mysterious and secret body of knowledge understood by only a few" (Laughter & Adams, 2012, p. 1106) and if they do not understand the master script, their voices become silenced. While activists continually work for educational reform in science education, they often fail because science is treated as objective and culture-free, even though researchers argue that it is not (Ladson-Billings, 1999; Ladson-Billings-Tate, 1995a). Aikenhead (1996) has noted "science curriculum, more often than not, provides students with a stereotype image of science: socially sterile, authoritarian non-humanistic, positivistic, and absolute truth" (p. 10). Students of color become marginalized when their perspectives of science do not align with this narrow view. As science moves away from this narrow view of knowledge belonging to one dominant group, researchers must encourage teaching practices that will lead to culturally responsive teaching. Education researchers must

commit themselves to studies that explore implementation of Culturally Relevant Pedagogy (CRP), such that they must seek to understand how teachers successfully educate students who differ from the master script (i.e. racially, ethnically, socioeconomically, and culturally).

Several researchers have addressed the issue of science teaching through CRP (e.g., Barton, 2001; Mensah, 2011; Milner, 2011). In one study, Atwater et al. (2010) explored "two science teacher candidates' understandings of Otherness and their culturally responsive teaching (or the lack thereof) of students they believe are the 'Others'" (p. 287). Findings suggest that the participants did not feel prepared to teach students who were considered "others." One participant claimed "many of the mentor teachers never thought about the roles of culture, race, and ethnicity in their classroom" (Atwater et al., p. 305). Continued authentic conversations are needed in areas where teachers sense that their students are othered because of race and ethnicity. Empowering them with the culturally proficient tools to embrace diversity can counter this "otherness" narrative they experience.

In a similar vein, Johnson (2011) followed two middle school teachers who participated in Transformative Professional Development (TPD) on how to become a culturally relevant science teacher. One teacher initially stated "he did not see color in his classroom" (Johnson, 2011, p. 179). This is a common response from teachers who believe that ignoring their students' color/culture is an equitable approach to teaching science (Leonardo, 2009). His response changed after engaging in TPD, and he stated, "There are many things happening in my students' lives that I have little control over. What I can do is create a learning environment for them that is engaging, challenging and supportive" (Johnson, 2011, p. 181). This view supports the characteristic of CRP in which teachers can change their beliefs of self and others, and create learning environments that provide opportunities for students to feel successful. This purposeful

reflection of teachers' epistemological beliefs is also essential when discussing CRP. The definition of epistemological beliefs varies, but in general it is what people "believe about the course, certainty, and organization of knowledge" (Schommer, 1994, p. 293).

In a similar study, Basu (2008) conducted research in which she used critical ethnography to explore the development of students' voice in a ninth grade conceptual physics classroom. She found that the youth participants leveraged and enhanced their "epistemic" and "positional" authority, two constructs discussed as it pertains to critical theory. One student participant's populist beliefs about science allowed her to think critically of the science lesson she created for her physics classmates. This study additionally provided assistance to the physics teacher and allowed her an opportunity to see how students would create a lesson using their background knowledge, experience, culture, resources, and position in society. The teacher's implementation of CRP in this case allowed the students more openness in expressing their views of the science content and changed the students' epistemological beliefs.

Lastly, in studies of teacher preparation, researchers find that components of CRP are lacking, but where it is evident, it is promising (Kelly-Jackson & Jackson, 2011; Meyer & Crawford, 2011; Milner, 2011b). In one promising study, Lee, Deaktor, Hart, Cuevas, and Enders (2005) explored the process and impact of a large-scale instructional intervention program, using instructional practices that focused on promoting positive beliefs about science with the goal of promoting both literacy and science. Lee et al. addressed three areas: (a) overall science and literacy achievement, (b) achievement gaps among demographic subgroups, and (c) comparison with national (NAEP) and international (TIMSS) samples of students. Lee et al. found that, although minority students often lagged behind White middle/upper class students, student achievement for minority students increased with intentional cultural practices (i.e.

CRP). Additionally, teachers reported: (a) heightened knowledge of science content and instructional practices (i.e. hands-on instructions and inquiry based science instruction); and (b) integration of literacy into science curriculum to meet the needs of their students.

While the studies above highlight a dismal reality that science teachers today are not prepared with the necessary skills to address students of color, they show promising results when teachers intentionally embrace components of CRP. In fact, the specific attention to urban education has called for colleges of teacher education to market urban education as a specialized study, in many urban cities in the United States (Lee, Eckrich, Lackey, & Showalter, 2010). The beauty of such programs is their intentional focus on providing teacher candidates with the necessary skills to succeed in urban classrooms. These programs specifically target cultural competency, differentiating for diverse urban learners, behavior strategies, etc. The disadvantages of such programs are that they are rarely content specific and their full course load revolves on cultural proficiency, with limited attention to how this plays out in discipline specific arenas (i.e. limited resources in a Physics Lab) (Drake, Moran, Sachs, Angelov, & Wheeler, 2011). Additionally, many of the largest teacher education programs are not located in large urban cities (Lin & Gardner, 2006), which is problematic because many urban school districts are located in urban cities.

Using Kapel and Kapel's[1] (1982) previously studied list of teacher colleges, designed for the education, preparation, and continuing training of professionals for urban schools, I conducted a brief analysis of state-approved Master of Education (M.Ed.) and Master of Teaching (MAT) Programs[2], extending the list to colleges and universities that had a stated

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[1] Other researchers (e.g. Sleeter, 2001 & Ullucci, 2010) have studied the effectiveness of teacher preparation programs for urban schools; however they do not list the names of schools in their studies.
[2] MAT/Med programs were selected because there is a significant shortage of highly qualified science teachers, in "hard-to-staff" schools," which are usually in urban and rural school districts (Ingersoll, 2001). When these

emphasis on Urban Education and Science Education (see Appendix A). To strengthen their

proposed list, I included other schools that are housed in cities that service urban school districts

(i.e. Atlanta, Boston, Chicago, Detroit, Saint Louis, etc.). Although brief in nature, this research

highlights the program requirements, in terms of total courses required for fulfillment of Master

of Arts in Teaching (MAT) or Master of Education (Med) degree[3]. The course requirements

highlighted are science education methods courses, science content courses (i.e. Biology,

Chemistry, Earth/Space, and Physics), teaching internship/practicum courses, and psychology

and/or special education courses, race/cultural studies courses, and teaching

internships/practicum requirements.

Through the stratified purposeful sampling approach, targeting colleges and university

situated in urban cities and/or specifically targeting urban education (Patton, 2002), I found that

standalone issues of cultural proficiency are not the primary focus of teacher education program

for science education. In some cases (e.g., Boston University, Georgia Southern University, and

University of Florida), the cultural education course was specific to issues facing English for

Speakers of Other Languages (ESOL) students. In other cases (e.g., University of Alabama), it

was an optional course, in a list of other psychology courses. In fact, cultural studies courses

were not a requirement of every teacher education program sampled, and they were given extra

emphasis when the degree was titled, "Master of Urban Education." In these rare cases (e.g.,

Davenport University and Providence University), cultural studies was emphasized more than

science content classes. This model is fine if we ignore the fact that science teachers need *both*

content and pedagogy to teach effectively. In the majority of programs, (e.g. Clark University,

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vacancies are filled, teachers usually are usually given a provisional license and can seek post-undergraduate teacher preparation from a local teacher preparation program (Gimbert, Cristol, & Sene, 2007; Cavallo, Ferreira, & Roberts, 2005).

[3] It is important to note that most MAT/Med. Programs are shorter in length, averaging one to two years max; therefore, the number of courses reported in my sample is low.

Georgia College and State University, and Georgia State University) cultural studies courses were limited, showing that the value of cultural studies, as it compares to the other mandated courses (i.e. instructional methods, science education methods, and content specific courses) was nonexistent. Researchers argue that these critical conversations of culture and its impact in education take place in random yet purposeful assignments embedded in their science methods course(s) and in their social foundations/psychology course (Saint-Hilaire, 2013; Tinkler, Hannah, Tinkler, & Miller, 2015; Whipp, 2013). Saint-Hilaire (2013) found that purposefully including issues of culture and race in prospective teacher's science methods course gave them awareness about cultural relevance and differentiation. However, from the tally of required courses, we see that teacher education programs' primary focus is on mastering science content. The illustration below highlights the approximate program requirement in relation to all program requirements to demonstrate the importance of colleges and universities requirements.
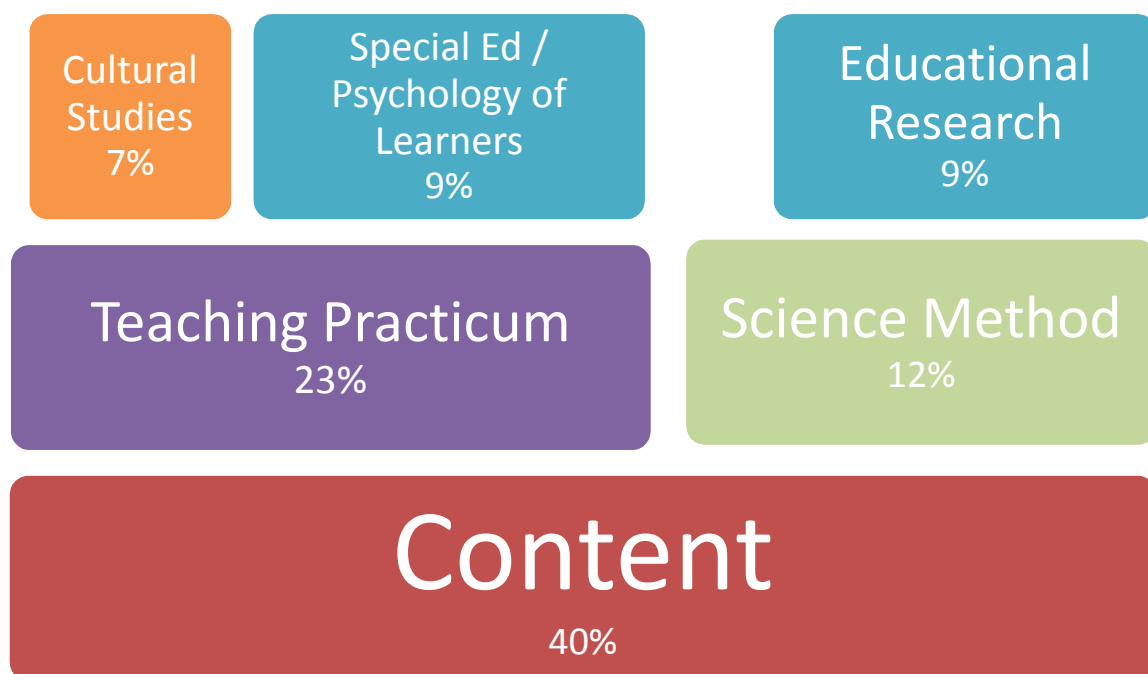
Figure 3. Secondary Science Education Master's Program curriculum emphases.

It is startling that a review of secondary science teacher preparation programs shows little emphasis on culturally responsive teaching when research shows that when exposed to CRP, students gained access to the instructional material and achieve cultural and academic success (Johnson, 2011; Lee, 2004). As noted in Demir and Ellett (2014), "A teacher's personal epistemology exerts a powerful influence on the ability to perceive and engage the diversity and complexity of learning environment" (p. 66). If this is the case, then teachers' beliefs can alter the instructional acquisition for their students and can either hinder or help the learning process.

Johnson (2009), Basu (2008), and Lee et al.'s (2005) studies can be expounded on by having science teachers look into their personal beliefs and explore how they use such belief to counter the deficit model that takes place in urban education. When teachers apply an asset-based perspective to students of color and use culturally relevant pedagogy to make science real and relevant to their daily lives, they counter the Master Script that reinforces the notion that science belongs to one White, upper class, and dominant group. Students are no longer forced to adapt a simplified version of science and can incorporate their communal knowledge into the learning process. Thus, teacher education programs should revisit course programs that do not call for the explicit instruction of cultural studies. As stated in Brown, Friedrichsen, and Abell's (2013) study of teacher preparation, "one goal of teacher preparation is developing teacher knowledge that is grounded in close observation of their experiences, students, and understanding of educational research versus training prospective teachers to be technicians, who acquire basic, mechanical, teaching skills" (p. 134). We must look past content and seek ways to make science accessible to *all* students.

Race in Science, Schools, and Society

In the U.S., science has become a course we teach "only to the elite, and we somehow assume that others cannot learn science" (Eisenhart, Finkel, & Marion, 1996, p. 265). However, critical theorists dare you to think of science without considering the influences of race, wealth, power, or social status. CRT specifically looks at the collective empowerment of oppressed groups, which challenges us to examine the social benefits of the elite, (e.g., being White and inheriting Whiteness as property). The tenet of Whiteness as Property explains that because, historically, White males were the only ones who could own legally recognized and protected property, Whites have continuously benefited from this dominant class role, in terms of housing, employment, education, etc. (Bell, 2000). Ladson-Billings and Tate (1995) claim that our society has perpetually linked human rights with property rights; thus, in a society that claims to value individual civil rights, the reality is that social benefits still go to property owners.

In order to address why students of color are marginalized, because of their socioeconomic status, racial backgrounds, and class, we must critically examine issues of equity and fairness. How would *equity* look for *all* children? What sort of rules might be created "for a system of justice in a new society where our position as a member of that society was not known" (Lynch, 2000, p. 1)? Lynch (2000) defines equity as "the quality of being fair or impartial" (p. 11); in science it "may be defined as justice and something more - fairness" (p. 11). Schools, curriculum, knowledge, assessment and access are not neutral and/or equitable grounds, rather they are "contested sites where power struggles are played out" (Enterline, Cochran-Smith, Ludlow, & Mitescu, 2008, p. 117). Schools illustrate the way society works (deMarrais & LeCompte, 1995). As stated in Warren's (2012) research on the effect of post-racial societies in education, schools are in essence, the derivative of:

The United States' nearly 400 year investment in the social construction of race to create

a stratified society; as well as White supremacy, have created a society in which non-

white children continue to bear the brunt of racial trauma through educational inequality,

institutional racism through Eurocentric curriculum and pedagogy, and race- based

teacher bias. (p. 197)

The educational, social, organizational, and financial measures aid in perpetuating "dominance

for dominant groups and oppression for oppressed groups" (Enterline et al., 2008, p. 117).

Academic discourse is often rooted in colorblind ideology. Where educators are often

turning a "blind eye" to racial difference, "despite the fact that skin color does indeed impact

how individuals are treated (Castro Atwater, 2008, p. 247). The hidden assumption that rights

belong to White males, is so well weaved into the American life that teachers often claim to be

colorblind. Teachers who are colorblind "claim that they treat all students 'the same,' which

usually means that all students are treated as if they are, or should be, both White and Middle

class" (Irvine, 2003, p. xvii). If educators believe that all students are inherently the same, then

our quest to equity and access to science curriculum is in vain.

James Wilkinson delivered a lecture to the Royal College of Surgeons, in 1847, entitled

Science for All. This axiom has taken on a life of its own and now the science education

community understands the need for equitable curriculum and instruction and has made this

motto explicit in reform documents. As stated in AAAS (1989), everyone is "responsible for the

deplorable state of affairs in education, and it will take us all to reform it" (AAAS, 1989, p. ix).

Current science reform documents are moving away from a "science for future scientists"

pipeline towards a "*science for all*" mainstream approach (Milford & Tippett, 2013). Science

opens doors to high paying occupations, gives a knowledge base for informed discourse; yet

studies show that urban students lose interest and develop negative perceptions of science by middle school, due to the lack of culturally relevant pedagogy (Barton, 2002; Charleston, Charleston, & Jackson, 2014; Gatchair, 2013). If we seek to change the historical hegemonic experiences for students of color, then we need to address issues of race relations as it relates to science, society, and the classroom.

As so eloquently noted in Howard's (1999) book about multicultural education, "diversity is not a choice, but our responses to it certainly are" (p. 2). It is only with these difficult research agendas that we can have authentic discourse about the various ways to open doors to the marginalized members of the science community. Unfortunately, there is a dearth of research when discussing Whiteness as property and science education. A review of literature in Education Resources Information Center (ERIC Database) shows no studies correlating the two. This does not come as a surprise because science is viewed as White, dominant, and peculiar to students of color. If this is how science is viewed and perpetuated, then it comes as no surprise why researchers are not seeking ways to investigate how CRP can be implemented through CRT. CRP is the pedagogical blend of activism needed for instruction, while CRT is the radical agenda needed to level instructional practices and learning experiences for students of color (Brown-Jeffy & Cooper, 2011; Hayes & Juarez, 2012).

In the context of students' learning science, Lee et al. (2005) and Aikenhead and Jegede (1999) argued that the language and conventional actions of many White teachers in science classrooms create cultural discontinuity for students who belong to a culture different from the teacher's. It is important that researchers look at the cultural discontinuity between teachers and students. Though not focused specifically on science teachers, such studies have been conducted at the school-level. For example, in Johnson's (2002) study of six White teachers of racially and

ethnically diverse students, teachers recalled that their earliest memories of race focused on "identifying a racial 'other,' not on their Whiteness or awareness of themselves as racial beings" (p. 162). The teachers in this study used their contented feelings of never being "othered" to work against injustice. They used this to rally in support of culturally relevant pedagogical practices in their class. Additional non-science education examples of the intersection of Whiteness as property and schools include Preston's (2008) study of the purposeful school segregation of "at the expense of African-Americans and other people of colour who were kept out of the suburbs by discriminatory mortgage packages, covenants on land purchases and a continuation of restrictive housing" (p. 472). And lastly, Buras (2011) studied the inequitable racial-spatial redistribution of resources, with the expansion of charter schools after Hurricane Katrina.

Much like the previously mentioned studies, science education needs empirical data linking Whiteness as property and CRP to see if it yields positive results for racially and ethnically diverse classrooms. If science reform documents are making an enterprising demand that science be accessible to *all*, it will need to include the conversation of race. An important aspect of CRP is acknowledging who students are and how they see themselves in relation to their position in society. Therefore, the intricacies of the social construction of race in the U.S. must also be explored and we must address how it factors in science, school, and society. White teachers need to know and understand Whiteness as property (an element of CRT) in order to critically examine their own curriculum, instruction, and assessment practices.

Conclusion

In summary, this paper provides a literature review of specific influences, confines, and conflicts (e.g. low academic achievement of students of color, limited resources, and deficit

models) that exist in urban schools, as a starting point to converse about the issues of race in science education and establish a strong theoretical rationale for the continued investigation of a race-based analysis of pedagogical practices of teachers of students of color. Within the larger context of CRP research, we see that teachers' ethnicity, race, and their background matters (Howard, 1999; Milner et al., 2012; Milner, 2011, 2013). While the social construction of race is a complex factor that is pervasive in all aspects of teachers' and children's lived experiences, CRP does not explicitly problematize race; yet the theory and praxis of CRP should "include a critical analysis of race and racism," such as conversations of how Whiteness and privilege affects teachers' abilities to effectively teach students of color (Brown-Jeffy & Cooper, 2011, p. 70). As evident in the research above, scholars should continue to examine how teachers navigate through the challenges of low student achievement (in terms of standardized tests), limited resources, and pervasive deficit models. All of these factors are results of students being continuously marginalized not only in science, but school and society (Otsuki, 2009; Patchen & Cox-Petersen, 2008; Rivera Maulucci, 2010). This line of inquiry requires us to consider a wide range of voices from students who do not fit the typical profile of American teachers: White, female, and middle-class. Further, this line of inquiry requires us to have courageous conversations with teachers about "their future classrooms [that] are not likely to have such homogenous or affluent student populations" (Groulx, 2001, p. 60). In this section, I revisit the literature surrounding teacher education programs and their primary focus on content and I propose a model that calls for a more inclusive approach to training teacher candidates about cultural proficiencies of CRP and CRT and its importance in the science classroom.

There is a plethora of researchers who believe in the tenets of CRP and who advocate for its continued research and implementation (Bidwell, 2010; Chepyator-Thompson, 1994; Esposito

et al., 2012; Johnson, 2011; Ladson-Billings, 1995; Laughter & Adams, 2012; Milner, 2011a). These researchers argue that we should continue with discussions on the successful implementation of CRP in the science classroom, which will ultimately aid in developing the habits of mind teachers need to address students of color. A brief analysis of regional teacher education program shed light as to why teachers had limited exposure to CRP[4]. Cultural or multicultural studies courses were a limited (if at all available) standalone course requirement(s) for their program of study and content knowledge was the leading program requirement, in terms of course hours. Teacher education programs have to decide how they will prepare teachers with pedagogical practices that are inclusive of CRP. According to programs of study for non-marketed "urban education" institutions, there is little clarity about the extent to which CRP is authentically embedded across the curriculum. In many cases, the program of study states that students will take an additional course or two in cultural studies.

Conversations about cultural proficiency should be embedded within the larger conversation and research agenda surrounding content and pedagogical competencies. One possibility would be to include race-based conversations within the larger Pedagogical Content Knowledge (PCK) theoretical framework, since this theoretical framework is often embedded in science teachers' methods' course (Brown, Friedrichsen, & Abell, 2013). PCK describes how teachers use instructional methods (pedagogical knowledge) to transform subject matter knowledge into discrete and applicable knowledge for students (Shulman, 1987). For science teachers, PCK "includes knowledge of students' thinking about science, science curriculum, science-specific instructional strategies, assessment of students' science learning, and orientations to teaching science" (Schneider & Plasman, 2011, p. 534). PCK has been described

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[4] It is important to note that this inquiry can be strengthened by also reviewing syllabi, course readings, and student assignments.

as the intersection of pedagogy and content knowledge and this knowledge is what separates science teachers from traditional scientists (Shulman, 1986). When science teachers have PCK, they have the ability to not only master science content, but also explore various ways to organize that knowledge (Gudmundsdottir, 1990).

In a more recent review of PCK literature, Schneider and Plasman (2011) found "that it is helpful for teachers to *think about learners first*, then to focus on teaching, and points out the essential role of reflection for teachers to rearrange their ideas in ways that develop their PCK" (p. 556). I propose that we extend the PCK model to encompass knowledge of others and self, through a careful examination of systems of oppression and teaching and learning practices that promote continued injustice (see: Figure 4). This requires practitioners to shift their understandings of PCK, to not only look at subject matter knowledge and knowledge of student learning, but also examine these two components of PCK through the critical lens of CRT. For example, teachers should explore what barriers are presents for students of color in their attempts to understand the content. In addition, teachers should explore how they can take their subject matter knowledge and make it more meaningful for students through using students' funds of knowledge and leveraging their cultural capital. Lastly, the PCK framework should look at the intersection of pedagogical knowledge and context knowledge (of students and school), and the various culturally relevant pedagogical practices they can use to meet the needs of students of color (e.g., CRP).
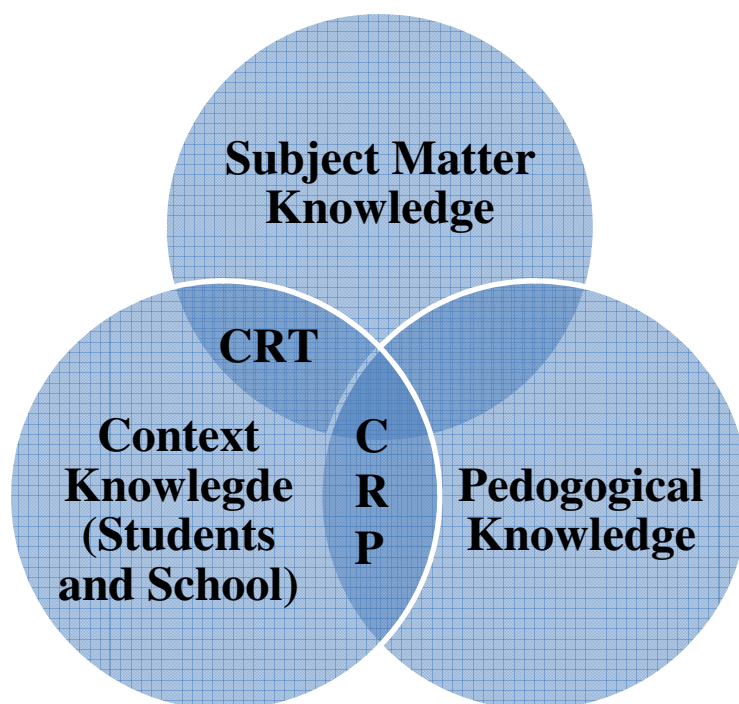
Figure 4. Pedagogical Content Knowledge Framework Through a Critical Lens

Because I call for the critical integration CRT and CRP, it is important that we examine

ways it can be applied in teacher preparation as well. Teacher preparation programs "face the

daunting task of preparing predominantly White middle-class college students with limited or no

experience with persons from another ethnicity or social class to be effective teachers of diverse

students" (Causey, Thomas, & Armento, 2000, p. 33). Unless these teachers undergo a teacher

preparation program that has issues of urban education as their stated philosophy, they may not

get explicit preparation in teaching students of color. Therefore, I suggest that we radically

change the current model of *all* teacher education programs by making race and cultural studies

an integral part of teacher preparation. This suggested model of teacher preparation should

involve the critical integration of CRP (with discussions of race) as the central focus of course

requirement (see: Figure 5). This model would have issues of race embedded in participants'

core courses. For example, in a research course, students would have a research project about

cultural issues; in their Psychology course, they would review the psychology of urban/rural areas or the effects of poverty on children of color; in their Teaching Practicum, prospective teaching candidates would have exposures to various teaching sites; and lastly in their Science Methods and Content courses, they would review a problem-based unit grounded in important issues in their local communities (e.g., sickle cell anemia in Biology or food/nutritional choice in Environmental Science).
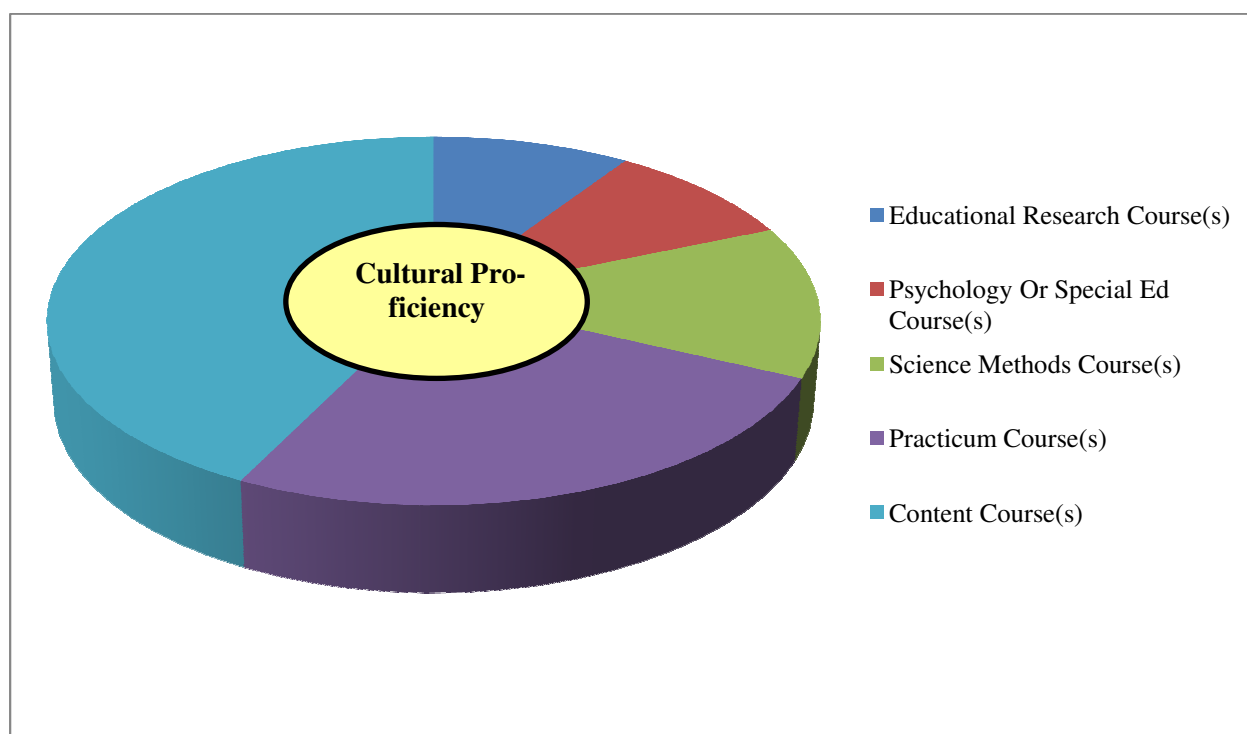
Figure 5. Inclusive Model of CRP in Teacher Education Programs

In Lee et al.'s (2010) study of a collaborative approach to teacher education programs that blended university courses with site-specific residencies, they found that teachers experienced higher satisfaction with teaching urban students and their perceptions of urban schooling was positively impacted with a curricular emphasis on cultural proficiency. Additionally, the blended approach allowed them opportunities to have guided discourse about

"beliefs, assumptions, dispositions, and concerns that they bring with them" when they enter urban schools (p. 102). Although the models varies between programs, this blended approach supports Levine's (2006) national study of teacher preparation programs, in that effective programs are the ones that achieve "curricular balance," by integrating "the theory and practice of teaching" by "balancing study in university classrooms and work in schools with successful practitioners" (p. 21).

We must continue to follow the leads of previous researchers (e.g., Kailin, 1999; McIntyre, 2002) and approach issues in urban education through the critiques of Whiteness or explore Whiteness in a racist society. Ladson-Billings (1995a), also notes, "I suggest that this[5] kind of study must be replicated again and again. We need to know much more about the practice of successful teachers for African American and other students who have been poorly served by our schools" (p. 163). It would be unfair to assert that teachers should carry the full responsibility for racial inequity; however, "teachers participate in the reproduction of racial inequality and teachers can mitigate or exacerbate the racist effects of schooling for their students of color depending on their pedagogical orientation" (Hyland, 2005, p. 429). Thorough examinations of systems of oppression and teaching practices/conditions that exasperate the problems are essential. The full weight of these problems should not rest solely on teachers, however. Ladson-Billings (1999) has attempted to push critical race theory conversations (by the use of CRP), stating "to reframe the notions of preparing teachers for teaching diverse learners so that we might understand the 'improbability' of such a task in public school systems that work actively at achieving school failure" (p. 211). This new way of understanding societal inequities must be a core focus in teacher preparation. The implicit overtones of race/racism in science

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[5] Ladson-Billing, is referring to her *Dreamkeepers*' study, about the successful practices of teachers who serve students of color. (see: Ladson- Billings, 1994).

education must be interwoven in all facets of teacher training. Through effective training, we can teach and reinforce teaching methodologies that promote liberation from systematic oppression. Looking at the dearth of research on the interconnectedness of race/racism and science, continued conversations must be had that juxtapose CRP and CRT lenses. Scholars must continue conversations that highlight and reinforce effective urban teachers of students of color. Moreover, practitioners must incorporate these findings as they deal with teaching and learning and preparing teachers to teach in a racially and diverse America.

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2 EXAMINING THE CULTURALLY RESPONSIVE PRACTICES OF WHITE FEMALE SECONDARY SCIENCE TEACHERS THROUGH CRITICAL RACE THEORY

I want to suggest that you, as a new president with presumably a new vision, begin rethinking or reconceptualizing this notion of the achievement gap. Instead of an achievement gap, I believe we have an education debt. The debt language totally changes the relationship between students and their schooling… The notion of education debt requires us to think about how all of us, as members of a democratic society, are implicated in creating these achievement disparities. (Ladson-Billings, 2008, p. 236)

Many educational reform efforts have been instituted to address the educational inequities present in urban schools. One recent initiative, the provision of the Elementary and Secondary Education Act, more commonly known as The No Child Left Behind Act of 2001 (NCLB, 2002), forced all public schools in the United States to become accountable for student success by creating common expectations and mandatory school reform. Its purpose was to close "the achievement gap between high- and low-performing children, especially the achievement gaps between minority and nonminority students, and between disadvantaged children and their more advantaged peers" (No Child Left Behind [NCLB], 2002). NCLB attempted to narrow the academic achievement gap by focusing attention on underrepresented children, low-income children, and students with disabilities (Ladson-Billings, 2008). With more than a decade of implementation, researchers have found that, although test scores have improved, the achievement gap has not narrowed. Test scores have improved equally for White students as they have for students of color (Guisbond, 2012; Krieg, 2011; National Center for Education Statistics 2012; Stiefel, Schwartz, & Chellman, 2007). If the goal is equitable student achievement for all

groups, as measured by standardized test scores, than "achievement gaps are the product of the learning opportunities available to different groups of students" (Santau, Maerten-Rivera, & Huggins, 2011, p. 775). Additionally, research finds that student achievement in science lagged during the NCLB era because of the instructional focus on math and reading, which led to decreased time for science (Griffith & Scharmann, 2008; Milner, Sondergeld, Demir, Johnson, & Czerniak, 2012). Science students' data were the lowest in urban schools, leaving urban students and schools even farther behind (Furumoto, 2005; Harris, 2012; Rojas-LeBouef & Slate, 2011; Simms, 2012; Waxman, Padron, & Lee, 2010).

Much like national reform efforts of NCLB, science education has tried to use reform initiatives to address science inequities. Science, Technology, Engineering, and Math (STEM) has been a top educational priority in the United States, which has caused the science education community to aggressively advocate for the creation of several influential policy reports, demanding comprehensive changes in science instruction, to include previously marginalized students (Hsu, Roth, Marshall, & Guenette, 2009; Kenny et al., 2007). With increasing talk of diversity in science reform documents such as *Science for All Americans, Project 2061*, the National Science Education Standards (NSES), America 2000, The Common Core State Standards for History, Science, and Technical Subjects, and *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*,[6] it is imperative that we engage in empirically based conversations that discuss ways to attain a more inclusive science community.

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[6] Science for All Americans, Project 2061 (see: American Association for the Advancement of Science, [AAAS], 1989), the National Science Education Standards (NSES) (see: National Research Council [NRC], 1996, 2000), America 2000 (see: U.S. Department of Education, 1991), the Common Core State Standards for History, Science, and Technical Subjects (see: Student Achievement Partners, 2012), and A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas, (see: Committee on Conceptual Framework for the New K-12 Science Education Standards [CCFSES])

All of these reform documents, in principle, have a goal of providing curricular support to deliver equitable science education for *all* children (NRC, 1996, 2000; NCES, 2012). Yet we observe student disengagement and dismal student achievement for the very same racially and ethnically diverse and gender groups that are under-represented in the STEM fields (Basu, 2008; Yerrick, Schiller, & Reisfeld, 2011). The academic gap between Whites and students of color in urban science classrooms remains expansive (Rojas-LeBouef & Slate, 2012; Simms, 2012). According to the U.S. Census Bureau (2012), thirty-six percent of the U.S. population is considered as racial minorities; and by 2022, the racial minorities is expected to become the majority[7], yet research finds that science education curricula have been vastly unsuccessful at reaching students of color, such as English Language Learners (ELL), Latino, Black, and other non-mainstream groups, who are unrepresented in science fields (Meyer & Crawford, 2011; Tobin, Roth, & Zimmermann, 2001). Some researchers argue that this is because science is taught in a Eurocentric (Warren, 2012), colonized (Freire, 1971), and urban child deficit model (O. Lee & Fradd, 1998; Mutegi, 2013) versus a meaning-centered model (Moll, Amanti, Neff, & Gonzalez, 1992).

Despite such high levels of underperformance for marginalized learners in the United States, we have barely begun to understand the varying needs for racially and ethnically diverse student populations (Barton & Yang, 2000; O. Lee & Fradd, 1998; Mutegi, 2013). Even though our schools "have experienced nearly 40 years of school reform since the civil rights movement, stark inequalities in the science education of poor urban children persist" (Barton, 2001, p. 904). With constant reminders that educational reforms models, such as stringent mandates of NCLB,

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[7] For this reason, I substitute the term "minority" with "students of color," to dismantle the "social prestige, institutionalized privilege, and normative power" the term "minority" carriers in society, unless "minority" is explicitly stated in the referenced text (Lee, Deaktor, Hart, Cuevas, & Enders, 2005, p. 881). Furthermore, the term "minority" is a misnomer in my study, as Black students actually composed of the majority of the student population and the majority of students underserved by their respective schools.

hurt students (Esposito, Davis, & Swain, 2012), now more than ever researchers battle to find ways to make curricula accessible by all. One identified way of addressing students of colors is through Culturally Relevant Pedagogy (Ladson-Billings, 2008).

Culturally Relevant Pedagogy (CRP) is the pedagogical, content, and cultural knowledge a teacher exhibits as an instructional leader. CRP rests on three criteria or propositions: (a) students must experience academic achievement; (b) students must develop and/or maintain cultural competence; and (c) students must develop a critical consciousness through which they are agents for change, challenging the current status quo of the social order (Ladson-Billings, 1995). CRP "maintains that teachers need to be non-judgmental and inclusive of the cultural backgrounds of their students in order to be effective facilitators of learning in the classroom" (Brown-Jeffy & Cooper, 2011, p. 66). CRP also looks at those who are responsible for addressing issues of inequality and seeing problems in deficit models (Goon & Kirk, 1975). CRP approaches teaching from a relational position, where teachers honor diverse cultural and ethnic experiences, identities, and contributions. This mindset changes the deficit ideology to an asset-based perspective that values children from diverse racial, ethnic, language, and socioeconomic status.

Because culture is an inherent part of CRP, it is imperative to define culture itself. Culture encompasses a variety of factors, such as race, gender, sexual orientation, ethnicity, socioeconomic status, spirituality, and other sociocultural and identity characteristics (Atwater, Freeman, Butler, & Draper-Morris, 2010). When practitioners align "their professional practice with their students' culture," they are often referred to as using components of CRP (Monroe & Obidah, 2004, p. 259). Culture exists within individuals as well as within institutions,

organizations, groups, "or even in approaches to teaching and learning, the culture of a subject's curriculum" (Lumby, 2012, p. 579).

The encompassing factors of culture are essential in forming "behaviors, attitudes, strengths, beliefs, and values" (Schellenberg & Grothaus, 2009, p. 441). Furthermore, Lee and Slaughter-Defoe (2004) state that culture is an acquired knowledge used to interpret people's experiences. This acquired knowledge contains "understandings about social roles and relationships, structures for communicating norms about what is appropriate to be communicated to whom and under what circumstances, and conceptions about the natural world and their roles in it" (Lee & Slaughter-Defoe, 2004, p. 289). Culture is often seen as assimilated patterns of human behavior that may include the various languages (Palmer, Sun, & Leclere, 2012), beliefs and values (Meier, 2012; Schein, 1985), and customs and norms (Moll et al., 1992) of ethnic, racial, religious, or communal groups. In this study, I adopted the broad and all-encompassing definition of culture, as defined by Ladson-Billings (2006), whereas culture is not the "exotic element possessed by 'minorities'" and is used as code for everything that is "nonwhite" (p. 107). Rather, culture is the system of values, beliefs and ways of knowing that guide communities and their daily lives. In summary, the term c*ulture*, as it relates to CRP, is defined as a range of learned behaviors as a result of being emerged with certain norms, values, habits, beliefs, and practices (Trumbull, 2005). These set of learned behaviors are a result of belonging to a certain identity group. CRP uses this broad definition of culture to examine the cultural competence teachers' exhibit in their interactions with students of color.

Schools are underserving students whose cultures differ from their teachers' cultures. Since census data projects that populations of color will become the majority, it is important for teachers to exhibit CRP when dealing with students who they perceive are different from

themselves (Johnson, 2011). Given that majority of the teaching force is comprised of young, White, and middle-class females (NCES, 2009) and less than nine percent express an interest in working with students from different ethnic groups (Gordon, 2000; Robinson & Clardy, 2011), now more than ever, we must evaluate our teaching practices. Repaying our education debt to marginalized members of society (Ladson-Billings, 2008) and improving science education for all students are educational priorities in the U.S. (Pruitt, 2010).

Within the three components of CRP, we can examine a teacher's awareness of his or her own assumptions, values, and biases. Villegas and Lucas (2002) define the practice of examining your awareness as sociocultural consciousness. Sociocultural consciousness is the understanding that race, ethnicity, class, and language influence one's way of thinking and behaving. When teachers critically examine their own sociocultural identities and the inequities between students of color and schools that support institutionalized racism/classism to maintain a privileged society, they exhibit characteristics of CRP (Howard, 1999). Additionally, we can see how examining one's sociocultural consciousness alters the educational experiences of teachers and students of color, using two frames: knowledge (amount of cultural depth a teacher has of diversity) and praxis (the pedagogical practices the teachers use to work successfully with diverse students) (Yang & Montgomery, 2011). CRP rests on the notion that "teachers cannot teach children effectively until they have come to understand critically the effect of their own enculturation into teaching" (Howard, 1999; Yerrick et al., 2011).

In light of this existing literature and the critical problem of a cultural disconnect between the predominantly-White teaching profession and their students of color, the purpose of this study was to explore how teachers make sense of their own racial selves in relation to teaching students from different racial backgrounds. In the following section, I highlight the evolution of

race and racism in schools through a theoretical lens of Critical Race Theory (CRT). Next, I

describe how three beginning White female teachers navigated race and racism, through their

definition, development, and implementation of CRP in their secondary science classrooms.

The Evolution of Race in Schools: Critical Race Theory in the White and Privileged Classroom

The white race deems itself to be the dominant race in this country. And so it is, in

prestige, and achievements, in education, in wealth and in power. So, I doubt not, it will

continue to be for all time, if it remains true to its great heritage and holds fast to the

principles of constitutional liberty. But in view of the Constitution, in the eye of the law

there is in this country no superior, dominant, ruling class of citizens. There is no caste

here. Our Constitution is colorblind, and neither knows nor tolerates classes among

citizens. In respect of civil rights, all citizens are equal before the law. The humblest is

the peer of the most powerful. The law regards man as man, and takes no account of his

surroundings or of his color when his sole rights as guaranteed by the supreme law of the

land are involved. (Plessy v. Ferguson U.S. 537, 1896)

The landmark decision of *Plessy v. Ferguson* (1896) cemented the colorblind ideology

for the United States. In that case, it was deemed acceptable that races can be separate *but* equal

in all aspects of American life. This became the stimulus for the colorblind racism that, even

today, exists economically, politically, socially, and educationally (Warren, 2012). This decision

illustrated how the privileged class could grant *sole rights as guaranteed by the supreme law of*

the land, but could not address why such protection of rights was necessary (Warran, 2012). This

case demonstrated *Whiteness as Property*, in that an improvement in outcomes for black people

(i.e. equitable education) "threatens the main component of status for many whites: the sense

that, as whites, they are entitled to priority and preference over black" (Bell, 2000, p. 77). In a

post-racial society[8], perceptions of effective teaching is often rooted in colorblind ideology.

Where educators are often turning a "blind eye" to racial difference, regardless of the fact that

skin color does undeniably impact how individuals are treated (Castro Atwater, 2008; Irvine,

2003). For example, White teachers may rationalize students of colors present-day status as "the

product of market dynamics, naturally occurring phenomena, and black's imputed cultural

limitations" (Bonilla-Silva, 2006, p. 92). If these "post-racial" ideologies are continued, members

of society indirectly admit that race does not matter; thus, colorblindness (much like the Plessy v.

Ferguson case) prevails again. The notion of colorblindness and whiteness as property are the

essence of Critical Race Theory (CRT).

As a critical framework for analysis, CRT questions "historical power structures and

advocates for equity for marginalized groups" (Basu, 2008, p. 882). CRT addresses power

relations present in social relationships, such as a White teacher's interactions between her

students of color and school systems (including peers, teachers, and the learning process). CRT

emerged out of legal scholarship, in response to the Critical Legal Studies (CLS) movement,

which critiqued the liberal discourse of Civil Rights and the suspected objectivism of the legal

system (Chadderton, 2013; Delgado, 1995; Ladson-Billings, 1995). CRT has since evolved and

now informs many fields, including education. Since the theory's inception, scholars have

described six key elements, arguing that CRT: (1) Recognizes that race and racism are central to

life in the United States; (2) is skeptical about dominant legal claims of neutrality and

objectivity; (3) insists on a contextual and historical analysis of the law; (4) recognizes the

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[8] The term "*Post-racial*" or "Post-Black" emerged from the 2008 presidential election of the first African-American U.S. President. To some, this political movement cemented the ideology that "race ceased to hold significant power, [and was] replaced instead by a colorblind social ethos (Smith & Brown, 2014, p. 155). The color-blind ethos is the belief that educators often turn a "blind eye" to racial difference, which means they in essence ignore what that students' culture bring to the learning experience (Irvin, 2003).

experiential knowledge of people of color as central; (5) Is interdisciplinary; and (6) works toward the elimination of racial oppression with the goal of ending all forms of oppression (Matsuda, Lawrence, Delgado, & Crenshaw, 1993, p. 6).

Across these elements, deMarrais and LeCompte (1995) find the purpose of CRT is to "uncover hidden assumptions that govern society—especially those about the legitimacy of power relationships—and it debunks or deconstructs their claim to authority" (p. 25). CRT looks at the power structures of society and questions "who has power, whose knowledge is privileged, and for whose experience and ends education feels purposeful" (Basu, 2008, p. 882). CRT is specifically committed to collective empowerment and not merely individual enablement.

This collective empowerment challenges researchers to look at the social benefits of being White and inheriting Whiteness as property. The concept of Whiteness as property argues that because, historically, White males were the only ones who could own legally recognized and protected property, Whites have continuously benefited from this dominant class role. The ownership or possession "of race and property—and the attendant rights to dispossess Others—produced another possession: citizen status and rights" (Vaught, 2012, p. 53). Bell (2000), widely recognized as the founder of CRT, argues that since slavery, Whiteness itself has been an important form of property. The framers of the U.S. constitution understood the critical conflict between property rights and individual rights and made slavery permissible on the ideology that Black slaves were property and therefore not eligible to receive the same basic human rights as Whites (Bell, 2000). Likewise, Ladson-Billings and Tate (1995) claim that our society has perpetually linked human rights with property rights; thus, in a society that claims to value individual civil rights, the reality is that social benefits still go to property owners.

In the event that members of the dominant class do not own property, their Whiteness functions as a type of social property for them.

For example, Bell (2000) explains that, historically, some Whites did not oppose slavery, even though they did not personally own slaves. Bell (2000) argues, "those at the top of the society have been benefited because the masses of whites are too occupied in keeping blacks down to note the large gap between their shaky status and that of whites on top" (p. 77). The use of slavery may not have benefited them directly, but it did provide them with the property of racial superiority. In a more recent example, Ladson-Billings (1999) states that, "although the policy of affirmative action is under attack throughout the nation, it is a policy that has benefited [privileged] Whites [thus proving that] Whites have been the primary beneficiaries of civil rights legislation" (p. 213). Further, Whiteness as property is replicated in the educational realm because working class Whites are afforded better quality housing and schools, thus legitimizing "existing race-based inequalities and further privatiz[ing] education" to keep Blacks out (Urrieta, 2006, p. 457).

CRT can also be used as a lens to understand the hegemonic processes in science education. Research shows that the percentage of people of color and women in science remains disproportionately low (Basu, 2008). In an effort to reform science education practices, Project 2061 was initiated by the AAAS. The proposal called for a scientifically literate society for all Americans. *Science for All Americans* (1989) defines scientific literacy as "being able to use scientific knowledge and ways of thinking for personal and social purpose" (p. x). Thus, one goal of science education is to aid all students in developing the habits of minds necessary to be successful, productive, and responsive adults (Brickhouse & Kittleson, 2006). The world has changed so much, in terms of the advancement of science, that now more than ever, scientific

literacy is essential to our daily lives (Eisenhart, Finkel, & Marion, 1996). This method of thinking, doing, and responding has become necessary for all Americans and not just the privileged. AAAS (1989) states that "science education will have to change to make that possible" (p. ix); however, in pursuit of scientific accomplishment for the privileged, we have ignored a portion of students we deem *underrepresented and underserved*. This negligence is the collective empowerment CRT seeks to counter because CRT theorists understand that educational failure for students of color is one way the system of white supremacy perseveres.

How do members of a democratic society collectively use educational, social, organizational, and financial capital to aid and enrich the lives of the oppressed group, when research finds that "a significant number of teachers doubt that education is important to the parents of students of color and students from families with low income" (Schellenberg & Grothaus, 2009, p. 441)? While this statement may be considered blatantly racist, they are often the status quo in education (Castro Atwater, 2008; Chadderton, 2013). CRP allows students to maintain their cultural integrity, while holding the bar of excellence high for all students (Ladson-Billings, 1995); however, CRP does not explicitly problematize race. The theory and praxis of CRP should include a critical analysis of race and racism. To do so, researchers have begun to use Critical Race Theory (CRT) to explore aspects of race and racism in education (Basu, 2008; Ladson-Billings, 1995, and Brown-Jeffy & Copper, 2011).

In this study, CRT juxtaposes science reform efforts with the ultimate goal of collective empowerment for students of color. Science reform documents describe the responsibility for educators and researchers to address the changing faces of students in the classroom; therefore, CRT is the necessary "philosophical underpinning, as to why cultural knowledge and implementation of CRP is a necessary conversation" (Singer, Lotter, Feller, & Gates, 2011, p.

204). In this study, CRT is the necessary theoretical lens to understand the competencies teachers must have in place, when dealing with students of color and how they use their respective competencies to empower students of color. To understand how race and racism exist and how to counter it, teachers must see CRP as the set of highly effective instructional practices and CRT has the theory behind these practices.

Methodology

According to critical race theorists, narratives are essential when gathering vital sources of information, in that "they make the social realities of people of color, as influenced by racism, visible to the rest of the world" (Wallace & Brand, 2012, p. 348). Coming from a Critical Race Theory (CRT) perspective, I explored the implementation of Culturally Relevant Pedagogical practices of White science teachers and how they exhibited it in their classrooms, conversations, and work-related materials. Narratives guided the methodological framework, as I sought to illuminate the counter-storytelling that is present in CRT research (Taylor, 2010).

Research question and design

In this qualitative case study, I examined the CRP practices and beliefs of beginning White female secondary science teachers (Merriam, 1998). Typically, teachers are considered "beginners" during their first five years in the profession, where they undergo the "unique process of learning to work within a new cultural setting that consists of colleagues, curriculum, and the organization" (Luft, Firestone, & Wong, 2011, p. 1201). To address the issues of cultural knowledge and praxis, the overarching research question for this investigation was: How do teachers make sense of their own racial selves in relation to teaching students who are different than themselves? To aid me in answering the overarching question, I explored the following sub questions: (1) What informal and formal factors have influenced participants' beliefs about race

and teaching? (2) How do participants attempt to implement CRP in their classrooms? (3)

According to participants, what are effective CRP practices in the science classroom that combat

critical urban issues and what are factors that prohibit CRP?

Research Context

The case study was conducted and bounded in three schools, during the 2013-2014

school year, within Paramount School District[9] (PSD), located in a major metropolitan area in

the Southeastern United States. PSD was chosen because the city it is situated in has had a long

history of Black (non-Hispanic) mayors and would be considered a post-racial city; however,

city and neighboring suburban schools (i.e. PSD) do not reflect the demographics of the city.

PSD has a population of about 50,000 students. The student population is 60% Black, 23%

White, 8% Multi-racial, 6% Hispanic, 3% Asian, and 0% American Indian/Alaskan and Other,

which mirrored the schools studied (see: Appendix A). Additionally, more than 90% of the

schools are designated Title-1, and more than 80% of the student population qualifies for the free

and reduced lunch program. The city is comprised of roughly forty (40) percent White (non-

Hispanic) residents and sixty (60) deemed "minorities."

Participants

The participants for this study were three White female teachers, who ranged in age from

24-30, with an average of 2.3 years of teaching experience (see Appendix for participants'

characteristics). For this study, I used purposeful, criterion-based sampling (Creswell, 2007;

Hatch, 2002) and a call from the district was sent to beginning year science teachers. Bogdan &

Biklen (2003) suggest using purposeful sampling if you believe the selected participants can lead

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[9] All district, school, teachers, and student names have been replaced with pseudonyms to protect the identities of the participants.

you to other willing participants that can facilitate the growth of a developing theory. Additionally, the creation based sampling is a suggested type of purposeful sampling where participants are selected because of specified characteristic (Patton, 1990) (For a the criteria list, see Appendix B).

The first participant, Gabby, was in her second year of teaching and taught at Jemison High School (JMS). Gabby taught four sections of Physics and two sections of Scientific Research, in a predominately Black school. Gabby grew up in Northeastern United States and had trepidations during her first year of teaching, because she had "never been a minority before." Eden, the second participant, was in her third year of teaching freshman Biology, at Daly High School (DHS). Eden self-identified as a White-Jewish middle class woman and attributed her academic success to working hard to learn White culture. She felt that she was often othered in her personal and professional life because of her Jewish status. Lastly, the third participant, Sabrina, taught Physical Science and Biology, at North Creek High School (NCHS). Sabrina's students lived experiences resonated with her, because she grew up on a small farm town, where expectations of academic success were marginal.

Negotiating Access as a Black Female Academic

Many Black feminist scholars argue that separation of race, gender, and class is difficult or nearly impossible when conducting research (Childers & Hooks, 1990; Crenshaw, 1995; Hill Collins, 1990; Naples, 2007). Within the context of this study, I must acknowledge the influences of my own identity (Haitian-American), race (Black), and gender (female) on this study. Scheurich (1994) suggests that one's culture influences, aids, limits, and constrains one's production of knowledge. This research paradigm allows us and our culture an opportunity to be a part of the research. It is the interaction between the researcher and the researched that allows

for the honest production of knowledge. A biased researcher is an honest researcher, who can admit that they bring subjectivity to their study (Mehra, 2002). This awareness brings a heightened sense to the criteria for trustworthiness. My position as a Black female academic who studies CRP and District Science Coordinator who monitors for effective instructional practices, brings a critical eye to my participant' classroom. The criteria for trustworthiness for this study is carefully selected and discussed in the following section, to reduce the biases I bring.

Data Collection

Interviews were the primary source of data for this study, and participant/classroom observations, unobtrusive data (i.e. curricula documents), field notes, and researcher's memos were used for secondary sources of data. Each participant was interviewed three times, and each interview lasted an average of 60 minutes. The interviews with the teachers were semi-structured in nature, with flexible questions (i.e. questions derived from the sub-research questions) to encourage open discussions (Seidman, 2013). The first interview discussed life histories and interactions with race, the second focused on culturally relevant pedagogical practices, and the third interviewed served as a post-interview to clarify and confirm themes uncovered during the observation cycle. See Appendix C for sample interview protocol.

Observations were also used to document use of CRP, using a Dunn's (2013) CRP observation protocol. I was careful to avoid major cultural holidays (i.e. Martin Luther King Day), to avoid bias to regular instructional practices. I observed each participant for two instructional units (between one to two months), for an average of 20 hours. It is important to note that these teachers were on block schedules (Huelskamp, 2014) and each class would run for two hours, with two teachers meeting every other day and one meeting every day. Classroom

observations focused on teachers' interactions with students and faculty, instructional strategies employed the teacher, and student interactions with peers and their engagement with the lesson.

Data Analysis

I followed Charmaz's (2000) guide for analysis of qualitative research, which includes: (1) instantaneous and reflective data collection and analysis, (2) two-step coding (open coding, followed by selective coding), (3) constant memo writing to explore themes, (4) literature sampling to explore and refine themes, and (5) the development of an analytic framework. Data was coded by the primary researcher (myself) and two other graduate students, who were used for peer-debriefing and to address trustworthiness. The first step consisted of InVivo-coding, looking for specific words, dialogues, and/or actions the participants used, which categorize my data into 51 initial categories (Saldaña, 2009). For the second cycle coding method, I used Focused Coding and ran a search query on QSR NVivo 9, a computer-assisted qualitative data analysis software, to compare codes. Comparable to the constant comparison method used grounded theory, I wrote constant researcher's memos and made decisions on how to proceed using previously collected data (Strauss & Glaser, 1967). The core categories were then merged to identify themes that expressed the essence of what the participants and their data reflected. Because the topic dealt with race relations, I thought it was vital to have two external debriefers (one Black and one White) who were well-versed in the area of CRT and/or CRP. Our team coded the data individually first, and then together as a team, discussed codes. We met biweekly, for four months, for peer-debriefing (Lincoln & Guba, 1985). Participants were given transcripts of classroom observations and interviews for member checking (Creswell, 2007). As feedback or clarity was provided, I made notes in my researcher's memos and considered it when completing my analysis. Lastly, I triangulated my codes and themes amongst data from interviews,

observations, and document analysis of unobtrusive data, to interpret recorded events as accurately as possible, during the data collection and composition portion (Bogdan & Biklen, 2003; Patton, 2002; Yin, 2008).

Findings

Findings from this study indicate that as the beginning White female teachers made sense of their own racial selves they grew in their understanding of CRP and the role of race/racism in the science classroom. In the sections below, I highlight two major themes that emerged about how teachers developed and implemented CRP. First, I found that teachers' explicit confrontation with/of "otherness" as White female teachers and their critical awareness of societal influences on students of color allows more opportunities to be race-conscious and directly address institutional racism. Second, I found that teachers' critical awareness of explicit and implicit power structures and how these relationships are embedded in a "hidden curriculum" influenced their beliefs and instructional practices, for better or worse.

In the sections below, I describe findings that support each of these two themes. I have chosen to tell their narratives individually within each theme because narratives are essential when expressing the social realities of racism on people of color (Wallace & Band, 2012). Additionally, narratives seek to understand human experience and social phenomena through the context of histories. Within each narrative, I also summarize findings related to the sub-questions of their definitions of CRP, their preparation as it relates to CRP, and the contextual factors that support or inhibit CRP in their classrooms.

Breaking the rules of silence: Confronting "Otherness"

The first theme that emerged from the data was how participants negotiated and defined (both explicitly and implicitly) "Others/ness" and how this affected their development and

implementation of CRP. "Otherness" is best described as the cultural system of how majority and minority identities are constructed and treated (Grant & Secada, 1990; Weis, 2008). Because representation of those identities are controlled by groups that have greater political power, we establish and negotiate our place and "Others" in society by who we think we are and how we think of other groups (Mead, 1997). This social dichotomy represents the established order of superiority: "Power is implicated here, and because groups do not have equal powers to define both self and the other, the consequences reflect these power differentials. Often notions of superiority and inferiority are embedded in particular identities" (Okolie, 2003, p. 2). From this critical framework, it is easy to see how the dominant ideologies represent power and set the stage for educational policies and practices. This has tremendous implications for both the macro (Education) and micro (Science Education) scenes. Otherness helps regulate and define students' expectations within the science classroom. Particularly, otherness plays a significant role when discussing how White female teachers define and negotiate CRP. In this study, all participants haphazardly negotiated their place and their students' places in society, using their beliefs about children and beliefs about effective science instruction. The narratives below highlight how some were further along with their understanding of CRP than others were. Additionally, the narratives describe their experiences with other races, from childhood as middle-class White females to self-described middle-class White females in predominately Black schools, and how they were prepared both formally and informally, during their induction years.

Gabby: I have never been a minority before.

Gabby described not having much diversity in her own schooling experiences, because of the separation of students, based on income. Gabby states, "I was in honors and AP courses so I was in the more well behaved side of the school. Typically, they were the students who were on

task. And most came from middle class" (Interview #1). Her implicit awareness of socioeconomic status and its relationship to students' academic performance formed her definition of the established normed - nice, quiet, and compliant (Irvine, 2003). Gabby pulled me aside after a classroom observation to explain that her students were not normally rowdy; however, during my observation of the lesson, students were just excited about a white-board energy challenge she had assigned (Observation 3). In one sense, she lobbied for students' to empower themselves, intellectually and emotionally, by creating curricula that manifested a multidimensional view of students' reality (e.g. creating student activities that allowed for collaboration and competition); however, she was unable to reconcile how students should behave with how she experienced students behaving during her schooling experience in White and middle-class environments. This in itself limited her capacity to fully implement CRP, because she was not empowering them socially. Gabby perceived CRP as "what I can do to help [my students of color], that is different from what they've already experienced" (Interview 2); however, they experienced being silenced on a daily basis.

Gabby's definition of CRP was emerging and slightly superficial. For instance, Gabby was hypersensitive to race and its implication in the classroom because this was her first time being in the racial minority. Gabby was extremely careful of what that meant in the science classroom, because she knew that factors such as race and class enabled her to cross cultural boundaries that separated her from her students. Reflectively, she stated, "I've never been a minority before, really. I grew up in a white dominated community, so it's taking a little getting used to. Like I would rethink everything I said to make sure it wasn't going to accidentally offend somebody" (Interview 1). Gabby's upbringing molded her beliefs about how students should behave in school; whereas her experiences showed that White culture has positioned itself

at the top of the hierarchy (CRT tenet 2), she displayed sociocultural consciousness that race and

racism was naturally embedded in society and that she controlled the production of it (CRT tenet

3). Gabby was culturally conscious enough to understand that, although school structures looked

different, the overall goal should be the same - to make learning meaningful for her students of

color. However, she struggled to see other aspects of racism, such as power, privilege, and the

material effects of her position.

Further, Gabby formed her definition and beliefs about best culturally responsive

practices formally through her district's Teacher Academy for Preparation and Pedagogy (TAPP)

Program, and informally with her working relationships with colleagues, students, and

administrators. She used her position of being a White middle class female teacher in a

predominately Black school to seize every opportunity to empathize with their experiences of

being "*othered*." She posed reflective questions to herself to examine why being a White female

teacher in a predominately Black school would cause her students and community members to

feel perturbed. For instance, she recalled her first year of teaching, and wondered why "the kids

would think that everyone was my sister if they were White?" (Interview 1). In the process of

learning about her and her relationship with her students, it was evident that both teacher and

pupils were trying to answer this question. Gabby and her students realized that race was a social

construction (CRT tent 3). She later came back to her previous reflections of her students being

rowdy and said, "When I was in school, I just sat down and listened, but I think these students,

they have a shorter attention span, so you have to be a lot more creative, but this might just be in

a generation issue" (Interview 1).

Gabby also formed her understanding about CRP through her interactions with her fellow

teachers and community members. Gabby had great working relationships with her colleagues

because she was open to them. On several classroom observations and even after school, as we debriefed, I witnessed other teachers coming in and asking her for assistance. She collaborated with other teachers to write lesson plans and they informally observed each other during their planning periods. She said, "Lucky for us we have a lot of great teachers here, who are women of color, who have their PhD's and EdD's, so I think they are good people to look up to, in terms of instruction" (Interview 3). She spoke highly of her administrator and called him a "do it person." Likewise, she challenged the hierarchical position of the teacher-parent relationship (the second component of CRT). She stated, "My parental relationship falls into the relationship I have with students. I see the student as kind of a limb of the parents" (Interview 1). She acknowledged the structural inequities that prevented her parents from being active (in terms of attending parent conferences), but she did not use this to alienate her parents from being active participants in their child's educational experiences and found alternate means to update parents on their child's progress, such as giving them her cell phone number and emailing them constant updates about their child's progress.

Eden: There's like this suburban white affluent bubble

Eden had the most limited understanding of CRP and racism, its definition, and various ways to implement it. She unsuccessfully implemented and developed CRP, because she had stereotypical views of students of color. Eden described her own education as "a suburban, predominantly White middle school and high school" (Interview 1). She enjoyed the vast course offerings that her school afforded her. Being in advanced classes gave Eden a biased view of how students should behave. Like Gabby, she was also taught that strict self-discipline was the hallmark of a great class. It was obvious from the interviews and classroom observations that she was trying to form her own definition of a "good student." She stated, "I tell them, 'Learn to be

quiet.' And I try to make my students advocates for their own education, advocates for their own

behaviors. So, I do use the word 'shame on you' because they're always quick to apologize and

say that they'll do better" (Interview 1). Unlike Gabby, she never reconciled that being a "good

student" was a racist view of how her students of color should act.

On one hand, Eden wanted to teach her students the *good student* skills she learned

earlier in life, because it aided her in navigating the cultural hierarchies in her high school.

Coming from a lower middle class background, she equated being a good student with quietness

and submissiveness. On the other hand, Eden knew that she had to allow students to be

themselves to be successful. In negotiating this balance between respecting students' cultures

and providing them with skills to access the culture of power (Delpit, 1988), Eden appeared to be

haphazardly demonstrating the second tenet of CRP, whereby teachers assist their students in

developing their cultural consciousness and the second tenet of CRT, an awareness of cultural

hierarchies. During classroom observations, Eden experienced the most difficulty with classroom

management, because her experience as a good student conflicted with her students' behaviors.

In some instances, she was caught telling her students to "shut up," but in other instances, she

encouraged them to embrace their individualities and culture and speak up. In one interview, I

asked her to explain the importance of the music moguls (e.g., Drake, Mos Def, Ace Hood,

Tyrese, Jay-Z, and T.I.) whose pictures were plastered around her classroom. She stated, "I

wanted them to see artists that they listen to... The same messages that we get from some of the

music that we listen to is the same thing that can be applied inside of a classroom" (Interview 3).

When I asked her what messages those quotes meant to her, she quoted the rapper Ace Hood,

and said "students should hustle had," which is slang for working to their maximum capabilities.

Here you see Eden's mental struggle to have her students conform to White culture by having a

quiet classroom, but also attempting to embrace her students' culture in terms of their music preference and the "pull yourself up by the bootstraps" messages of these musicians. Their music preferences and the music artists she used, however, contradicted the cultural consciousness she was trying to exercise in her class. Eden did not really understand the subliminal meanings of these musicians' work if she was simultaneously telling them to "shut up."

Eden's limited understanding of her definition of CRP was also formed formally by her TAPP program and informally with her interactions with her colleagues and community members. Eden found her TAPP program as helpful, because as she stated, she had "a lot of teachers who were of color and that was really powerful, that we all came from the same school district. And they really were able to give a completely different insight [on students of color]"; however, Eden admits that she was unable to adsorb all of their knowledge because she was engrossed with her school's mandate of weekly lesson plans. Additionally, Eden formed her definition of CRP from being *othered* because of her background as a White Jewish woman. Eden noted, "Sometimes I clash with other staff members, because I'm also Jewish, and I'm the only teacher at my school that is Jewish. And, for certain Jewish holidays, I can't work. And that's kind of caused barriers" (Interview 1). In one instance, she described being picked on because her staff was having a holiday luncheon and asked her to bring "dressing." She proceeded to purchase a Kraft bottle of Italian salad dressing and was mocked because she did not understand the cultural definition of dressing, which is a side dish made of cornbread. Being the only White female teacher at her school, her racial background did not allow her to connect to others in her building, which caused mutual distrust and disrespect, which ultimately affected how she implemented CRP. She said, "I've had students come to me and tell me what other teachers or the office staff has said about me, and I think that that's extremely unprofessional"

(Interview 1). Her stance on developing her and her students' cultural knowledge was inconsistent in theory and in practice. She stated,

> Especially in certain neighborhoods, I think that if you look at parent involvement and if you look at a teacher who has 100% of their parents calling them every single day, making sure their child is okay… at some point it is the teacher's responsibility to make sure that they're giving [that child] a good solid education. But at the same time...if 100% of my parents don't ever contact me [and] if my students are not engaged. It could cause somebody to say, 'Why do I need to go above and beyond if nobody is coming in to follow suit behind me?' (Interview 1)

Here we see Eden's cultural consciousness is not evident because she is blaming her students' parents for their low academic achievement and she is not challenging the status quo of social order. She is not reflective about how some parents in "certain neighborhood" can afford to call their child's teachers every day, while other cannot. Eden's social construction of her students' inferiority was developed by her interactions with students, parents, and colleagues, as demonstrated above. Her development of CRP came from her experiences with *otherness* and it had gross implications for how she manifested beliefs about cultural disadvantages. Eden inadvertently defined CRP as having high expectations, which is an essential tenet of CRP, but also not making excuses for her students. She realized that there were certain key issues at play in an urban school, such as the constant disrespects and lack of parental involvement that she experienced. However, she did not make allowances for these barriers. Being *othered* as a White Jewish female teacher enforced cultural hierarchies she had established before entering the classroom.

Sabrina: They didn't really care if we did well or not.

Sabrina had the most developed understanding of CRP and construction of race in the classroom, which she attributes to her rural upbringings. In one instance, she described the low academic and racial expectations she experienced, growing up in a small farm:

I pretty much hated my school, because I felt like everyone just expected us to either be a farmer or be a farmer's wife. There's actually a lot of racism in that school. The school is pretty much still segregated. They still have segregated proms. (Interview 1)

Sabrina's view of her schooling experience, although negative in nature, gave her the resolve to make her students' experience different. Sabrina described being *othered* in high school, not because of her cultural background, but because of her unwillingness to accept complacency. She had two teachers (AP Literature and Spanish) that challenged her. Sabrina's interactions with her Spanish teacher had a tremendous influence on her definition of CRP, which was empowering her students of color to understand how systems could contribute to the manifestations of group disadvantages. For example, in one interview, she explained her lecture to students about the district's low expectations of academic achievement. She said,

I feel like a 50 percent pass rate, that is nothing! It makes me sick to think about it. But then, the fact is, they're not passing! I want to say to them, 'your peers in wealthier school systems, they never hear the words, Regents Exams, until they take that damn thing.' Yeah you might be segregated now into this school system, but when you go to college, you're going to be in college with the same kids who did not even blink at this exam. (Interview 2)

Her experiences growing up in a small farming town that wanted to maintain the integrity of their community allowed her to see her teacher being *othered* because she wanted her students

to a) succeed academically in a town that did not prioritize education and b) get rid of their "small town thinking" so that they could develop their own critical consciousness (tenets one and three of CRP). What Sabrina witnessed with her teacher's implementation of CRP, formed the necessary background to develop her own definition of CRP when she would eventually become an educator. Low academic expectations were not acceptable, especially since she knew that "not all schools, in general, have these low expectations."

Not only was Sabrina's definition of CRP and beliefs about her students formed informally, from being *othered* and watching her teachers *othered,* Sabrina used her interactions with her peers from her graduate program to redefine how her students would experience otherness, through her enactment of CRP. Sabrina was the only participant who attended graduate school and described her program as being extremely diverse. She said, "In my Grad School, we had a lot of teachers who were people of color and I think that was really powerful. Some of them came from my school district. And they really were able to give a completely different insight" (Interview 2). Sabrina explained how their perspective and how they had constructed race issues within their schools made her more comfortable dealing with complicated situations because she was able to debrief with them while these situations were occurring. She stated, "That's why I say that my first year I really wasn't a teacher, because I understood the concept of it but to really be in the classroom and actually keep up [with my students]? At first I was teaching the way that I was taught, which wasn't working."

Although Sabrina credits most of her CRP strategies to trial and error, the lasting relationships she formed with her peers were instrumental in implementing CRP in her classroom. Much like Eden, Sabrina did not have much support from her colleagues at her school. She described the relationship as being unfriendly because they would often leave her out

of events, both school-related and personal. They would never invite her to school outings or even lesson planning sessions. She was often handed a stack of papers with what the other teachers had decided to use for their Biology and Physical Science classes. Since they were framed as the experts, they assumed she would just accept the lessons. However, Sabrina was charged with the memories of her former Spanish teacher and knew she had to do something different to reach her students. These experiences formed Sabrina's definition of CRP in that she wanted her students to experience academic achievement and she wanted them to be critically conscious of the current status quo.

In summary, the participants were influenced by their cross-cultural educational and professional experiences in four general areas: (1) understanding their life experiences and how it impacted their cultural consciousness (CRT tenet 1 and 3); (2) understanding their position of otherness as a White female teacher in predominately Black schools (CRT tenet 2); (3) accepting and integrating their students' and schools' cultures to develop cultural competence (CRP tenet 1 and 2); and (4) understanding the urgency to develop critical conscious students (CRP tenet 3). Sabrina had the most developed understanding of CRP and CRT, because she understood the nominalization of institutional practices (e.g. low achievement goals) and worked with her students to make them aware of it. Gabby had partially developed her understanding of CRT and CRP, in that she was beginning to become aware of race and racism in the classroom. Eden, on the other hand, had the most restricted understanding of CRP and CRT, because she blamed her students, parents, and colleagues for issues that caused the manifestation of group disadvantage. Their personal and professional experiences challenged them to form a dual definition of otherness from the perspective of being a White female teacher in a predominately-Black school and serving traditionally marginalized students who face *otherness* in their daily lives.

Unmasking the hidden curriculum: Negotiating power to ensure equity

The second theme that emerged from the data is how participants negotiated their power as White female teachers to unmask the hidden curriculum. Coming from a place of privilege, the participants of this study understood the hidden rules of education. All three participants related academic success to White culture, in that students had a better chance of success if they would just adhere to these unspoken rules of good schooling: "sit down in class, be quiet, and do your work" (Eden, Interview 1). Still, all three participants realized that there were systematic inequities that prevented students from being successful. All three participants shared similar stories of bully, fights, and other classroom disruption, that's "made [her] teaching suffer a little bit, because [she] have to deal with little administrative things that could have been handled in another space and time that would have freed out more instructional time" (Gabby, Interview 1).

Regardless of the barriers, my participants looked for ample opportunities for their students to experience success. Although all three participants used a plethora of instructional practices, I will highlight the five culturally responsive practices that they all had in common: (a) building relationships with students and communities; (b) involving students in the construction of knowledge (i.e. continuous checks for understanding and modifications to the lesson, build on their understanding etc.); (c) building on students' linguistic resources (i.e. specific attention to vocabulary instruction); (d) making real world connections to the curriculum (i.e. alternative food sources in a global economy); and (e) finding appropriate instructional materials (i.e. student-centered classrooms, examine/question text, used varied assessment practices). The following participants' narratives highlight how they used their power as an instructional leader to attempt to ensure equity.

Gabby: There has to be a product... But I think, in order to get to that point, you have to build that connection with the student.

Gabby's awareness of her students and her community's population caused her to view her students with empathy. She had a developing understanding of her students' needs and the relationship between their needs and their behaviors. She used her knowledge of her students' circumstances to mitigate the academic impact that institutional inequities would have on their achievement. Gabby was aware of the hidden messages of student and parent failure that plague her students of color; however, she had a holistic view of community involvement. She saw parents as a necessary resource in the educational experiences of her students. She says, "I make myself available outside of the classroom in terms of email and text. I give them all my phone number. And so that gives them really no excuse not to ask me for help. Even on the weekends" (Interview 2). Gabby made herself readily available because she wanted to ensure her students' success and she understood that she had to do her part to foster equity, inclusion of students and parents in the schooling process, and empowerment.

Gabby realized within her first two years of teaching that she had to get her students motivated to learn about science. The traditional White-dominated discourse of science positioned her students as unsuccessful. Nevertheless, along with compassion and a vision for academic success (a component of CRP), she used a variety of effective culturally responsive pedagogical practices in her classroom to meet the needs of her students. Some examples of how she made learning meaningful to their daily lives were outdoor labs to calculate speed (Observation 2), Physics problems via team challenges (Observation 3), and an Energy Card Game to foster academic discourse and argumentation (Observation 6).

One instructional practice that made Gabby's classroom observations standout was her consistent use of video clips of real word connections. She had a video clip for every topic. During my second observation, she showed a video about an alternative heating source in Africa, to discuss heat transfer for her Physics students. In another, she showed the impact of force during sports. I asked her why she showed these brief clips and she responded:

I think it's very important to expose them to their own and different cultures and things going on in the world. Through my exposure clips, we get to talk a lot. It's something that's going on in the world to show them that we're not just in our little space. Because sometimes I hear them misspeak about things going on in the world. (Interview 2)

Gabby's constant focus on students' experiences in her class was evident not only in the way she designed her lesson, but also in the way she designed her assessments. Gabby's school required teachers to give a unit exam every four to five weeks. To ensure her students' success, she revamped the unit exams and scaffold questions so that students could build their confidence and persevere through the long mandated exams. She said, "I scaffold them a little bit and add some to organize by standard. Then I start off kind of low level to make it safe for everyone. Then I kind of start with those recognition/description questions and try to work my way up to the more complicated questions" (Interview 2). Additionally, Gabby seized every opportunity to review missed items with her students by having students complete a data self-tracker. The students said she was the only teacher from whom they received feedback. These practices exemplify a more developed understanding of CRP, in that she attempted to have her students experience academic success (CRP tenet 1) and she encouraged them to be effective facilitators of learning by being responsible for their learning in the classroom (CRP tenet 3).

Repeatedly, Gabby used her knowledge of self-motivation to turn her students' frustrations into positive learning experiences. Often, students expressed their frustration through loud murmurs that would cause classroom disturbances for other first year teachers, but these expressions were not problematic in Gabby's class. In my second classroom observation, she assigned group work. I noticed how the students would get loud during some parts of the assignment and she would walk by and check to see if they were on task. In our interview, I followed up with her about this practice and she said,

> I think that they like sitting with certain people and certain groups. And they can bounce ideas off of each other. And, you know, sometimes I hear them, they're really loud, like today. And I'm just about to scold them for it. And then I realize they're actually talking about the materials. So I've realized they really like to talk and bounce ideas off each other. (Interview 3)

Because of her stance on classroom management and the way she encouraged students to help each other construct knowledge via active discourse and argumentation, she received tremendous support from her students, parents, fellow teachers, and administrators. Within her first few years of teaching, she learned that solid instructional practices are the key to helping her students master the Physics content. Additionally, she learned that she can teach her students something more valuable than content. She said,

> You have to know your students and their needs… So I think it's a combination of care and compassion, mixed with the obvious, the instructional, and the learning piece. You know realistically, you don't remember the teachers who always had the most organized lesson plans or always had the most exciting information. I remembered the teachers that

said good morning, that asked me how my day was, that knew that I had a meet, and did

really well at it. (Interview 1)

Gabby saw building her relationship with her students as the most effective way of

implementing CRP. She was also open to trying new instructional strategies by observing her

colleagues (who were women of color) teach the same group of students. She reached her

students through multiple mediums to make the science content meaningful for her students. She

brought in examples of things they were accustomed to (e.g. video of encephalopathy for her

football players). In sum, she leveraged culturally responsive practices to unmask the hidden

curriculum of guaranteed failure for her students. She took tools that were normally used to

marginalize students (i.e. school's science data sheets) and used it to empower her students to

identify areas of strength and areas with which they needed additional support.

Eden: I had to really learn how to meet the needs of the students while still pushing them to succeed.

Eden had the least evidence of effective culturally responsive practices, as she battled

with her desires to push students to succeed and the realities of her school's and community's

dire situation. Unlike the other two participants, Eden had the least collegial and administrative

support. She said,

I do know that specifically in predominately African-American schools or predominantly

in schools that have a significant amount of the students who are behind a grade level, or

need additional time, or need additional resources and support, I think that the

administration is absolutely key and critical. (Interview 1)

Eden used the excuse of lack of support to explain her limited her implementation of

CRP practices. This was troubling because Eden was on the county's curriculum mapping team

and had designed the Biology curricula for the entire district. Her desire for her students to experience academic success was irregularly evident. For instance, in the beginning of her Evolution Unit, she taught her students about acceptance and how everyone would have different beliefs and that listening to each other's points would lead to genuine understanding. She stated, "I think that it was crucial to teach my students about different cultures because I think that by learning about different cultures, from different backgrounds, and bringing them all into the classroom was both powerful and meaningful" (Interview 3). However, during observations, Eden only discussed her race (as a White Jewish woman) and the race of the majority of her students (Black), while failing to address the few Hispanic and White students in her class. Her vision of unmasking the hidden curriculum was to strip students of their cultural identities, to make them comply with White culture. She said one of the most important things to her was, "not necessarily allowing [students of color] to become a product of the community" (Interview 2). This misrepresented view of developing change agents, only if they left their communities, signified her limited understanding of both CRP and CRT, in theory and in practice.

Additionally, Eden failed to implement culturally responsive practices because she blamed her students and administrators for their poor performance. She haphazardly applied Villegas and Lucas' (2002) recommendations to build vocabulary instruction into the lesson. She said her students' biggest barrier to mastering the content was their reading level and understanding of content-specific vocabulary, so she heavily focused on vocabulary acquisition. Eden taught Biology to freshmen, which posed a serious problem, because it contained a vast amount of content-specific vocabulary and her students were below grade-level. She described this experience by saying, "The academic level is extremely difficult and so even though I'm teaching my students to a higher level and holding them to a higher expectation, I still have to

meet my students where they are" (Interview 2). However, during my observations, she never moved beyond basic recall. Unlike Gabby's and Sabrina's classes, her class did not participate in more advanced reasoning skills.

During my observations, Eden used the most direct instructional practices, and her classes were extremely scripted. Many classroom observations operated in the same rudimentary format. Students would walk in and begin their daily warm-up activity. The teacher would walk around and check to see if students answered it correctly. Then the teacher would lecture and at times, do a short activity or lab. The students had a worksheet for every day's lesson. Students had to follow a specific format to write their notes and practice problems. Finally, at the end of the lesson, students had an exit quiz. In our third interview, I asked Eden about this practice and she stated that she wanted to prepare her kids for the end of the year statewide Biology assessment. Eden did not feel as if she had the authority to change the curriculum; however, Eden had the authority, because she was one of the district's curriculum writers. Therefore, it was not because of her authority that she could not change the curriculum to implement more culturally responsive practices; it was her inability to do so because she was limited to viewing her students of color through the lens of deficit and failure.

Sabrina: He pushes me to be a better teacher.

Sabrina had the most developed understanding of effective culturally responsive pedagogical practices and recognized that her teaching got better as she challenged existing conditions. She realized there was this hidden message in her school system, that failure was acceptable, and she was not okay with that. She said, "We have an end of the year assessment, to test students on mastery of the standards, but I feel like the questions on there are common sense and they're too easy, even though a lot of my students fail" (Interview 2). Sabrina exemplified

the first tenet of CRP, in that she wanted academic success for her students and not merely the 50 percent pass rate that was the designated achievement bar for her students. She wanted them to challenge this notion that success was passing their state exam with 50 percent mastery. She challenged them to develop their critical consciousness and question why 50 percent mastery was okay for them but not for other "wealthier students." She said she wanted them to question the status quo, in that "Not all schools have this low rigor. Not all schools, in general, have these low expectations that it's fine for them to meet now because yeah they're technically passing" (Interview 2). In practice, this meant that Sabrina had a data wall, colored by mastery. She would post the district's average and show their individual average highlighted in various colors (red - below the district's average; yellow - on average; and green - above average). Here she rationalized that she is empowering them; however, she does not realize that her public "ranking" is adopting the district's philosophy that achievement is only mastered on exams.

Sabrina challenged herself to find engaging ways to make science meaningful and applicable to her students. She sought out appropriate instructional strategies (i.e. various hands-on labs, videos, and group projects) to make her students understand the concepts better. She was aware of the fact that many of her students read below grade level, so she became an advocate of kinesthetic learning. She stated, "I try to support all learning styles and I think that science is often factual and maybe listening and reading-based, so they really need something to solidify them on the kinetics level" (Interview 2). In one observation, she used candy to have her students build a double helix model (Observation 4). During another observation, she used a card sorting activity to have students play the role of RNA in protein synthesis to correctly assemble the amino acids and to translate the genetic code into functional proteins (Observation 7). Both

examples showed how she leveraged deep knowledge of her students to find ways for them to learn the lessons best (CRP 1).

Sabrina also looked for other ways to include her students in the learning process. Although Biology is a developed subject, she wanted them to be creators of knowledge, so she often gave them assignments where they had to complete a case study, using evidence from the text, to predict or explain what they would do. In one lesson, she had students do background research on genetic abnormalities and draw the pedigree for the genetic disorder. Additionally, they had to detail its phenotypes and predict how different points of mutations would impact gene expression. She believed that her students learned best from each other, so she created an environment that fostered collaboration. Although these tasks were extremely complex in nature, she would scaffold her lesson and provide multiple checkpoints to ensure students felt safe navigating their uneasiness together. She felt that this was a good strategy because it allowed them an opportunity to discuss the content in a safe zone while learning the content for mastery.

Sabrina felt the charge of encouraging her students to do better than what was expected of them, despite their academic challenges. She considered it her moral responsibility to help her students become successful, despite the subliminal messages they received about what they were capable of. Much like her Spanish teacher, she realized the unspoken rules of success and maximized her time with her students, finding various and appropriate instructional strategies, to give them a better chance. Her ethic of caring was critical to her students' success. She believed that the relationships she held with her students encouraged them to want more for themselves. Sabrina felt it was her duty to motivate and challenge her students, despite the barriers she felt from her school and district. She considered it her responsibility to ensure access to the curriculum, despite their reading level, socioeconomic level, or parental involvement.

Conclusively, the participants' primary goals for their students consisted of establishing mutual trust and respect to foster a symbiotic relationship. Eden had the least developed implementation of CRP, because although she wanted them to experience success, she likened it to White culture. Gabby and Sabrina demonstrated the most implementation of CRP, because they (a) gave students access to grade level material in a nonthreatening manner, using appropriate resources and culturally responsive practices, (b) believed that all students were capable of achieving academic success, despite their reading level, socioeconomic levels, or outside support, and (c) advocated for their students and imparted in their students the need to be critically consciousness. Gabby and Sabrina took care to learn about the communities their students were from and how their experiences formed their views of learning. And they included parents into their child's educational experiences while Eden blamed her parents for her students' low achievement. Gabby and Sabrina understood that there were structural inequities that prevented their parents from being active participants or systematic practices (like parent-teacher conferences) that fostered a general distrust of schools and resistance to entering those arenas. They also understood that parents' non-involvement did not signify a lack of care about their child's education. The teachers' discussion of their classroom practices and their students revealed the importance of altering their teaching style to accommodate the sociocultural needs of their students of color.

Discussion and Implications

Because teachers, much like other professionals, operate from the concept of positionality, it is important that the interpretations of my participants' interviews, classroom observations, and classroom artifacts develop from a framework that explores the pervasiveness of the social and political construction of race. Thus, the Critical Race Theory Framework allows

us to examine the covert manifestation of race and racism in the schooling process and how science reform efforts can juxtapose CRT to arrive at the ultimate goal of collective empowerment for students of color (Delgado & Stefanci, 2004). In general, CRT scholars have two goals: (a) understand how racial bias is created and maintained in America and (b) work towards breaking the quandary between racial supremacy and law (Yerrick, et al., 2011). Unfortunately, too often, race and power relations in education are framed by the theory of Culturally Relevant Pedagogy (Brown-Jeffy & Cooper, 2011). Although false in label, this term is seamlessly used to merge effective pedagogical practices and race themes. While the social construction of race is still a complex factor, in a "post-racial" society, race and racism is pervasive in the lived experience of students and teachers, thus affecting their experience with the science curriculum, school, and society. Researchers and practitioners of CRP need to problematize race more explicitly than they already do, meaning that teachers should not only develop students' critical consciousness to make students of color change agents, they also need to expose them to critiques and critical analysis of the hierarchy of Whiteness.

The manifestation of race and racism and how White female teachers make sense of their own racial selves in relation to teaching students who are different than themselves, via effective culturally responsive practices, was the focus of this study. CRT was used to examine how beginning White female teachers attempted to implement CRP in the science classroom, to combat the manifestation of racism their students of color were subjected to, while teaching in urban schools. Additionally, this study examined the informal (i.e. *otherness* via collegial relationships) and formal factors (i.e. teacher preparation) that have influenced participants' beliefs about race and teaching.

CRT exposes race and racism that is inherent in schools and the schooling process of students of color. As reflected by my participants, the hidden curriculum of failure was manifested in students' of color low test scores, low parental involvement, unsupportive administration, lack of school discipline, and low expectations. I found that my participants had a limited, but an emerging understanding of race and racism and effective culturally responsive practices that combat critical issues faced in urban classrooms, as defined by CRP scholars (e.g., Grant & Ladson-Billings, 1997; Irvine, 2003; Ladson-Billings, 1994; Villegas & Lucas, 2002). Some were further along their understanding and implementation of CRP than others were. They all verbalized that they wanted their students to experience academic success (CRP tenet 1); however, their instructional practices did not always align with this ideology. For example, all three looked for various ways to develop their students' cultural competence (CRP tenet 2) but deemed them unruly or disobedient if they did not adhere to White culture - compliant, docile, and respectful (Delpit, 1988; Dent, 1976). Students were expected to conform to behaviors that their teachers were familiar with – anything less was inappropriate, disruptive, and disrespectful. Irvine (2003), explains that this desire for conformity is because White teachers often "possess stereotypical beliefs about urban students" and "have little knowledge of racism, discrimination, and structural aspects of inequality" (p. xvi). During the course of this study, Gabby and Sabrina were reflective about their positionality and personal schooling experiences and admitted that teaching students about compliance was not achieving their ultimate goal of making them change agents. Gabby even admitted that her students' short attention span was more so a "generational thing" and it was her job to be more creative to meet their needs. Gabby and Eden's response to developing their students' cultural competence aligned with Wallace and Brand (2012) study of science teachers' use of CRP with African American students. In their study, their teachers

"hinted an understanding of how [racism] can be used as a tool for stratification, [and] disenfranchising ethnic group" (p. 369). In this study, Gabby and Sabrina talked about unfair assessment practices by their district and leveraged effective CRP practices to combat those issues. Eden also stated that she wanted her students to develop their critical consciousness and did so by putting up hip-hop moguls and their lyrics around the classroom to encourage them to be socially and critical conscious. However, her understandings of the lyrics contradicted what she claimed to want to do, which was deconstruct the social definition of race and empower her students with the skills to position themselves further along the cultural hierarchy.

Lastly, Gabby and Sabrina understood that they had to develop their students' critical consciousness, so that they could be agents for change, to challenge the status quo (CRP tenet 3). They both had innovative assessment practices where they were open with their students' about their progress and growth in the course. Eden on the other hand, felt she was "othered" by the system, and placed those same limitations on her students. She refused to challenge the status quo and even gave in to it by believing her students were inferior because of their low academic proficiencies and low parent involvement. Although Eden identified as a "White" woman she did identify with White culture, exemplifying the fact that culture is not tied to a "color." Here we see the contrasting ways my participants confronted otherness and did or did not use it to develop their critical consciousness of societal influences on students of color. Whereas Gabby and Sabrina leveraged their understanding of otherness (even at the expense of being othered) to support their students, Eden used it as an excuse to continue the manifestation of unjust practices on students of color.

The social construction of race was a constant guide for my participants as they explored the manifestation of racism and developed and implemented a culturally responsive classroom to

combat it. While this research applied the tenets of CRT as a whole and as the theoretical framework, every aspect of teachers grappling with the concept of race was witnessed between the three participants, as they explored the hidden curriculum of low expectations and students' failure. Gabby was well aware that she was the only White female teacher at her school and her students' impressions of her were remnants of their previous experiences with other female White teachers. Eden, was still struggling with her identity, as a White Jewish woman, and admittedly said, "I don't really know what my skin color is" (Interview 1). Lastly, having been perceived negatively, because her family were farmers, Sabrina was able to identify with her students and how various factors (such as race and socioeconomic status) influenced her position on the social hierarchy where White upper/middle class males reigned. Collins (1998) refers to these various intersections as the matrix of domination, whereas our social status serves as oppressive us and changes our lived experiences. All three of their definitions of the social construction of race, resonated with Landsman's (2001) work about White teachers and their construction of race. She said, "Race…is part skin color, part privilege, and part social construction. White people do not usually think of themselves as having a race; race is a marker for the 'other'" (p. xv).

My participants were guided by their experiences as middle class privileged White women. Eden related this to being in a bubble and never having to step out. Truly practicing CRP through CRT required them to make sense of their own racial selves in relation to teaching students of color. Admittedly, they were still grappling with this concept as novice teachers; however, they knew that they had to purposely view their students from the outside of this bubble in order to understand their culture and its implications for the learning of science. Traditionally, White knowledge is law and there is no room to create knowledge in such an

esteemed and complex subject, such as science. As complex as science is, it is quite simple to the privileged. Force equals mass multiplied by acceleration. If you do not understand that, many argue it is a content understanding issue and is not a race-based issue. However, Gabby and Sabrina fought this notion that there was one correct science. Students' experiences and differences were highlighted and not understood to be indigenous (Aikenhead & Ogawa, 2007; Hirst & Vadeboncoeur, 2006). This was only able to happen when they were reflective about their instructional practices. At first, Gabby battled with her beliefs about having a noisy classroom with ensuring that students were developing socially. Eden's views that students' learning experience was to be delivered in a specified format that did not resonate with her students. And Sabrina was open to using various methods after she realized that teaching the way she was taught was not effective. These findings are similar to Durden, Dooley, and Truscott's (2014) study of teacher candidates' racial awareness of self and others. They found that teacher's "racial awareness of self and others are key to developing culturally relevant teachers" (p. 18). As teachers were more reflective of their racial awareness, they were more willing to examine the hidden curriculum of students' failure that was pervasive in their respective schools. This hidden curriculum conveyed a consistent message about who owns science and who can successfully master science. As referenced in Aikenhead's (1996) study of Western science, as a means to enhance students' cultural identity, "the 'taught' science curriculum, more often than not, provides students with a stereotype image of science: socially sterile, authoritarian, non-humanistic, positivistic, and absolute truth" (p. 10). These messages were communicated subtly to students and parents through the schooling process. As participants developed their critical consciousness, they worked diligently to ensure each student experienced a level of success. Gabby and Sabrina were further along in realizing how their social construction of race (CRT

tenet 2) impacted students' experience. Eden, on the other hand, reinforced White culture as the top of the hierarchy (CRT tenet 2) by setting strict classroom routines and practices that did not allow her students to grow socially, emotionally, and intellectually.

Implications for policy and practice

Over the past two and half decades, science educators and scientists alike have become increasingly interested in science education reform for underserved and underrepresented groups. Rightly so, their interest has generally been fueled by a strong desire to eliminate social injustice. Contemporary visionaries would like to see science shift from an Anglo-centric view to one that includes a more diverse array of viewpoints, voices, and lived experiences. For true social justice to be enacted, we will need to see equitable representation and success within the science curriculum by students conventionally marginalized within this subject, on the basis of students' cultural identities.

Though we have seen progress in marginalized students mastering science content, it has been slow (Yerrick, et al., 2011). For true advancement to occur, we will need to engage in critical discourse that highlights the need for systemic changes. We know from previous research on CRP that it takes a concentrated effort to enact race-based pedagogical changes (Irvine, 2003; King, 1991; Krieg, 2011). Perry (2003) highlights this in her work discussing how some school sites were able to see African American students achieve, while other school sites with the same student body and socio-economic make-up were not. She highlights the notable features of the successful sites:

In addition to being sites of learning, they also instituted practices and expected behaviors and outcomes that not only promoted education - an act of insurgency in its own right - but also were designed to counter the ideology of African Americans' intellectual

inferiority and ideologies that saw African Americans as not quite equal and as less than

human. Everything about these institutions was supposed to affirm Black humanity,

Black intelligence, and Black achievement. (p. 88)

Exploring the perceptions of beginning White female science teachers, as they make

sense of their own racial selves in relation to teaching students who are different than themselves

has important implications for future policymakers and education stakeholders. CRT questions

"historical power structures and advocates for equity for marginalized groups" (Basu, 2008, p.

882). CRT addresses power relations present in social relationships, such as a White teacher's

interactions between her students of color and school systems (including peers, teachers, and the

learning process). Some researchers argue that "the culture of our urban schools historically has

been filled with negative and racist assumptions that guarantee failure" (Harris, 1992), because

White teachers have limited understanding of racism and structural aspects of racism (Irvine,

2003). As findings from this study and others have confirmed, teachers experience trepidation as

they attempt to break the rules of silence and unmask a hidden curriculum while dealing with

issues particular to students of color in urban areas (Bryan & Atwater, 2002; Johnson, 2011).

For students of color to be successful in science, teachers must help students learn the

rules of science. Students must learn how to make claims, backed with evidence, to form

reasoned justification (Dunac & Demir, 2013; Nielsen, 2013; Sampson & Blanchard, 2012).

However, these advanced level skills are lacking in the majority of underrepresented students'

science backgrounds. For this reason, it is critical for teachers to be prepared to serve students

from all types of backgrounds. New teachers are the most susceptible to the traps of teaching

how they were taught. The problem with this is that most White female teachers were taught in

settings that do not mirror the ones in which they teach now. This implication means that much work will need to be done to modify the curriculums of teacher education programs.

Limitations and suggestions for future research

This study was limited in that it was localized to three schools in Southeastern U.S., with random sampling of secondary White female science teachers who had different training backgrounds (e.g., TAPP and Graduate Teacher Preparation Program). Although the study was situated in a large metropolitan Additionally, I did not fully delve into the differences of participants' preparation programs. Lastly, this study was limited to one academic year, during their induction phase. Researchers should expand on this study to explore how teachers develop their understanding and implementation of CRP (with a critical lens) after induction years (i.e. a longitudinal study from year one to year five). Additionally, researchers should explore how alternative versus traditional training influences implementation of CRP, since my participants came from different preparation programs. Further, researchers should look at suburban sites to see how teachers navigate their racial selves where they may share the same ethnic backgrounds as their student but differ in their cultural backgrounds (e.g., class, socioeconomic status, gender, etc.). Lastly, education researchers and school districts can explore job-embedded professional development, where teachers work on strengthening their culturally responsiveness through on-site training.

Although there were limitations present, the culturally responsive practices of teachers in this study mirrors what research has found about beginning White female teacher across the country; thus shedding light on teacher preparedness. In addition to content knowledge, science teacher preparation programs should have more meaningful and authentic experiences where race and cultural issues are candidly explored. All of the participants attempted to navigate race

and racism in the schooling process through self-discovery and constant reflection. For those that were successful in implementing effective CRP practices, their moral obligations to explore race, racism, and their sociocultural consciousness were deliberate. While it was noteworthy that these participants listened to their students of colors and rationalized how dominant institutions contributed to the social, cultural, economic, and political marginalization of these oppressed groups, it was not explicitly taught to them in the formal schooling process of becoming an educator.

Science educators must formally be taught what science looks like in different contexts. Science educators must be given multiple opportunities to explore their biases and their privileged status affords them. Further, they must be open to adjusting their instructional "tool-box" to incorporate a plethora of instructional strategies that have proven effective in reaching underrepresented and underserved students in science. There is a dearth of research that explores the interconnectedness of CRP and CRT (Brown-Jeffy & Cooper, 2011; Howard, 1999). The science education community needs continued research on CRP, systematically viewed through the lens of CRT. Only if this type of research is in place will we challenge the status quo of the social order.

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APPENDICES

Appendix A – Teacher Education Program Requirements

Program	Total # of Courses	# of Educational Research	# of Science Methods	# of Science Content	# of Psychology/ Special Ed	# of Cultural Studies	# of Practicum
Boston Univ.*	14	0	5	2	4	1 (ESOL)	2
Clark Atlanta Univ.*	12	2	0	5	2	1	2
Columbia Univ.*	20	2	5	5	0	2	1
Columbus State Univ.	14-15	1	2	3	2	0	2
Davenport Univ.*	15	2	3	0	1	5	1
Georgia College & State Univ.	12	1	0	5	1	1	1-5
Georgia Southern Univ.	14	1	1	5	1 (optional)	1 (ESOL)	4
Georgia State Univ.*	15	1	3	5	1	1	3
Providence Univ.*	12	1	0	0	0	5	1
Michigan State Univ.*	10	1	1	3	1	1	1
Univ. of Alabama	15-16	1	1	4	0	1 (optional)	2
Univ. of Florida	13	0	3	5-8	0	1 (ESOL)	2
Univ. of Missouri - Kansas City*	12	2	2	4	3	2	2

Table 1. Teacher Education Program Credit Hours. On average, each course meets for three hours per week for one semester (15-18 weeks). Schools that have a public and marketed emphasis on urban education are denoted with an asterisk (*).

Appendix B - Participants' characteristics

The criteria for participant sample included:

(1) Participant had to self-identify as a White, female science teacher, who stated she believed in and implemented culturally relevant pedagogy;

(2) Participant had to be a certified secondary science teacher (grades six through twelve) to ensure guaranteed instructional time with the science curriculum; and

(3) Participant must have had no more than five years since matriculating from a certification program, because I sought participants with recent exposure to teacher preparation programs, and in the state in which my research was conducted, teachers are allowed to teach on an emergency license for up to five years.

Pseudo-nym	Age	Race	Subjects	Years Teaching	Childhood Upbringing	Teacher Training	Financial Status as a Student
Gabby	24	White	Scientific Research Physics	2	Suburban – Northeast US	TAPP Program	Middle-class
Eden	27	White	Biology	3	Suburban – Southeast US	TAPP Program	Middle-class
Sabrina	31	White	Physical Science Biology	2	Farmland – Southeast US	Masters in Secondary Science	Lower Middle-Class

Appendix C - Interview Protocol

Background Interview Questions:

Can you give me a little background about your educational history?

      What did your school look like? Give me a scenic image please.

      Was your middle school, in the k-12 setting, as diverse at this population?

Can you tell me about any clubs or organizations you did in K-12?

How long have you been teaching science? In this school?

      What led you to select this major?

In addition, what clubs were you active in your undergrad? (And Graduate, if applicable)

What is your idea of good schooling? What does it look like?

What led you to decide that you wanted to become a teacher?

How long have you been teaching science? In this school?

What is your current teaching position?

Can you describe your current school site to me?

How is your school culture? How would you describe your school culture?

Can you give an example of a typical day at your school?

How would describe your management style?

How was the topic of diversity addressed in your teacher preparation program?

What are some of the challenges your students face in and out of the classroom?

What are the biggest challenges you face in teaching science to racially and ethnically diverse

      students?

Do you see your students of color as being different or having different needs than other students

      in your classes?

How important do you think it is for teachers to learn about the different cultures and back-

> grounds of their students?

How is a good science education going to benefit your students in their lives?

Do you believe parental or guardian support is important and what kind of support do your stu-

> dents have at home?

To what extent are parents involved in the school?

> What ways do you reach out to parent or guardians?

What are some of the areas you feel you need support in to teach science effectively to all stu-

> dents?

How prepared do you feel to meet the needs of the various learners you have?

Pre-Observation Interview Question:

What are the objective(s) of the lesson you would like me to observe?

What instructional format are you using for your lesson? (e.g., Direct Instruction, Cooperative

> Learning, Lecture, Lecture with Discussion, Small Group, etc.)

What is the student population like during this particular class?

What are the normal routines and procedures during the class?

What are the specific observable student behaviors desired during the lesson?

What do you expect the students to learn?

How do you plan to meet the needs of all of your students?*

How will you know if the objective(s) have been met? Or that student learning has occurred?

What specific teaching strategies /behaviors will be used to address the needs of all your stu-

> dents?

What led to and what follows this lesson?

When would you like to have the post- conference?

Post-Observation Interview Question:

Given what you were trying to accomplish, how do you think things went during the lesson?

If you were doing this lesson over, what would you change?

Do you think the objective(s) of the lesson were clear?

Do you think the objective(s) of the lesson were accomplished?

> What evidence do you have that would suggest accomplishment or non-accomplishment?

> What evidence do you have that would suggest that student learning did or did not occur?

> Were the needs of all your students addressed during this lesson?

Are there things you could have done to make the lesson more successful for all your students?

Did you use the teaching strategies that were discussed in the pre-conference?

If not, why not?

If so, how were they implemented?

If and how would you change your strategies if you were doing the lesson again?

Would you mind sharing sample work from a diverse student population?

> Do you think the work of all these children reflects the lesson objective?

> Please explain…

Final Question: When I transcribe this and if I have any questions, can I call you?