VOICES OF SUCCESSFUL SCIENCE TEACHERS IN AN URBAN DIVERSE SINGLE GENDER GIRLS' SCHOOL

A Dissertation

by

JYOTI MALHAN

Submitted to the Office of Graduate and Professional Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Chair of Committee,	Norvella P. Carter
Committee Members,	Abelardo Saavedra
	Gwendolyn Webb Hasan
	Kamala Williams
Head of Department,	Michael de Miranda

December 2016

Major Subject: Curriculum and Instruction

ABSTRACT

This research study was conducted as a qualitative case study of four successful science teachers of female students in a diverse, title 1, urban, public girls' school. The study was designed to hear the 'muted' voices of successful science teachers concerning their beliefs and practices when they effectively provide learning opportunities for female students of color in their classrooms.

Ethic of Care, equity pedagogy and culturally responsive pedagogy, created the theoretical framework for interpretation of the powerful narratives and storytelling that influenced this group of successful teachers. Data were collected by conducting in-depth, semi-structured interviews. Constant comparative method and narrative analysis were used to code and categorize the data. Analysis was conducted after each interview to discover emergent themes. Teachers conducted member checks throughout the process.

The findings from the study yielded the following: (1)teachers had a passion for science and incorporated ongoing scientific developments and real-life examples and applications in their teaching, (2) teachers adopted a caring, concerned, and student-centered approach to teaching, (3) teachers acknowledged certain benefits to a single-sex girls education which included fewer distractions, increased confidence and comfort level of students(5) teachers built relationships with students that encouraged students to engage with rigorous course content and meet higher expectations for performance. Themes that emerged included: care, culturally responsive pedagogy and culturally relevant curriculum.

DEDICATION

To my mother, Manjit Kaur Kahlon, I cannot thank God enough that I am your daughter, for you have not only given me life but also inspired me to live it with your unending love, encouragement and support.

To my husband Raj, for always being there for me, in rebellion and resolution.

To the two miracles in my life, my son Prajit and my daughter Piya, my inspiration and my life's

cause for celebration.

ACKNOWLEDGEMENTS

I could not have embarked on this journey without the unconditional support of Dr. Carter, who is my scholarly mother, my mentor, philosopher, and guide. Thank you, Dr. Carter for supporting me always, for lifting my spirit in moments of despair and doubt, for embracing me unconditionally and for all that you do. Through the years I have known you, I have depended on your support to carry me through in my professional and scholarly life. I cannot thank you enough ! Dr. Webb Hasan, I cannot thank you enough for your inspiring and reaffirming support to me and your faith in my ability as a practitioner and a scholar. I am indebted to Dr. Saavedra for believing in me, for staying with me and for unconditionally supporting me. Dr. Williams, I could not have completed a truthful, comprehensive and scholarly study without the support of your expertise and advice. I shall always be indebted to my committee for their shared wisdom and the extra time each one of them took in preparing and advising me throughout my journey.

I would like to thank and show my appreciation to the wonderful teachers from Houston Independent School District who enthusiastically participated in this study. They shared with me just not their perceptions and beliefs about themselves and their students but also opened their hearts and shared their dreams and disappointments. Without their enthusiasm and assistance, this research effort could never have been completed.

I also want to thank the principal of the Young Women's College Preparatory Academy for being so forthcoming with all requests for information and her unconditional support in this journey.

CONTRIBUTORS AND FUNDING SOURCES

This work was supervised by a dissertation committee consisting of Professor Norvella Carter Ph.D. [advisor], Professor Kamala Williams, Ph.D. of the Department of Teaching, Learning and Culture, Professor Gwendolyn Webb-Hasan, Ph.D., and Professor Abelardo Saavedra, Ph.D. of the Department of Educational Administration and Human Resource Development.

All work for the dissertation was completed by the student, under the advisement of Dr. Norvella Carter of the Department of Teaching, Learning and Culture.

There are no outside funding contributions to acknowledge related to the research and compilation of this document.

TABLE OF CONTENTS

Page

Page

Page

Page

CHAPTER I

INTRODUCTION

Amidst ongoing efforts to improve academic performance and eliminate academic achievement gaps given momentum by the passage of No Child Left Behind (NCLB), Congress amended Title IX regulations in 2006 to allow federal funding for single sex schools and single sex programs within public schools (Goodkind, 2013; Hayes, Pahlke, & Bigler, 2011; Hoffman, Badgett, & Parker, 2008; Mansfield, 2013). According to estimates by the National Association for Single Sex Public Education, by the 2011-2012 school year, students were attending classes at 116 single sex public schools in the U.S., with an additional 390 schools offering single sex educational programs (Goodkind, 2013). Some observers argue that the numbers may actually be much higher.

The schools in this current wave have been referred to as "second generation" single sex schools (Mansfield, 2013). Single gender private and parochial schools have been an integral part of American education for generations. What distinguishes the current generation of single sex schools is that they are designed to address educational inequalities and expand learning opportunities with the aim of improving achievement for students that have traditionally been underserved by public education.

Efforts to improve lagging academic achievement and low graduation rates among African American boys have been a major force in the proliferation of single sex public schools (Patterson, 2012). However, as observed by the authors of a joint report

by the National Women's Law Center and the NAACP Legal Defense and Educational Fund titled *Unlocking Opportunity for African American Girls: A Call to Action for Educational Equity*, an absence of data combining gender and race has produced the erroneous assumption that "all girls are doing fine in school" (NWLC & LDF, 2014, p. 1). Although girls per se have higher graduation rates than their male peers, girls of color graduate at substantially lower rates than White girls or boys. High school graduation rates for African American girls fall below the national average in most states, with unfortunate economic consequences for their future lives.

The most striking gap based on race and gender is in STEM (science, technology, mathematics, and engineering) education, where girls of color are seriously underrepresented in STEM classes and careers (Farinde & Lewis, 2012; NWLC & LDF, 2014; Perry, Link, Boelter, & Leukefeld, 2012; Pinder & Blackwell, 2014; West-Olatunji et al., 2010). Two major causes have been implicated in this situation: (1) scarcity of STEM courses in economically disadvantaged schools where students of color are disproportionately enrolled, and (2) stereotypes associated with both race and gender that discourage minority girls from STEM education (Farinde & Lewis, 2012; NWLC & LDF, 2014). The severe underrepresentation of girls, especially girls of color, in STEM education, is often cited by advocates of single sex education, who argue that girls may be more inclined to study mathematics and science in single gender programs that support them in developing identities as scientists. From this standpoint, single sex classrooms provide girls with a learning environment where they feel free to express themselves with support from teachers and peers. Regardless of gender, race, ethnicity,

or social class, students respond to good teaching, a caring, supportive classroom environment, and rich and varied learning opportunities.

Background of the Problem

Single Sex Education

Single sex schools have been utilized in the history of education for very different purposes. For example, so-called "first-generation" single-sex schools came into existence as male-only institutions to educate and make them capable (Blount, 2005; Lee, 2002; Meyer, 2008; Riordan, 2002; Salomone, 2003; Tyack & Hansot, 1992). It was much later that all-female academies were born to prove that women, too, were capable of learning and also deserved a share of societal attention in the education sphere (Blount, 2005; Tyack & Hansot, 1992). Most single gender schooling was reserved for the "financially and the intellectually well endowed" (Meyer, 2008, p. 12).

In the United States, the legal aspect of single-sex provision in public schools was unclear until 2006. A number of initiatives at the regional level were introduced regarding single-sex schooling like the Single-Gender Academies Pilot Program in California, initially intended to provide single-sex schools but subsequently focussing on providing single-gender classes within coeducational schools. The educators noted that the initiative was "working for the girls" but that "boys were becoming more troublesome" (Herr & Arms, 2002). Issues were raised about the lack of attention to challenging gender stereotypes and about the fact that the intervention was driven by the desire to improve test results rather than to foster gender equity (Herr & Arms, 2002). As

a result the number of California districts providing single-sex classes reduced significantly.

To improve academic performance and eradicate academic achievement gaps, Congress amended Title IX regulations in 2006 that allowed federal funding for single sex schools and single sex programs within public schools (Goodkind, 2013; Hayes et al., 2011; Mansfield, 2013). As a result there was a proliferation of schools that were single gender especially in the public school arena.National Association for Single Sex Public Education estimated that as of the 2011-2012 academic year there were 116 single sex public schools in the U.S., with additional 390 schools offering single sex educational programs (Goodkind, 2013). The Feminist Majority Foundation noted that from 2007 to 2009 the number of single sex schools grew to 1,000 (Goodkind, 2013).

Second Generation Single-Sex Schools

Single gender private and parochial schools have been part of the educational landscape for generations. Indeed, the notion of single sex education often invokes images of elite private schools with strict selection criteria and students from affluent families. What distinguishes the current generation of single sex schools is that they are being advanced to address educational inequalities and expand learning opportunities with the goal of improving achievement for students that have traditionally been underserved by public education. These schools have been referred to as "second generation" single sex schools (Mansfield, 2013).

In recent years "second generation" single-sex schools have reinvented themselves to combat the impact of societal prejudices on male and female students

alike, not "as a reactive counterweight to exclusion but as an affirmative vehicle for inclusion and an antidote to social disadvantage" (Salomone, 2003, p. 9). For example, Detroit and Milwaukee school districts attempted to establish single-sex academies for boys of African heritage yet met with rigorous resistance. Proponents of the Afrocentric academies cited the "failure of the civil rights agenda to improve the lives of poor innercity residents" to legitimize the establishment of the all-boys schools (Riordan, 2002, p. 52). Parents of female students rejected the schools due to the legacy of male privilege associated with all-male academies while overall some members of the Black community were alarmed by what they considered a resurgence of racially-segregated schools into the policy debate (Riordan, 2002; Salomone, 2003). The establishment in 1990 of *The African American Immersion Schools of Milwaukee* was controversial, as well. However, unlike the Detroit schools, the Milwaukee programs continue to be reviewed and renewed regularly. Later, during the 1990s, attempts to establish single-sex schools for girls also met threats of litigation from civil rights groups. The most famous case was the Young Women's Leadership School in New York City. Besides offering a rigorous academic program, proponents of the New York all-girls school claim to offer a unique atmosphere – impossible to capture in a coeducational setting – that is essential to its success with inner-city girls (Jost, 2002; Meyer, 2008; Salomone, 2003).

The issue of separating students by gender remains controversial. Arguments based on allegedly "hardwired" gender differences in learning have been debunked by numerous studies (Eliot, 2013). In fact, some advocates of that perspective have walked back their claims (Patterson, 2012). The American Civil Liberties Union (ACLU)

claims that single gender schools and classrooms violate the equal protection clause of the constitution (Patterson, 2012). The American Association of University Women (AAUW) initially supported same sex education on the grounds that single sex classrooms promoted leadership development and achievement among girls (Spielhagen, 2011). However, the AAUW later reversed that position, concurring with the ACLU that separate treatment of students is likely to be unequal.

Prior to the changes to Title IX there were several legal cases challenging the establishment of single sex schools on the grounds that they represent a violation of civil rights (Mansfield, 2013). According to Mansfield, the most high profile case involved the Young Women's Leadership School in New York City, designed to provide low-income, minority girls with a rigorous academic program and high quality learning experiences they were unlikely to find in overcrowded and under-resourced neighborhood schools. Advocates claimed that the unique learning environment would be impossible to replicate in a coeducational setting. The Ann Richards School for Young Women Leaders in Austin, Texas, has consistently been one of the highest performing schools in the state (Patterson, 2012).

Efforts to improve academic achievement and high school graduation groups for African American boys have been a major force in the proliferation of single sex public schools (Patterson, 2012). Proponents of single sex education for girls often cite the severe under-representation of girls, particularly girls of color, in STEM education. Girls may be more likely to study mathematics and science in single gender programs that support them in developing identities as scientists. To some scholars while the

motives may be noble, the practice of separating disadvantaged students by gender runs the risk of creating "academic ghettoization" that further marginalizes the students they were intended to help (Mansfield, 2013). They are not against single gender education per se but rather their point is that the practice must be implemented in ways that ensure, in the words of Pedro Noguera, "the young people targeted for such services are actually being helped and not marginalized and isolated by providers who claim they want to help" (as cited in Mansfield, 2013, p. 5).

A common uncontroversial position on single sex education is that it represents an option that can be advantageous for some students depending upon the child and the available schools (Patterson, 2012; Spielhagen, 2013). Much of the existing research on the effectiveness of single sex education has been criticized for methodological flaws, notably failing to account for the self-selection of students into same gender schools. Recent studies have sought to correct these weaknesses and provide deeper insight into the attitudes of teachers, parents, and students.

According to Hayes et al. (2011), a major flaw in research on single gender education is that studies fail to control for selection bias and peer effects. To address this problem, the researchers compared the academic performance of girls in a public single sex middle school to two groups: girls who applied to the school but were not chosen by lottery, and girls attending a coeducational magnet school. The ethnically diverse sample of girls was followed over a three-year period. At the end of the first year (6th grade) the girls at the single sex schools outperformed their peers at both coeducational schools. However, despite the assumption that the lottery would produce

two equivalent groups, the girls admitted to the single sex schools performed significantly higher in fifth grade than those not admitted. Therefore, Hayes et al. analyzed data from a subsample with equivalent fifth grade achievement. The findings still pointed to superior performance for the students attending the all-girls school.

In fact, the single sex school had the highest achievement scores of all non-magnet schools in the district. Hayes et al. (2011) ascribed this to the superior academic performance of students who entered the school. After controlling for prior academic performance the students at the all-girls school and the coeducational magnet school had comparable standardized test scores in sixth and seventh grade. The overall findings suggested that peer quality and selection effects exert a stronger impact on girls' academic achievement than whether they attend single gender or coeducational schools.

Pahlke, Bigler, and Patterson (2014) investigated attitudes toward all-girls single gender education in a survey of 589 middle school students, 281 mothers of middle school students, and 115 teachers from a large metropolitan school district. The students included 398 girls attending an all-girls public middle school and 96 girls and 95 boys attending coeducational public schools. An instrument was created for the study entitled *Rationales for All-Girls Schools,* covering four rationales: (a) gender differences in learning, (b) gender differences in interests, (c) ingroup preferences, and (d) gender discrimination.

Not surprisingly, support for all four rationales was stronger among the students, teachers, and parents connected with the all-girls school. Pahlke et al. (2014) were concerned with support for the three essentialist rationales implying that girls and boys

differ in learning, interests, and peer relations. They found teachers' endorsement of brain-based gender differences in learning disturbing given that these beliefs are not supported by neuroscientific research (Eliot, 2013). Pahlke et al. (2014) also suggested that teachers who endorse those beliefs might be reinforcing gender stereotypes. Additionally students who concur with essentialist rationales may be limiting their own activities and opportunities according to gender stereotypes. In earlier research, Patterson and Pahlke (2011) found that this actually undermined girls' academic achievement.

Finally, Pahlke et al. (2014) suggested that gender segregated environments may perpetuate gender stereotyped social relationships and behavior. Although the stakeholders associated with the all-girls school also expressed stronger agreement with gender discrimination as a rationale for single sex education, they endorsed this to a lower degree than the more essentialist reasons. Pahlke et al. proposed that this may be due to evidence of increasing academic achievement which is equal to if not superior to boys. An unexpected finding was that there were no gender differences in support for the four rationales.

STEM Education

Since the inception of second generation single-sex schools, critics have argued that separating students by gender (and often race) runs the risk of reinforcing cultural stereotypes and further marginalizing students that have traditionally been underserved by the educational system. Indeed, even Mansfield (2013) has expressed this perspective. Mansfield (2013) is highly critical of essentialist arguments for single

gender education, which includes claims that have been debunked scientifically (Eliot, 2013). Essentialist views seem to be prevalent among parents, teachers, and students who are more supportive of single-sex education (Pahlke et al., 2014). At the same time, schools such as the YWLS demonstrate how gender stereotypes and beliefs that limit girls' learning opportunities can be successfully challenged in an inquiry oriented, enriching, empowering learning environment (Mansfield, 2013, 2014). This is the type of learning environment in which all students thrive (Bonner, 2014; Ladson-Billings, 2009). It also represents an ideal milieu for encouraging disadvantaged young women to pursue STEM education (Adams, Gupta, & Cotumaccio, 2014).

In a study of low-income sixth graders, Perry et al. (2012) found that girls overall had higher school self-esteem and more favorable attitudes toward science than their male peers. The attitudes of African American and Latina girls were comparable to White students while African American and Latino boys held more negative attitudes than White boys or girls of any ethnic group. While on the surface the findings seem positive for girls of color, Perry et al. noted that their low-income status could easily limit future opportunities for science learning. The findings *Unlocking Opportunity* confirm that assumption (NWLC & LDF, 2014). All the students were participants in TRY-IT!, a project designed to help students apply technology for understanding biomedical science, the type of innovative program students in low-income schools typically lack (Perry et al., 2012).

West-Olatunji et al. (2010) focused on school counselors, who often act as gatekeepers to learning opportunities in math and science for students from underserved

groups. Therefore, their attitudes could help or hinder the pursuit of STEM studies by girls of color. As part of a longitudinal study exploring the attitudes of teachers, parents, and school counselors toward low-income African American girls as mathematics and science learners, West-Olatunji et al. interviewed three school counselors (two White women and one African American woman) from economically disadvantaged elementary schools with predominately African American students.

Only the African American counselor was aware of the marked cultural disparity between the school curriculum and the realities of the girls' lives (West-Olatunji et al., 2010). By comparison a second counselor was more concerned with maintaining discipline in the classroom than involving students in active, experiential learning. The most alarming finding was that one counselor exhibited a complete absence of cultural awareness and seemed unable to envision low-income students pursuing higher education beyond an associate degree. According to West-Olatunji et al., all three counselors showed genuine caring for their students but despite good intentions were likely to perpetuate the inequities that hold low-income back girls of color.

The Lang Science Program at the American Museum of Natural History (AMNH) is an example of a program designed to support adolescent learners from groups traditionally underrepresented in STEM fields. Adams et al. (2014) conducted a focus group study with six young women who had been part of the program to explore the nature of their experiences in the program, and their successes and challenges in science-related pursuits since graduation. The ethnically diverse group included three African American women, one Latina, one South Asian, and one Caucasian.

According to Adams et al. (2014), four key themes captured the connection between the young women's long-term participation in the Lang Program and their STEM-related identities and career paths: *Building a collective identity, Belonging in a physical space, Broad exposure to science topics and careers,* and *Moving from the museum to college.* Adams et al. viewed the first theme as a marked contrast to the belief that being a smart, high-achiever isolates urban students from their peers. Being with others who shared their interests and goals provided the young women with a safe space to "be a nerd" (p. 16). Sharing "cool" and exciting experiences fostered a strong sense of collective identity and belonging that not only motivated the young women to stay with the program but even more important, helped them to overcome obstacles and self-doubt later in college. The museum was both a physical space and a community of scientists; being part of this special community imbued them with a sense of empowerment.

The final theme, the transition from the museum to college is especially pertinent to women and minorities who often face a hostile climate in STEM disciplines (Adams et al., 2014). Many drop out of STEM programs (Farinde & Lewis, 2012; NWLC & LDF, 2014). According to Adams et al. (2014), the young women's responses implied that long-term out of school STEM programs "can provide young women of color with key identifying experiences to help them persevere in college and beyond" (p. 19).

STEM Teachers

Bonner (2014) examined the practices of successful mathematics teachers in classrooms populated by traditionally underserved students, noting that neither Ladson-

Billings (2009) nor other proponents of culturally relevant pedagogy focused on how culturally responsive teaching would be implemented in a mathematics classroom. In describing how culturally relevant lessons were embedded in an American History course, Sampson and Garrison-Wade (2011) noted the logical fit between the subject matter and African American culture. It is much more challenging to create culturally relevant lessons in a subject like mathematics.

A hallmark of the three successful teachers, "who inspired passion in the community" was that they helped children gain knowledge and confidence in mathematics while valuing their cultural identity (Bonner, 2014, p. 381). A veteran African American teacher in a predominately Black, low-income school infused her lessons with music, chanting, dance, and recitation. She used a variety of teaching strategies combined with high expectations and high standards for student performance, producing students who consistently demonstrated progress and achieved high scores on state assessment tests.

The second teacher, a second career White teacher taught middle school students (primarily Hispanic and poor) who had failed the state mathematics achievement test at least once (>50% more than once) and were considered "at risk" for repeated failure (Bonner, 2014). Setting high expectations, the teacher created a learner-centered, "comfortable" and "family-like" atmosphere designed to boost the students' self-esteem as well as their math performance (p. 385). The third teacher taught at an all-girls middle school where most students were Latinas from low-income families. Despite their disadvantages the students achieved high passing rates on the state assessment and

many girls enjoyed gains in mathematics since they entered the school. Culturally responsive teaching, high standards, technology integration, and lessons that called on students to display knowledge through a variety of techniques, including speaking, writing, presenting, and demonstrating as well as providing students with opportunities to discuss and solve problems with peers contributed to a classroom that "provided a sense of empowerment and strength that many of the girls had not experienced in a mathematics classroom (p. 385).

Personal Story

I was born in India in a traditional and conservative north Indian family. My father was an army officer in the Indian Infantry and my mother although a certified teacher stayed at home as my father's job resulted in frequent transfers from one corner of the country to another. My two brothers and I grew up in army cantonments until I was twenty one. My parents then moved to Canada and my mom now lives in Vancouver.

Our frequent moves or postings as we called them at the time took a toll on my family at the time as it caused a lot of heartbreak every time. With every move we lost friends that we had made, had to leave teachers that we liked, move out of homes that we had gotten used to. In reflection though I think it made us all so much stronger as individuals. We learned to adapt to new environments, new people, new language and new foods. We adapted, adopted, absorbed and assimilated the habits of those around us. It made us appreciate the unity and the diversity that exists in India. I now think that those experiences that seemed hardships then were truly privileges that enriched and

broadened our minds and prepared us for our future lives. All three of us moved to America on our own merit and at different times in our lives. We are now proud residents of the most beautiful country in the world. We are proud to call America our home.

It takes courage to make life changing decisions that break generational patterns. In 2003, when I decided to move to Houston to take a job as a teacher in one of the most challenging school districts in the nation, everyone thought it was going to be short lived and temporary. I had no idea of the struggles our kids face in poverty ridden school districts. This world of young kids from broken homes, single moms, incarcerated parents, daily threats and insecurities, abject poverty broke my heart. This could not be the America we read about when growing up, the land of opportunity and dreams did not seem possible for my students. I was in anguish for myself and for my students, at an impasse, as this affected both our futures.

One of the first things I decided was to not give up, no matter what the challenge would be. Although I was certified to teach Science and English, the district offered me a position as an ELA teacher at the High School. I was assigned 10^{th} grade Pre AP English. I started in February so the kids were used to a long term substitute and had a relationship with her. I realized that they did not respect me as they did not trust this new international teacher. One of the first things I did was befriend the substitute in my class and gaining her trust as my friend. We still talk to each other to this day. She became my strongest ally, she was a graduate of that same high school, understood the sentiments of kids and the community, and was the biggest force in helping me acclimatize to the

culture and norms of a new campus, culture, country and society. This substitute teacher at Forest Brook High School was my mentor and guide, as I began my new life in this new land. With her support I was able to win my student's trust. The next challenge was I had no teacher resources. No one on the campus had any clue where they could be. They said the recent flood destroyed everything and most materials were thrown away. I decided to contact the publisher, shared the loss of teaching materials due to the flood and was able to get them to mail resources for my class. Grit, tenacity, resiliency, determination, call it what you may, I had decided I would not quit. The campus assigned me to teach five different classes the following year that included, ESL, Dual Credit, AP English Language, 10th grade Pre AP and SAT prep. I was excited that I was being asked, as I was told that I was the only teacher certified, qualified to do so. The first year with these preps was overwhelming to say the least, as I was up all night, several nights that year creating lessons for these different courses. My kids and my husband moved to Houston and joined me from India still apprehensive about the longevity of my job and our stay in the US. The scores for the TAKS test at that time came back and my students were the highest scoring on the campus. I was so proud of them, the campus wanted me to teach English in summer school to kids who did not pass, as passing the same on the 11th grade state test was required to graduate from high school. In a short period of a little more than one year, I was the teacher that the campus and kids could count on. I could not be more elated, more proud of myself and my kids. Often parents would ask, was I certified, what was keeping me from moving to another school district. Their question intrigued me so much that I took multiple certification

tests and passed all of them. ETS approached me to write items for the certification exam due to my eleven licenses and the teacher prep programs asked me to hold a Saturday session to help new teachers prepare for the state licensing exam. Why would I leave a school that taught me so much, I taught at the same high school, teaching the five different courses of my own choosing, for five consecutive years. The high school was merged with another high school in the district due to dwindling enrollment caused by various factors, and I decided to move on that year. I had also completed a master's degree in educational administration and was offered a position as a magnet coordinator at Booker T Washington High School for Engineering Professions.

The world of magnet schools was as new to me as being a teacher was five years ago in North Forest ISD. I absorbed each word, each story, every fact about this new unique program. I was tasked with moving enrollment numbers up in the magnet program. I researched this magnet school, it's glorious past years, its astounding success with preparing kids to go to the best colleges, and compared it to magnet schools in the district and in the nation. I sought past and current students, parents, teachers and counselors, talked to them to understand what was a successful magnet school. As a result of these in depth, astounding conversations with them, I created a strategic plan to recruit kids. I was nervous, not sure if it would work. The plan was demanding and needed me to live and dream marketing my program, sometimes alone and at other times with the help of key parents, teachers and students. I was able to increase the magnet enrollment in one year by 87%. We were excited. The teachers and parents participated in welcoming the new kids. We revived the alumni, they started an annual fund raiser for

the current students that is held until today. We were on track. Two years later, I presented at the National Magnet Schools of America Conference in Florida, the story of my magnet program and its new revival.

A few months later in April, I was approached by the district to open a unique 6-12 magnet school for girls. I was offered the dean of instruction position and had to open the school with the principal in 5 months. We were in the Houston Chronicle for low enrollment and not attracting enough girls. The challenge was clear, if we did not have students, we would not open school in August. By April, in a little over two months, we had a waiting list of girls applying to this unique magnet. In reflection, I think my previous job was preparation for this. I embarked on a crusade to market my unique program and get young girls excited about a girls school focused on Engineering, Robotics, and leadership development. As the dean of instruction I pushed girls in Math and the 6th grade girls in Math Pre AP that took the 8th grade math test were the highest performing group in Houston ISD. My girls broke the stereotype that girls do not do well in Math!

While in my second year at the Young Women's College Prep Academy I was approached to be the founding principal of another unique medical magnet school, the first and only one of its kind in the nation. I was offered the position on April 15, 2013 and charged to open the school in August 2013. The challenges were many and enormous. I had to recruit students for this magnet school when the application process for the magnet schools in our district was already over, I had to recruit staff when most teachers had signed contracts. The task of parent buy in included assuring parents that

the curriculum would be rigorous and Pre AP, the teachers would be excellent, though I had none, our campus in the third ward would be secure, though the area around is not. The same challenges existed when I had to convince my stellar future staff that I was recruiting and was nothing less than the best. I had to convince each of them to buy in to my new school and join my team. The campus that existed at Ryan had a total of 247 students in May 2013 and the campus was 85 % Black. We opened in August with 249 students in 6th grade and the demographics changed to 45 % Hispanic, 33% Black and the rest a mix of Anglo and Asian. My aggressive city wide recruiting efforts paid off, and my campus attracted students from 97 elementary schools in the first year. We received a rating of A+ in our first year from Children At Risk. In the second year we received more than 1100 applications and in the third year the total applications received were approximately 2300. The school is a 100 % open enrollment campus with no screening, pre requisite requirement, matrix, entrance test or interview. The selection is based on a random lottery conducted by the School Choice office. In our second year we were one of four middle schools in HISD to receive all distinctions and were in top 25 % of all schools in the state of Texas for our STAAR scores. We have attracted a lot of local, state and national attention in a very short time, and never in my dream did I dare to think I would open a school such as this. The miraculous journey of the school I founded has left me speechless, and despite the trials and tribulations this is my biggest honor, my biggest award as a school principal in the public school arena. The wait list of my school is third longest in Houston ISD, and we have only graduated our first group this year.

My family, my two kids and my husband have been the pillar of support, proud and loving in every moment of this journey. I too am proud of both my kids, one a junior in college and one in high school. I hope that they will value my story, my journey to America and the opportunities that our country has to offer. I hope that they will work hard, give back and be proud citizens of our nation. I am not sure what the future holds, but I hope that I will be able to impact kids until I live, and continue to be a lifelong teacher.

Statement of the Problem

The emphasis on boys in the literature on racism and academic achievement gaps has led some scholars to apply terms such as "voiceless" and "nothingness" to the experiences of girls of color (Friend, Hunter, & Fletcher, 2011). Despite the upsurge in interest in single gender education, there are few studies that focus on teaching and learning in all-girls public schools and minimal evidence of whether these schools successfully serve students of racial and ethnic minorities. In fact, much of the research on the effectiveness of single sex education has been criticized for methodological flaws, in particular, failing to account for the self-selection of students into same gender schools (Hayes et al., 2011). Recent studies have endeavored to correct these weaknesses and provide deeper insight into the attitudes of teachers, parents, and students. Spielhagen (2011), who conducted an exploration of middle school teachers in same-sex academies, noted a dearth of research soliciting teachers' perspectives.

In a study designed to elaborate the practices of highly successful mathematics teachers of traditionally underserved female students, Bonner (2014) turned to

community members to nominate teachers they deemed successful. A disturbing finding was that successful mathematics teachers in low-income schools seemed to be scarce. Girls in urban schools often encounter teachers who reinforce gender and racial negative stereotypes about succeeding in STEM disciplines (NWLC & LDF, 2014). In many schools, they have no exposure to high quality experiential learning opportunities.

Findings derived from analyses of multiple datasets (including national and longitudinal surveys) reveal that from high school to college and beyond, African American female students have fallen behind in science and mathematics (Farinde & Lewis, 2012). Illustrating how racial comparisons obscure disadvantages for Black female students, African American girls and young women outperform African American male students but lag behind White students of both genders.

Critics of same sex education argue that segregating students by gender has the potential to reinforce and perpetuate rigid, limiting, and detrimental racial and gender stereotypes (Eliot, 2013; Goodkind, 2012; Patterson, 2012). In contrast is Mansfield's (2014) description of classrooms at the Young Women's Leadership School (YWLS) in which the teachers engaged students in animated discussions about the "pseudoscience of females' supposed inherent lack of ability in STEM fields" (p. 408). The students, primarily low-income Latina and African American girls, were found to be regularly engaged in challenging, inquiry oriented, hands-on mathematics and science activities. The YWLS is located in Texas, as is the Ann Richards School for Young Women Leaders in Austin, which has consistently been one of the highest performing schools in the state (Patterson, 2012). If studies of teachers at single-sex schools are few, studies

that focus on science or mathematics teachers in all girls' schools are virtually nonexistent.

This study was conducted at the Young Women's College Prep Academy, an all-girls school serving students in grades 6-12 and located in the Houston Independent School District (ISD). The student population at this girls school comprised of 54% African American, 39% Hispanic, 3% Asian, 2% White and 1% other. 70% of the student population was on free and reduced lunch. Thus this was predominantly a campus with girls of color with majority of the students from economically disadvantaged backgrounds. Regardless of setting, there is widespread agreement that good teacher-student relationships are vital to students' success, especially students of color (Douglas, Lewis, Douglas, Scott, & Garrison-Wade, 2008; Evans, 2013a, 2013b, 2014; Roberts, 2010; Shaunessy & McHatton, 2009; Wilkins, 2014). Knowledge of the perspectives and practices of successful science teachers at an urban girls' school has the potential to increase the representation of young minority women in STEM disciplines as well as fill a gap in the literature on second generation single sex schools.

Purpose of the Study

The purpose of this narrative study is to explore the perceptions, attitudes, and beliefs of highly effective science teachers of urban female students of color at an all-girls academy. The school is a Title I school in the Houston ISD, the seventh largest school district in the U.S. and the largest school district in Texas. Studies of effective teachers have often focused on reading and mathematics, which have traditionally been the main measures of student achievement. Less attention is given to science, even

despite recognition of the increasing importance of STEM disciplines in a technology-driven world, and in particular, the underrepresentation of girls, and minorities in science careers. Individual, in-depth, semi-structured interviews were conducted with four teachers nominated by their principal as highly successful teachers based on their annual appraisals and student performance scores. The interviews illuminated the personal and professional characteristics of exemplary science teachers of girls and the strategies they employ to maximize learning opportunities for all their students and thus promote intellectual, social, and emotional growth and development that helps them succeed in school and beyond.

Significance of the Study

Through a discourse on effective science teachers in single gender girls' schools, this research study can add relevant insights that have been traditionally excluded in the research of effective teaching of science to girls in single gender enviromennts. The study seeks to increase the knowledge base about the perceptions, attitiudes and beliefs of highly effective science teachers of urabn female students of color in all girls' schools. As a result, the impact of effective science teaching on student academic achievement of female students of color in a large, successful, urban school district can be acknowledged and appreciated. Also, it will provide educators with insights that will guide their professional development.

Research Questions

In *The Dreamkeepers*, Ladson-Billings (2009) described the qualities of successful teachers of African American students who designed stimulating and

effective lessons, and provided their students with a variety of learning experiences in a caring and supportive environment. This study focused on the beliefs and practices of science teachers who successfully promote high achievement in students of color at an urban all-girls academy. This study was guided by the following research questions:

Q1. How do successful science teachers in an urban single gender girls school describe their personal characteristics that contribute to their students' success and achievement?

Q2. How do successful science teachers in an urban single gender girls school describe their effective acts of teaching in the classroom ?

Q3. How do successful science teachers in an urban single gender girls school describe factors that impact their students' achievement ?

Theoretical Framework

Teacher quality has been a prominent topic for four decades but at the same time it can elude a precise definition. Effective urban teachers are skilled classroom practitioners capable of adapting their teaching strategies to the needs of diverse groups of learners to ensure that all students have opportunities to be active participants in learning. These teachers combine pedagogical expertise with subject matter mastery and a caring and commited attitude toward their students. Among the philosophical principles that guide the beliefs and behaviors of successful teachers of urban students are care ethics, equity pedagogy, and the related concept of culturally responsive pedagogy.

Care Ethics

Noddings's (2012) work is often invoked in descriptions of caring teachers (Roberts, 2010; Shaunessy & McHatton, 2009; Tosolt, 2010). Relationships are fundamental to care ethnics (Noddings, 2012). Some relationships, such as teacher and student, are inherently unequal, but they are built on the actions of both partners toward creating and sustaining care.

The paramount quality of the carer is being *attentive.* A caring teacher is invested in listening to the *expressed* needs of the student as opposed to the student's needs as presumed by the educational institution and the prescribed curriculum (Noddings, 2012). This point is important in understanding the nature of good teacher-student relationships because teachers and students may have different conceptions of caring (Shaunessy & McHatton, 2009; Tosolt, 2010). For the student to perceive the relationship as caring, the teacher's actions must be matched with the student's needs. Listening is essential for meeting students' emotional and intellectual needs (Noddings, 2012). According to Noddings, good teachers should have discretion in exercising their moral and professional judgment in responding to students' needs. A caring relationship must be grounded in mutual trust and respect (Douglas et al., 2008; Noddings, 2012; Shaunessy & McHatton, 2009; Wilkins, 2014).

Caring involves cognitive as well as emotional dimensions (Noddings, 2012). Caring also means that teachers are competent. In earlier work, Noddings stressed that teachers should be able to draw on all the humanities in ways that will enrich their teaching, and as a result, the intellectual, social, and cultural lives of their students.

From Noddings's perspective, creating a climate of care and trust should be a top priority for all educators and policymakers. In response to teachers who view a climate of care as extraneous to covering the prescribed curriculum and promoting academic achievement, Noddings declares that a climate of care is the foundation for good teaching. Cultivating and sustaining a climate of care is essential for high quality teaching and learning.

Equity Pedagogy

McGee Banks and Banks (1995) elaborated the concept of equity pedagogy at a time when public schools were becoming increasingly diverse and reducing achievement gaps based on race, ethnicity, and socioeconomic status (SES) became a top priority for education reform. Their definition of equity pedagogy, which recognizes that a classroom designed to help diverse groups of students gain the knowledge and skills needed to be successful members of "a just, humane, and democratic society" invokes John Dewey's vision of classrooms as laboratories for democracy.

Teachers who embrace equity pedagogy create classrooms based on social constructivist principles (Vygotsky, 1978). Students are actively engaged in constructing knowledge while the teacher acts as a facilitator of knowledge as opposed to an authority figure who imparts knowledge on passive students (McGee Banks & Banks, 1995). Equity pedagogy is distinguished from other constructivist teaching approaches by the awareness of power dynamics within and outside of the classroom. McGee Banks and Banks view equity pedagogy as *transformative.* They assert that it must be considered in the context of school and classroom power structures that

perpetuate unequal treatment of students. Tracking, for example, plays a prominent role in denying Black girls access to the advanced mathematics courses requisite for pursuing STEM education (Campbell, 2012). Teachers' stereotypical beliefs influence their recommendations of students for advanced mathematics courses to the disadvantage of girls and students of color. According to McGee Banks and Banks (1995), teachers must engage in critical reflection and analysis to transcend these beliefs.

Social justice pedagogy is an expansion of equity pedagogy. Beyond dedication to an abstract ideal, Evans (2013a) emphasizes that translating the rhetoric of social justice into action entails providing all students with high-quality learning experiences with special attention to expanding learning opportunities for students from traditionally underserved groups. Moreover, a social justice orientation requires that teachers value diversity and oppose all types of discrimination.

Culturally Responsive Pedagogy

Including elements of students' cultures in their teaching helps teachers meet the needs of culturally and linguistically diverse students, especially students that have traditionally been underserved or marginalized by the educational system. According to Gay (2000), culturally responsive teaching includes the following characteristics: (1) acknowledging the cultural heritages of different ethnic groups, (2) bridging the students' home and school experiences through lessons that are relevant to their lives, (3) employing a wide variety of instructional strategies that are associated with different learning styles, (4) teaching students to know and appreciate their own as well as others'

cultural heritages, and 5) incorporating multicultural information into all subjects and skills taught in schools.

Although the two concepts are related, culturally responsive pedagogy differs from multicultural education in that it must be relevant to the cultures of students who populate the particular class (Rychly & Graves, 2012). According to Sampson and Garrison-Wade (2011), the challenge for teachers is integrating culturally relevant lessons into the classroom curriculum in ways that appeal to all students. To correct inequalities teachers must be aware of individual differences. A potential danger in adopting culturally relevant teaching, which is equally pertinent to teaching in single gender classrooms, is inadvertently perpetuating cultural stereotypes. Teachers must be attuned to the fact that within-group differences consistently surpass inter-group differences; there is much greater overlap in the learning preferences of children of different racial, ethnic, and gender groups than there are differences between groups (Eliot, 2013; Schmeichel, 2012).

Rychly and Graves (2012) delineated four teacher qualities that are critical for enabling teachers to successfully design and implement culturally responsive pedagogy. First, teachers must be caring and empathetic. To Noddings (2012), caring and empathy are crucial for all good teachers. Second, teachers are reflective regarding their beliefs about people from other cultures (Rychly & Graves, 2012). Third, teachers are reflective toward their own cultural perspective. Fourth, teachers must be knowledgeable about other cultures.

The belief system guides the teachers and motivates them acting as a compass (Pang, 2005). The trust and relationship between the student and the teacher is an integral part of teaching and preparing students of color in classrooms for academic success (Rychly & Graves, 2012). Multicultural education is built on a foundation of care centered approach, the establishing of trusting relationships and understanding and teaching within the sociocultural context of students. It is a relationship-centered and culture-centered framework in education (Pang, 2005). In urban public schools, students bring with them a plethora of languages, backgrounds and cultures, thus culturally relevant teaching and pedagogy is integral to their cognitive as well as emotional development. Care-centered teaching combines caring, culture, and community in the classroom and school. Research on teacher care affirms that students experience positive school outcomes and success in the areas of attendance, attitude, self-esteem, effort and school pride, if they believe that the teachers care for them (Noddings, 1995).

Research Method

This qualitative study focused on four successful science teachers of female students at a Title I second generation all-girls academy serving students in grades 6-12 and located in a large, urban school district. By focusing on STEM teachers of economically disadvantaged girls of color, this study gives expression to the perspectives and practices of teachers of a group that has traditionally been "voiceless" (Friend, 2006). The main data sources are the in-depth semi-structured interviews conducted with each participant and coded and categorized through constant comparative analysis and narrative analysis. Consistent with the research design,

multiple data sources are utilized. In this study, varied sources were used to identify highly successful science teachers. The participants were identified via four key sources: (1) teacher (type), (2) years of service, (3) student performance data for the last three years, and (4) principal recommendation.

The study is constructivist (or interpretivist) in nature. According to Creswell (2007), this paradigm allows researchers to inductively construct meaning by recognizing the rich and varied experiences of people's lives. Rather than simplify data as in quantitative research, a constructivist qualitative interpretation of data strives to elaborate the complexity of views and experiences that characterize commonalities and individual differences among the participants.

According to Lindlof and Taylor (2010), narrative can be used to give visibility to perspectives that have always existed but have been overshadowed by the dominant culture. Narrative gives "voice" to the marginalized "other" through storytelling (or counter-storytelling), dialogue, autobiography, and parables. Unlike quantified research which reflects an objectivist paradigm, narrative embraces experiential knowledge and provides context for understanding, feeling, and interpreting events (Ladson-Billings, 1995). With much of the national conversation on girls and student achievement focused on standardized assessment, narrative provides a valuable channel for teachers of low-income female students to provide insight into the nature of successful science classrooms, the learning opportunities offered to students, and the interactions between teachers and students that contribute to building a positive learning environment.

Data Collection

The site of the study was the Young Women's College Preparatory Academy in Houston, Texas. Data on the demographic composition of the school and the Houston ISD is provided in the appendix. By definition, this study is focused on a select sample of teachers. In addition to their success in the classroom as documented by the three data sources, the teachers were chosen for their ability to articulate and elaborate their views and experiences, a key feature of qualitative research (Patton, 2002). The teaching practices of the four exemplary teachers were aligned with the characteristics of successful teachers outlined by Ladson-Billings (2009). The initial nominees were contacted to explain the nature of the research study and asked that they sign the consent form if they were interested in participating. The primary source of data was the one-on-one in-depth interviews. The interviews were conducted at a mutually acceptable place and time. The participants signed a consent form prior to having their interviews audiotaped for transcription. Each interview was semi-structured but conversational and lasted approximately 60 – 90 minutes. Follow up interviews were conducted later.

Definition of Key Terms

The following terms are defined for the purpose of this study:

Successful/effective teacher: A teacher who is committed to the belief that all students can be successful learners and who possesses a repertoire of teaching strategies that that enables her or him to design and deliver lessons that meet the needs of diverse groups of students. Successful teachers are able to create a community of learners in the

classroom, make all students feel they belong and are cared for, and have positive interactions with parents and community members (Ladson-Billings, 2009).

Equity pedagogy: Equity pedagogy encompasses "teaching strategies and classroom environments that help students from diverse racial, ethnic, and cultural groups attain the knowledge, skills, and attitudes needed to function effectively and help create and perpetuate a just, humane, and democratic society" (McGee Banks & Banks, 1995, p. 153).

Cultural awareness: Becoming functionally aware of the degree to which behavior is culturally informed and influenced‖ (Schram, 1994, p. 63).

Culturally responsive pedagogy: Learner-centered approach in which teachers draw on cultural knowledge, prior experiences, frames of reference, and performance styles to make learning relevant to their students' lives (Gay, 2000). Culturally responsive pedagogy is distinguished from multicultural education in that culturally responsive education must be relevant to the cultures of students in the particular class (Rychly & Graves, 2012).

Cultural sensitivity: attitudes, beliefs and behaviors towards students of other cultures‖ (Larke, 1990, p. 24).

Social justice pedagogy: Expansion of equity pedagogy defined as "the teacher's commitment to equal rights for all regardless of race, ethnicity, gender, or sexual orientation" (Evans, 2013a, p. 17).

Learning opportunities: Opportunities created by the design and delivery of lessons that maximize student engagement via conscious and intentional use of

pedagogy, techniques, strategies, lesson plans and schemata that drive effective instructional practice; they can be defined as empirical connections to students' social, emotional, and academic development generated by their interactions with teachers and peers (Hamre & Pianta, 2007).

First generation single sex/gender schools: Schools originally established as male-only academies on the grounds that only males were worthy education, but followed by all-female academies "to prove that women, too, were capable of learning and also deserved a share of societal attention in the education sphere" (Mansfield, 2013, p. 4). Regardless of gender, these schools served primarily affluent groups, elite groups of students.

Second generation single sex/gender schools: Schools established after the change in Title IX and created to address educational inequalities and provide high-quality learning opportunities for students traditionally underserved by public education (Mansfield, 2013)

Urban school district: A school district with more than 50,000 students. (Johnson, 1998).

Secondary teacher: A teacher who teaches any of the grades from six through twelve

Teacher attitude/beliefs: An individual's viewpoints or disposition toward a particular object. An attitude can have three components: affective (feelings toward the object), cognitive (beliefs or knowledge about the object), and behavioral (predisposition to act toward the attitude object) (Gall, Gall, & Borg, 2003).

Teacher efficacy: Teacher beliefs about his or her personal ability to produce a positive effect on the educational achievement of students (Bandura, 1997).

Teacher perceptions: the lens through which teachers view and evaluate the behaviors of others (Neal, McCray, Webb-Johnson & Bridgest, 2003).

Voices: Framework of detailed expressions of one‘s way of knowing

CHAPTER II

REVIEW OF LITERATURE

Introduction

This chapter provides a review of the literature that includes conceptual and empirical research that supports instructional strategies of effective science teachers in an urban girls' school in America. This literature begins with a historical overview of single gender girls' schools. The next section discusses the current state of girls schools and STEM education for girls and thus the need for this study. This is followed by a discussion of urban STEM education that includes teacher preparation, teacher efficacy, and the deficit model. The review of literature concludes with a closer look at characteristics of science teachers, students' perspectives, ways to facilitate their learning in the science classroom.

Second generation single-sex schools have emerged as a strategy for improving academic achievement and in particular, eradicating achievement gaps based on race, ethnicity, and SES. Although much of the impetus for single-sex education has focused on the poor academic performance of African American boys, examining race and gender in isolation has led to the false assumption that girls of color are doing well in school, when in fact, they lag behind White students in academic achievement and graduation rates. In particular, girls of color are severely underrepresented in STEM education. Given this situation, this study seeks to illuminate the attitudes, beliefs, and

classroom practices of highly effective science teachers of girls at an urban, Title I all-girls academy.

Historical Context of Girls' Schools

Single-gender education is not a novel concept in our nation (Madigan, 2009). Single sex schools have been utilized in the history of education for very different purposes. Case in point, so-called "first-generation" single-sex schools – also known then as Dame Schools - came into existence at the sun-set of the 18th Century, in Colonial America as male-only institutions. Provisions were later made on a smaller scale to establish Dame Schools for girls (Meyer, 2008; Riordan, 2002; Salomone, 2003; Tyack & Hansot, 1992).

The primary emphasis of the Dame schools was to prepare boys for admittance to the town schools which, until the 19th century, girls were not permitted to attend (Riordan, 1990). When girls were finally admitted to the town schools, they attended at different times of the day than the boys or on days when boys did not attend, such as summertime or holidays (Madigan, 2009). It was much later that all-female academies were born to prove that women, too, were capable of learning and also deserved a share of societal attention in the education sphere (Blount, 2005; Tyack & Hansot, 1992). Most single gender schooling was reserved for the "financially and the intellectually well endowed" (Meyer, 2008, p. 12).

Education in Texas, on the other hand, dates back to the 1700s in Texas. During this time, the schools established focused on instruction in agriculture and industry. These schools also included training for females. By the early 1830s the state established

land grants in support of local schools. These schools included separate primary instruction for girls, and the girls followed a similar curriculum to that for boys, with an added emphasis on sewing, embroidery, and other domestic skills (Cottrell, 2010a).

As the number of settlers increased in the state of Texas, numerous private schools were opened. Such institutions frequently provided girls with the privilege of attending school, generally in a separate female quarter. The first recognized boarding school for girls in Texas, was the Frances Trask Thompson's school in Coles Settlement (later Independence), established in 1834. This school was the antecedent of Independence Academy, Baylor Female College, and Mary Hardin-Baylor University. Another school for girls was started by a woman named Lydia Ann McHenry in Washington County in 1835 (Madigan, 2009; Eby, 1925; Aiken, 1957).

In the following years of the Republic of Texas and antebellum Texas, the number of educational facilities grew consistently. As municipal leaders, devout groups, and educational associations endorsed the emergeence of several educational institutions, private academies for girls continued to be structured institutions, an actuality that revealed a desire to educate young women while remaining dedicated to the widespread reaction against coeducation. These schools were mainly comprised of female teachers. The female department of Rutersville College, a renowned institution of its time was started in 1840 in proximity to La Grange (Fayette County) and was controlled by the Methodist Church (Cottrell, 2010a; Aiken, 1957).

The foundation for current Texas public schools were laid in 1854, with the establishment of a $2 million school fund. Women's presence in the teaching profession

became promonent, as their educational prospects improved in the state. The after-effects of the civil war brought on a continuing feminization of the educational field.This resulted from male teachers having to go to war, in addition to the general broadening of educational opportunities for teachers. It is noteworthy that by 1900, Texas women out-numbered men for the first time in the teaching profession. Texas women consequently lobbied to achieve more professional recognition as teachers, often soliciting organizational efforts for help (Cottrell, 2010b; Collins, 2000).

In the United States, the legal aspect of single-sex provision in public schools was unclear until 2006. A number of initiatives at the regional level were introduced regarding single-sex schooling like the Single-Gender Academies Pilot Program in California, initially intended to provide single-sex schools but subsequently focussing on providing single-gender classes within coeducational schools. The educators noted that the initiative was "working for the girls" but that "boys were becoming more troublesome" (Herr & Arms, 2002). Issues were raised about the lack of attention to challenging gender stereotypes and about the fact that the intervention was driven by the desire to improve test results rather than to foster gender equity (Herr & Arms, 2002). As a result the number of California districts providing single-sex classes reduced significantly.

To improve academic performance and eradicate academic achievement gaps, Congress amended Title IX regulations in 2006 that allowed federal funding for single sex schools and single sex programs within public schools (Goodkind, 2013; Hayes et al., 2011; Mansfield, 2013). As a result there was a proliferation of schools that were

single gender especially in the public school arena.National Association for Single Sex Public Education estimated that as of the 2011-2012 academic year there were 116 single sex public schools in the U.S., with additional 390 schools offering single sex educational programs (Goodkind, 2013). The Feminist Majority Foundation noted that from 2007 to 2009 the number of single sex schools grew to 1,000 (Goodkind, 2013).

The historical review of women's educational experiences in the United States, showed that girls raised to awere ssume specific and limited roles in society, compared to their male counterparts. With the dawn of Title IX, and the implementation of equal access legislation, the alternatives for girls improved significantly. It is however imperative to continually be guided by the accomplishments of past pace-setters, as the journey continues into new educational territory, breaking ground for those lives that will be touched in the future (Madigan, 2009).

Single Sex Education

On the 50th anniversary of the landmark *Brown v. Board of Education* Supreme Court decision, as well as the Civil Rights Act of 1964 and Freedom Summer, the National Women's Law Center and the NAACP Legal Defense and Educational Fund issued a collaborative report entitled *Unlocking Opportunity for African American Girls: A Call to Action for Educational Equity* (NWLC & LDF, 2014). The authors began their report by pointing out that despite a plethora of data on children in the American educational system, the absence of data combining gender and race has produced the erroneous assumption that "all girls are doing fine in school" (p. 1). In reality, while girls per se have higher graduation rates than their male peers, girls of color graduate at

substantially lower rates than White girls or boys. High school graduation rates for African American girls fall below the national average in most states, with unfortunate economic implications for their adult lives.

As part of the initiative to boost academic performance and eradicate academic achievement gaps, Congress amended Title IX regulations in 2006 to allow federal funding for single sex schools and single sex programs within public schools (Goodkind, 2013; Hayes et al., 2011; Hoffman et al., 2008; Mansfield, 2013). Over the last decade the number of single sex programs has grown exponentially. According to estimates by the National Association for Single Sex Public Education, as of the 2011-2012 academic year there were 116 single sex public schools in the U.S., with an additional 390 schools offering single sex educational programs (Goodkind, 2013). These figures may actually be low. The Feminist Majority Foundation claims that from 2007 to 2009 the number of single sex schools grew to 1,000 (Goodkind, 2013).

Single gender private and parochial schools have been part of the educational landscape for generations. Indeed, the notion of single sex education often invokes images of elite private schools with strict selection criteria and students from affluent families. What distinguishes the current generation of single sex schools is that they are being advanced to address educational inequalities and expand learning opportunities with the goal of improving achievement for students that have traditionally been underserved by public education.

The issue of separating students by gender remains controversial. Arguments based on allegedly "hardwired" gender differences in learning have been debunked by

numerous studies (Eliot, 2013). In fact, some advocates of that perspective have walked back their claims (Patterson, 2012). The American Civil Liberties Union (ACLU) claims that single gender schools and classrooms violate the equal protection clause of the constitution (Patterson, 2012). The American Association of University Women (AAUW) initially supported same sex education on the grounds that single sex classrooms promoted leadership development and achievement among girls (Spielhagen, 2011). However, the AAUW later reversed that position, concurring with the ACLU that separate treatment of students is likely to be unequal.

Prior to the changes to Title IX there were several legal cases challenging the establishment of single sex schools on the grounds that they represent a violation of civil rights (Mansfield, 2013). According to Mansfield, the most high profile case involved the Young Women's Leadership School in New York City, designed to provide low-income, minority girls with a rigorous academic program and high quality learning experiences they were unlikely to find in overcrowded and under-resourced neighborhood schools. Advocates claimed that the unique learning environment would be impossible to replicate in a coeducational setting. The Ann Richards School for Young Women Leaders in Austin, Texas, has consistently been one of the highest performing schools in the state (Patterson, 2012).

Efforts to improve academic achievement and high school graduation groups for African American boys have been a major force in the proliferation of single sex public schools (Patterson, 2012). Proponents of single sex education for girls often cite the severe under-representation of girls, particularly girls of color, in STEM education.

Girls may be more likely to study mathematics and science in single gender programs that support them in developing identities as scientists. To some scholars while the motives may be noble, the practice of separating disadvantaged students by gender runs the risk of creating "academic ghettoization" that further marginalizes the students they were intended to help (Mansfield, 2013). They are not against single gender education per se but rather their point is that the practice must be implemented in ways that ensure, in the words of Pedro Noguera, "the young people targeted for such services are actually being helped and not marginalized and isolated by providers who claim they want to help" (as cited in Mansfield, 2013, p. 5).

A common uncontroversial position on single sex education is that it represents an option that can be advantageous for some students depending upon the child and the available schools (Patterson, 2012; Spielhagen, 2013). Much of the existing research on the effectiveness of single sex education has been criticized for methodological flaws, notably failing to account for the self-selection of students into same gender schools. Recent studies have sought to correct these weaknesses and provide deeper insight into the attitudes of teachers, parents, and students.

Effectiveness of Single Sex Education

Hoffman et al. (2008) conducted a mixed methods evaluation of the effectiveness of single sex education at an economically disadvantaged urban high school. The study unfolded over two years, examining teacher efficacy, teachers' instructional strategies, classroom culture, student behavior, and academic achievement. Academic achievement was measured by comparing the grades and standardized test scores of 10th graders in

single sex classrooms with a control group of students who had been in 10th grade before the inception of single sex programs.

Interestingly, the students' opinions of single gender education were largely negative, while the teachers expressed positive opinions indicating they felt comfortable in single gender classrooms, observed fewer behavior problems, and felt the atmosphere was more conducive to teaching and learning (Hoffman et al., 2008). The teachers' experiences supported the assumptions that single sex classrooms would elicit greater classroom participation from girls and better behavior from boys. In fact, the teachers were virtually unanimous that the single sex learning environment was advantageous for girls. The students were far less enthusiastic; 70% did *not* prefer single gender education, with many expressing strong disagreement.

Standardized test scores favored the coeducational classes while the findings for subject grades were mixed (Hoffman et al., 2008). Although teachers who were more enthusiastic about single sex education were more confident in single sex classrooms, for the most part teacher efficacy was independent of the classroom arrangement. As one teacher commented "Good teaching is good teaching" (Hoffman et al., 2008, p. 24). The overall findings were ambivalent, but there was some suggestion that single sex education might be beneficial for disadvantaged secondary school girls.

According to Hayes et al. (2011), a major flaw in research on single sex education is that studies do not control for selection bias and peer effects. To address this issue, the researchers conducted a comparison study, comparing the academic performance of girls in a public single sex middle school to two groups: girls who

applied to the school but were not chosen by lottery, and girls attending a coeducational magnet school. The fact that students applying to the single sex school are randomly selected by lottery makes it likely that the two groups are equivalent. The ethnically diverse sample of girls was followed over three years.

Data from the end of the first year (6th grade) indicated that the girls at the single sex schools outperformed their peers at both coeducational schools (Hayes et al., 2011). However, despite the assumption that the lottery would produce two equivalent groups, analysis revealed that the girls admitted to the single sex schools performed significantly higher in fifth grade than those not admitted. Consequently, the researchers analyzed data from a subsample with equivalent fifth grade achievement. The results still showed superior performance for the students attending the all-girls school.

Indeed, the single sex school had the highest achievement scores of all non-magnet schools in the district. Hayes et al. (2011) attributed this to the superior academic performance of students who entered the school. After controlling for previous academic, the students at the all-girls school and the coeducational magnet school had comparable standardized test scores in sixth and seventh grade. This finding highlights the importance of peer quality in students' academic performance. The overall findings suggested that peer quality and selection effects have greater impact on girls' academic achievement than whether they attend single gender or coeducational schools.

Hayes et al. (2011) noted that much of the research on single sex education had traditionally been conducted with schools that had stringent admissions policies, often

elite private schools. This contrasts with current support for single sex schools as part of initiatives to improve academic outcomes for disadvantaged students. Goodkind (2013) conducted a critical review of research on single sex public education with a focus on economically disadvantaged minority youth. The research of Eliot (2013), Hayes et al. (2011), and Spielhagen (2011) were included in the review.

A review of the literature for this project confirmed Goodkind's (2013) observation that there is a dearth of research on single sex public education for low-income students of color. Indeed, Goodkind is extremely skeptical of its purported benefits. Rather, she believes that single sex education has the potential to further marginalize students by reinforcing rigid, limiting, and harmful racial and gender stereotypes. Goodkind also brings up a topic rarely addressed, namely the exclusion of lesbian, gay, bisexual, transgender, and queer (LGBTQ) youth who do not conform to gender binaries. Intersectionality includes sexuality as well as gender, race, ethnicity, social class, nation, and age (Collins, 2000). According to Goodkind (2013), investing in single sex education as a panacea for underperforming low-income schools diverts attention from addressing the adverse effects of poverty and racism on youth and may be detrimental to students of all genders.

Second Generation Single-Sex Schools

Single gender private and parochial schools have been part of the educational landscape for generations. Indeed, the notion of single sex education often invokes images of elite private schools with strict selection criteria and students from affluent families. What distinguishes the current generation of single sex schools is that they are

being advanced to address educational inequalities and expand learning opportunities with the goal of improving achievement for students that have traditionally been underserved by public education. These schools are referred to as "second generation" single sex schools (Mansfield, 2013).

In recent years "second generation" single-sex schools have reinvented themselves to combat the impact of societal prejudices on male and female students alike, not "as a reactive counterweight to exclusion but as an affirmative vehicle for inclusion and an antidote to social disadvantage" (Salomone, 2003, p. 9). For example, Detroit and Milwaukee school districts attempted to establish single-sex academies for boys of African heritage yet met with rigorous resistance. Proponents of the Afrocentric academies cited the "failure of the civil rights agenda to improve the lives of poor inner-city residents" to legitimize the establishment of the all-boys schools (Riordan, 2002, p. 52). Parents of female students rejected the schools due to the legacy of male privilege associated with all-male academies while overall some members of the Black community were alarmed by what they considered a resurgence of racially-segregated schools (Riordan, 2002; Salomone, 2003). The establishment in 1990 of *The African American Immersion Schools of Milwaukee* was controversial, as well. However, unlike the Detroit schools, the Milwaukee programs continued to be reviewed and renewed regularly.The attempt in 1990s to establish single-sex schools for girls also met threats of litigation from civil rights groups. Prior to the changes to Title IX there were several legal cases challenging the establishment of single sex schools on the grounds that they represent a violation of civil rights (Mansfield, 2013). According to Mansfield, the most

high profile case involved the Young Women's Leadership School in New York City, designed to provide low-income, minority girls with a rigorous academic program and high quality learning experiences they were unlikely to find in overcrowded and under-resourced neighborhood schools. Advocates claimed that the unique learning environment would be impossible to replicate in a coeducational setting. The Ann Richards School for Young Women Leaders in Austin, Texas, has consistently been one of the highest performing schools in the state (Patterson, 2012).

The issue of separating students by gender remains controversial. Arguments based on allegedly "hardwired" gender differences in learning have been debunked by numerous studies (Eliot, 2013). In fact, some advocates of that perspective have walked back on their claims (Patterson, 2012). The American Civil Liberties Union (ACLU) claims that single gender schools and classrooms violate the equal protection clause of the constitution (Patterson, 2012). The American Association of University Women (AAUW) initially supported same sex education on the grounds that single sex classrooms promoted leadership development and achievement among girls (Spielhagen, 2011). However, the AAUW later reversed that position, concurring with the ACLU that separate treatment of students is likely to be unequal.

Although efforts to improve academic achievement and high school graduation groups for African American boys have been a major force in the proliferation of single sex public schools (Patterson, 2012). Girls may be more likely to study mathematics and science in single gender programs that support them in developing identities as scientists. To some scholars while the motives may be noble, the practice of separating

disadvantaged students by gender runs the risk of creating "academic ghettoization" that further marginalizes the students they were intended to help (Mansfield, 2013). They are not against single gender education per se but rather their point is that the practice must be implemented in ways that ensure, in the words of Pedro Noguera, "the young people targeted for such services are actually being helped and not marginalized and isolated by providers who claim that they want to help" (as cited in Mansfield, 2013, p. 5).

A common uncontroversial position on single sex education is that it represents an option that can be advantageous for some students depending upon the child and the available schools (Patterson, 2012; Spielhagen, 2013). Much of the existing research on the effectiveness of single sex education has been criticized for methodological flaws, notably failing to account for the self-selection of students into same gender schools. Recent studies have sought to correct these weaknesses and provide deeper insight into the attitudes of teachers, parents, and students.

According to Hayes et al. (2011), a major flaw in research on single gender education is that studies fail to control for selection bias and peer effects. To address this problem, the researchers compared the academic performance of girls in a public single sex middle school to two groups: girls who applied to the school but were not chosen by lottery, and girls attending a coeducational magnet school. The ethnically diverse sample of girls was followed over a three-year period. At the end of the first year (6th grade) the girls at the single sex schools outperformed their peers at both coeducational schools. However, despite the assumption that the lottery would produce two equivalent groups, the girls admitted to the single sex schools performed

significantly higher in fifth grade than those not admitted. Therefore, Hayes et al. analyzed data from a subsample with equivalent fifth grade achievement. The findings still pointed to superior performance for the students attending the all-girls school.

In fact, the single sex school had the highest achievement scores of all non-magnet schools in the district. Hayes et al. (2011) ascribed this to the superior academic performance of students who entered the school. After controlling for prior academic performance the students at the all-girls school and the coeducational magnet school had comparable standardized test scores in sixth and seventh grade. The overall findings suggested that peer quality and selection effects exert a stronger impact on girls' academic achievement than whether they attend single gender or coeducational schools.

Pahlke et al. (2014) investigated attitudes toward all-girls single gender education in a survey of 589 middle school students, 281 mothers of middle school students, and 115 teachers from a large metropolitan school district. The students included 398 girls attending an all-girls public middle school and 96 girls and 95 boys attending coeducational public schools. An instrument was created for the study entitled *Rationales for All-Girls Schools,* covering four rationales: (a) gender differences in learning, (b) gender differences in interests, (c) ingroup preferences, and (d) gender discrimination.

Not surprisingly, support for all four rationales was stronger among the students, teachers, and parents connected with the all-girls school. Pahlke et al. (2014) were concerned with support for the three essentialist rationales implying that girls and boys differ in learning, interests, and peer relations. They found it disturbing thast teachers

endorsed brain-based gender differences in learning disturbing given that these beliefs are not supported by neuroscientific research (Eliot, 2013). Pahlke et al. (2014) also suggested that teachers who endorse those beliefs might be reinforcing gender stereotypes (Pahlke et al., 2014). Additionally students who concur with essentialist rationales may be limiting their own activities and opportunities according to gender stereotypes. In earlier research, Patterson and Pahlke found that this actually undermined girls' academic achievement.

Finally, Pahlke et al. (2014) suggested that gender segregated environments may perpetuate gender stereotyped social relationships and behavior. Although the stakeholders associated with the all-girls school also expressed stronger agreement with gender discrimination as a rationale for single sex education, they endorsed this to a lower degree than the more essentialist reasons. Pahlke et al. proposed that this might be due to evidence of increasing academic achievement, which is equal to if not superior to boys. An unexpected finding was that there were no gender differences in support for the four rationales.

STEM Education for Girls

The most glaring gap based on race and gender is in STEM education, where girls of color are seriously underrepresented in STEM classes and careers (Farinde & Lewis, 2012; NWLC & LDF, 2014; Perry et al., 2012; Pinder & Blackwell, 2014; West-Olatunji et al., 2010). Two key causes have been implicated in this situation: (1) a dearth of STEM courses in economically disadvantaged schools where students of color are disproportionately enrolled, and (2) stereotypes associated with both race and gender

that discourage minority girls from STEM education (Farinde & Lewis, 2012; NWLC & LDF, 2014). Perry et al. (2012) describe the underrepresentation of women and minority students in STEM fields as "the product of a stratified American educational system that shapes academic and career choices long before students arrive on a college campus" (p. 725).

Out of school programs such as the Lang Science Program at the American Museum of Natural History (AMNH), designed to support adolescent learners from groups traditionally underrepresented in STEM fields provide excellent opportunities for girls of all ethnicities as well as minority and low-income boys to pursue their interests in STEM fields and develop strong self-identities as scientists (Adams et al., 2014). Indeed, young women of diverse ethnicities credit the Lang Program with providing them with the confidence to overcome obstacles they encounter as they fulfill their career aspirations. However, many students do not have access to an enriching out of school program, and moreover, the presence of such programs does not compensate for schools that shortchange students based on ethnicity, gender, and so ss.

Apart from the literature on STEM education, searches of scholarly databases using terms such as "academic achievement," "race," "ethnicity," and "gender," give the impression that African American *boys* are at risk for poor educational outcomes while, as the authors of *Unlocking Opportunity* observed, scant attention is given to African American girls. One of the few journal articles to address the intersection of race and gender comes from the United Kingdom. Using 2006 statistics on academic achievement among U.K students, Rollock (2007) stressed that simply comparing the

achievement of Black girls and Black boys exaggerates the attainment of Black girls by comparing them to a population that performs well below the national average. Conversely, when compared with White girls, Black girls are *not* doing well, similar to the disparities observed in the United States (NWLC & LDF, 2014).

Further disaggregating performance data, Rollock (2007) noted that Black girls of Caribbean heritage were at particular risk for poor school performance. Researchers in the U.S. found that Black Caribbean adolescent girls are especially vulnerable to depression and diminished life satisfaction in the face of perceived discrimination (Seaton, Caldwell, Sellers, & Jackson, 2010). Seaton et al. (2010) recognized the intersection of ethnicity, gender, and age in the way youth perceive discrimination. Discrimination at school can have a marked adverse impact on the academic achievement of African American and Black Caribbean students, with effects varying according to gender, ethnicity, age, racial socialization, ethnic identity, and peer support (Brittian & Gray, 2014; Chavous, Smalls, Rivas-Drake, Griffin, & Cogburn, 2008; Dotterer, McHale, & Crouter, 2009; Friend et al., 2011; Thomas, Caldwell, Faison, & Jackson, 2009).

Studies that recognize how multiple identities, as well as individual differences, shape the experiences of students are rare. Most educational studies focus on race and gender in isolation thus failing to capture how their interaction affects the educational experiences of girls and young women of color (Evans-Winters & Esposito, 2010; Farinde & Lewis, 2012; Friend et al., 2011; Rollock, 2007). Kimberle Crenshaw introduced the concept of *intersectionality,* denoting the intersection of gender and race.

Crenshaw (1989) argued that attention only to gender or race made Black women virtually invisible. Patricia Hill Collins (2000) popularized intersectionality within the context of Black feminism. Evans-Winters and Esposito (2010) drew on the work of Crenshaw (1989), Collins (2000), and Ladson-Billings (2009) to outline a theory of Critical Race Feminism for illuminating the experiences of Black female students. According to Evans-Winters and Esposito (2010), educational researchers must be attuned to the "multiple realities" of Black girls' lives (p. 15).

The focus on boys in the literature on racism and academic achievement gaps has led some scholars to apply terms such as "voiceless" and "nothingness" to the experiences of Black girls (Friend, 2006). Effort to improve the academic performance of Black boys has been one of the driving forces in the growth of single sex schools (Patterson, 2012). Other researchers point to studies showing that from preschool onward, boys receive more attention from teachers and dominate classroom culture, inhibiting girls from active participation (Hoffman et al., 2008). From this perspective, single sex classrooms provide girls with a learning environment where they feel free to express themselves with support from teachers and peers.

On the other hand, critics argue that same sex education perpetuates race and gender stereotypes (Eliot, 2013; Goodkind, 2013; Patterson, 2012). The weakest argument for same sex education is the idea that there are "profound differences" in male and female brains thus "boys and girls learn differently" (Eliot, 2013, p. 363). This claim is unsupported by scientific research, which instead consistently demonstrates the malleability of children's brains. Children, regardless of race, ethnicity, gender, or

social class respond to good teaching, a caring, supportive classroom environment, and rich and varied learning opportunities. Like their colleagues in coeducational schools, teachers in single sex schools need administrative support and high quality professional development to best serve their students (Spielhagen, 2011).

Roberts (2010) explicitly states that while students gain tremendous benefits from schools with a well-designed, cohesive curriculum, first class equipment and cutting edge technology, and strong educational leaders, creating a caring classroom environment is no less important for helping young learners succeed. Roberts (2010) is among many educational scholars who stress the critical importance of good teacher-student relationships, especially for students of color (Douglas et al., 2008; Evans, 2013a, 2013b, 2014; Shaunessy & McHatton, 2009; Wilkins, 2014).

In research designed to illuminate the practices of highly successful mathematics teachers of traditionally underserved students, Bonner (2014) turned to community members to nominate teachers that defined or met their own conceptions of "success." A troubling finding was that successful mathematics teachers in high-needs schools seemed to be scarce; several community meetings produced no viable candidates. The study focused on three exemplary teachers: an African American teacher who used a culturally responsive pedagogy to teach her African American students, a White teacher who created a comfortable, learner-centered classroom for struggling Latino middle grade students, and a teacher of Latina and Arab heritage who created an empowering, inquiry oriented classroom environment at an all-girls middle school. High expectations, rigorous standards, and a repertoire of instructional strategies were a hallmark of all

three teachers' classrooms. Caring and equity were implicit in their pedagogical approaches.

Girls of Color and STEM Education

In observing mathematics and science classes at the YWLS, Mansfield (2014) noted that the teachers engaged the students in lively discussions about the "pseudoscience of females' supposed inherent lack of ability in STEM fields" (p. 408). The students responded with disdain and disgust for the sexist stereotypes. In a math lesson where the girls were involved in a challenging, hands-on activity, the teacher made a point of declaring, "See, some people think girls just can't do this kind of work. But look! You're doing it. And you're doing it well" (p. 409). Girls in urban public schools are more likely to encounter teachers who reinforce negative gender and racial stereotypes about succeeding in STEM fields (NWLC & LDF, 2014). In many schools they may have no exposure to meaningful experiential learning opportunities.

Analyses of findings from several datasets (including national and longitudinal data) confirmed that from high school to college and beyond, African American female students have fallen behind in mathematics and science (Farinde & Lewis, 2012). Highlighting the way racial comparisons mask disadvantages in Black female students (Rollock, 2007), African American girls and young women outperform African American male students in mathematics but lag behind White students of both genders (Farinde & Lewis, 2012).

In a study of low-income sixth graders, Perry et al. (2012) found that girls overall had higher school self-esteem and more positive attitudes toward science than boys. The

attitudes of African American and Latina girls were similar to White students while African American and Latino boys expressed more negative attitudes than White boys or girls of any ethnic group. Although superficially the findings seem positive for girls of color, Perry et al. acknowledged that their low-income status could easily limit future opportunities for science learning. All the students were participants in TRY-IT!, a project designed to help students apply technology for understanding biomedical science. The Lang Science Program was created to provide rich learning opportunities for students who may lack the resource to study science beyond what their schools offer (Adams et al., 2014).

Out of School Learning Experiences

Lang Science Program

The Lang Science Program at the American Museum of Natural History (AMNH) is a multi-year program designed to support adolescent learners from groups traditionally underrepresented in STEM fields. Adams et al. (2014) conducted a focus group study with six young women who had been part of the program to explore the nature of their experiences in the program and their successes and challenges in science-related endeavors since graduation. The ethnically diverse group included three African American women, one Latina, one South Asian, and one Caucasian. The qualitative study was undertaken to generate themes for a larger, more formal, longitudinal investigation.

The Lang Science Program is part of a series of programs offered by the AMNH created for children from age two onward (Adams et al., 2014). A unique feature of the

Lang Program is its cohort design, which encourages participants to stay with the program. Designed primarily for girls and boys who are attracted to science but might not otherwise be able to pursue their interests, the participants engage in active, experiential, self-directed learning experiences and complete an annual group research project. Eleventh and 12th graders participate in a college and career readiness curriculum, which was added in response to alumni feedback.

According to Adams et al. (2014), four major themes captured the connection between the young women's long-term participation in the Lang Program and their STEM-related identities and career paths: *Building a collective identity, Belonging in a physical space, Broad exposure to science topics and careers,* and *Moving from the museum to college.* Adams et al. framed the first theme as a sharp contrast to the belief that being a smart, high-achiever isolates urban students from their peers. Being with others who shared their interests and goals provided the young women with a safe space to "be a nerd" (p. 16).

The final theme, the transition from the museum to college is especially relevant for women and minorities who often face a hostile climate in STEM disciplines (Adams et al., 2014). Indeed, women and minorities often drop out of STEM programs (Farinde & Lewis, 2012; NWLC & LDF, 2014). Implicitly, the Lang Program tapped into the four sources of self-efficacy (Bandura, 1997). The participants were immersed in learning experiences that built their self-confidence as scientists, saw others like them succeeding (including meetings with scientists.

Book Clubs

According to Polleck (2010), book clubs for adolescents can serve as *transformational spaces*. The book club is framed as a safe, collaborative space that not only fosters young people's literacy development, but also their identity development and personal and social growth. This perspective is embedded in social constructivism, whereby understanding of the self and the learning material is enhanced through discussion and interaction with others (Vygotsky, 1978). Polleck (2010), a literacy coach, also views book clubs as an excellent venue for raising awareness and expanding dialogue on diversity and gender equity issues.

Polleck (2010) led three book clubs at a small, progressive urban high school whose enrollment was 55% Latino and 35% African American, and most were from low-income families. The study was based on two book clubs that were all girls, one composed of freshmen and sophomores and the second exclusively juniors. (The third club was composed of girls and boys of all grade levels). All participants self-selected into their own groups. The mixed methods study included interviews (pre- and post-participation), observations, recorded discussions of book club meetings, evaluation surveys, and the researcher's field journal.

All the books were young adult novels selected by the girls. In fact, Polleck (2010) strongly stressed the importance of allowing the participants to choose the books, which enhanced their sense of ownership and ensured that the topics were aligned with their interests. The 13 books discussed included *The Sisterhood of the Traveling Pants, Push* by Sapphire, two books by Judy Blume, and *Speak,* which was also the subject of

Park's (2012) study of urban middle school girls involved in an after-school book club. Virtually, all the books had female protagonists dealing with family and peer relationship issues and/or issues related to identity development, self-esteem, and being female (Polleck, 2010).

From an academic perspective, Polleck (2010) places book clubs within the context of alternative and enriching learning experiences with the power to negate academic achievement gaps. Polleck's conceptual framework has three levels: *Transaction or Reader Response,* which promotes individual literacy and personal growth; *Interaction,* based on social constructivism; and *Transformation,* the outcome encompassing reading development, identity development, personal growth, and social growth. Reader response has emerged as a powerful paradigm for shaping middle and secondary school literature instruction (Park, 2012). In contrast to the notion that texts have one "true" meaning, reader response theories recognize the influence of social, cultural, and individual factors on readers' interpretations of text. The reader is acknowledged as "active and situated, bringing to the text a wealth of experiences, knowledge, and beliefs," even in early childhood (Park, 2012, p. 192).

In Polleck's (2010) book clubs, the girls first summarized the texts, and then shared their analyses and interpretations, which were refined through dialogue and collaboration. According to Polleck, while there was no formal assessment of the girls' literacy skills, their feedback suggested that participating in the book club enhanced important aspects of reading, including vocabulary, summarization, analysis, fluency,

and comprehension. Perhaps more important, the girls enjoyed reading more and desired to read more books.

At the same time as they gained academically, the book club was an environment where the young girls could discuss personally relevant issues such as self-esteem, body image, and maintaining a strong sense of self in the face of peer pressure (Polleck, 2010). Transformation was evident in comments in which the girls expressed enhanced self-confidence, self-worth, self-esteem, independence, and open-mindedness. Furthermore, family issues that arose in the books helped the girls better understand their relationships with their own families and furthered personal growth and development. Polleck (2010) noted that as a literacy coach, her primary role at the school was mentoring teachers to improve their literacy instruction. Within or beyond the classroom, she called on educators to provide students with opportunities for authentic learning, and above all, to recognize the interrelationship of cognitive and socioemotional development in fulfilling the needs of adolescent learners.

Park (2012) made specific recommendations for teachers of adolescents, with particular attention to challenging students to consider how gender, race, class, and other social factors influence the characters' actions. By framing characters' actions "as reflective of a larger framework of cultural and ideological forces," teachers can encourage students to challenge deeply entrenched cultural stereotypes (Park, 2012, p. 207). Analogous to the girls in Polleck's (2010) book club, communal reading provided the girls in Park's (2012) study with a transformative learning experience that deepened their understanding of text and altered their self-perceptions and perceptions of others.

Race and gender were studied as two key variables (Murray, Waas, & Murray, 2008). Race emerged as a significant moderator of the association between teacher-child relationships and school adjustments. Specifically, for African American children, closeness enhanced their liking for school and conflict detracted from it to a greater degree than for White or Latino children. Gender showed no similar effect. The only gender differences observed was that girls who perceived more support from teachers were less likely to display school-avoidance. To Murray et al., the most significant finding was the powerful influence of student-teachers relationships for low-income students of color during their first year of school.

At the same time, the findings refuted both the gender socialization hypothesis, which posits that teacher warmth is more important for girls, and the vulnerability hypothesis, which claims that boys are more susceptible to the adverse effects of conflict (Hughes, Wu, Kwok, Villarreal, & Johnson, 2012).

There was minimal stability in warmth from year to year, thus highlighting that a close bond between teacher and student is built on the interplay between individual student and teacher characteristics (Spilt, Hughes, Wu, & Kwok, 2012). In contrast to the finding of Hughes et al. (2012) that African American children perceived greater warmth, when reported by teachers, African American children experienced more limited warmth (Spilt et al., 2012). Children with behavior problems and low IQs were also likely to receive lower warmth in the early grades. There was some increase in warmth for these children and African American children over time, though warmth levels remained moderate.

Conflict levels were low for most children, though 30% of the girls and 40% of the boys experienced increases or decreases over time (Spilt et al., 2012). Girls experienced higher warmth and lower conflict throughout the study. A small subgroup of boys and girls had higher than average levels of conflict, with a small group of boys only characterized as experiencing chronic conflict. Boys with chronic conflict were also chronic underachievers. Girls generally enjoyed more supportive and less hostile relationships with teachers, but conflict appeared to harm girls more academically than boys. African American girls and boys were more likely to experience increasing conflict, which was strongly linked for both genders with diminishing academic performance.

Perspectives of Stakeholders

Pahlke et al. (2014) conducted a survey of 589 middle school students, 281 mothers of middle school students, and 115 teachers from a large metropolitan school district. The student group included 398 girls attending an all-girls public middle school and 96 girls and 95 boys attending coeducational public schools. An instrument was created for the study entitled *Rationales for All-Girls Schools*. The survey captures four rationales: (a) gender differences in learning, (b) gender differences in interests, (c) ingroup preferences, and (d) gender discrimination.

Not unexpectedly, support for all four rationales was stronger among the students, teachers, and parents associated with the all-girls school (Pahlke et al., 2014). Some critics argue that supporters of same sex education tend to hold essentialist perspectives of gender. Pahlke et al. noted that three of the rationales reflect essentialist

views. The implication is that educators might draw on these differences to enhance educational performance (as opposed to using educational experiences to narrow gender differences).

Pahlke et al. (2014) expressed concern over the endorsement of rationale implying that girls and boys differ in learning, interests, and peer relations. They find teachers' endorsement disturbing of brain-based gender differences in learning disturbing because these beliefs are not supported by neuroscientific research (Eliot, 2013). They also suggest that teachers who endorse those beliefs may be predisposed to reinforcing gender stereotypes (Pahlke et al., 2014). Moreover, students who concur with essentialist rationales may be limiting their own activities and opportunities according to gender stereotypes. In earlier research, Patterson and Pahlke found that this actually undermined girls' academic achievement. Finally, Pahlke et al. (2014) suggested that gender segregated environments may perpetuate gender stereotyped social relationships and behavior.

The stakeholders associated with the all-girls school also expressed stronger agreement with gender discrimination as a rationale for single sex education (Pahlke et al., 2014). However, they expressed lower endorsement for this rationale than for the more essentialist reasons.

Spielhagen (2011) explored the perspectives of teachers at single sex middle schools in a mixed methods study. The schools arose from the reorganization of a middle school that had repeatedly failed to meet No Child Left Behind (NCLB) requirements in a neighborhood where all students (100%) qualified for free and

subsidized meals. Sixth grade students were relocated to two single sex academies, although students could opt to attend other schools and students from other schools had the option of choosing the same sex venue. Failure to provide students with alternatives to same sex education led the ACLU and the Women's Law Project to threaten to sue the Pittsburgh public schools with the result that the school district ended the same sex program (Patterson, 2012).

The principal, assistant principals, and teachers were all carefully selected (Spielhagen, 2011). Beginning with focus groups, the study unfolded over the school year, ending with a follow-up at the end of the spring semester. Interestingly, the teachers, who had been chosen through a highly competitive process, had eagerly looked forward to teaching at the single sex academies but their satisfaction declined significantly over the school year. Spielhagen ascribed this to organizational issues at a new school rather than to the schools being single gender; however, the survey was not designed to capture these issues.

The overwhelming majority of teachers (87%) surveyed in the spring expressed gender essentialist views that girls and boys process information differently and that single gender classes enabled them to best meet their respective needs (Spielhagen, 2011). This concurs with the findings of Pahlke et al. (2014), as all the teachers chose to teach at single gender academies. Additionally, most teachers felt that boys and girls seemed comfortable in single sex classrooms (61%) and that both genders were more active participants in single sex classes (68%; Spielhagen, 2011).

Although there was strong agreement on these issues, the survey included only 31 teachers (Spielhagen, 2011). Moreover, there were significant disparities in the responses of teachers from the girls' and boys' academies. Notably, 71% of the boys' teachers felt their students were more focused and on-task in single sex classes compared to 57% of the girls' teachers, and 82% of the teachers felt boys participated more in single sex classes compared to only 50% of the girls' teachers. Teachers in both academies felt that the single sex classrooms had a negative effect on the students' behavior, in contrast to their optimism at the onset of the program. At the same time, the vast majority (94%) felt that the programs should continue.

The major complaints of the teachers were not unique to single sex settings: lack of sufficient professional development opportunities and poor administrative support (Spielhagen, 2011). According to Allensworth (2012), the key to improving teaching and learning lies in cultivating an environment that fosters collaboration among teachers, school administrators, and families. Theoretically, a small single sex academy should be an excellent venue for this type of collegial atmosphere. However, that was not the case in the middle schools. The teachers questioned the teaching strategies they employed because they did not observe gains in achievement and seemed unprepared to deal with behavioral problems (Spielhagen, 2011). It is probable that some students benefited while others did not, but whether that could be attributed to being in single gender classrooms or other factors is debatable.

Mansfield (2013, 2014) presented case studies of the Centro Urbano (Texas) Young Women's Leadership School (YWLS), which grew out of community effort to

improve educational opportunities for poor Latina and African American girls. To most stakeholders, the school was viewed as a vehicle for social justice for students who had been traditionally marginalized and denied opportunity. Low-income students in Texas have extremely high dropout rates and advocates of the school pointed to studies showing that girls are more likely to take STEM courses in all-girls schools. The school was designed to provide students with a rigorous curriculum and meet high standards.

Mansfield (2013) is highly critical of gender essentialist rationales being used to support single sex education. Rather, she views single sex education from the perspectives of social justice, choice, accountability, and the need to provide "a robust, non-sexist learning environment to girls presently living at the intersection of race/ethnicity, gender, and class complexities" (p. 20). Currently, the YWLS involves a partnership between the local education authority and a nonprofit philanthropic organization. As Spielhagen's (2011) study illustrates, innovative new schools do not necessarily have the support they need to provide students with a first-class education..

Mansfield (2014) conducted a detailed case study of the Centro Urbano YWLS. The ethnographic case study, designed to give "voice" to the young learners, took place over two years and included participant observation, photography, ongoing conversations with teachers, support staff, and parents, a student survey and focus group interviews. The school is located in an impoverished, primarily Hispanic community. Underscoring the socioeconomic situation of the students, the principal urged the researcher to offer the students a meal during focus groups. In marked contrast to the failing schools the girls might have otherwise been forced to attend, Mansfield

immediately noticed a clean, orderly, comfortable atmosphere where public spaces were decorated with college banners, photographs of students engaged in a variety of activities, and quotations from figures like Martin Luther King, Jr., Maya Angelou, and Eleanor Roosevelt. Books and posters throughout the school celebrate the achievements of women.

Student survey responses described the school climate as friendly and responsive to students' needs (Mansfield, 2014). Asked for their favorite features of the school, "friends" and "clubs and sports" were the most popular (72%), followed by teachers (69%). In response to what they would change about the school, there was widespread interest in having more classes and clubs in the fine and performing arts, along with more opportunities to learn languages other than Spanish.

The girls gave generally high ratings to their teachers, who were described as exciting and interesting as well as competent (Mansfield, 2014). Although overall, the teachers were rated as friendly and helpful, language arts and social studies teachers were given superior ratings compared to mathematics and science teachers. This may simply be a reflection of differences in the disciplines. Lively discussion was an intrinsic element of responsive social studies and language arts classes. In general, the students described the teachers, school staff, and learning environment in extremely positive terms. A theme that consistently emerged in responses was how well the school was preparing the students for college.

The students' portrayal of their current learning environment was a sharp contrast to their depiction of former schools, where "gangs, guns, and pregnancy" were rampant

(Mansfield, 2014, p. 416). The girls also described marked differences in academic emphases; their previous schools offered few opportunities for high quality learning experiences. Rather than offering upward mobility, attending overcrowded, poorly run, and inadequately resourced schools can have serious deleterious consequences for the economic futures of girls of color (NWLC & LDF, 2014). Even girls who reported getting good grades in their former schools commented that it was hard to learn in the disruptive environment (Mansfield, 2014).

One conflict that arose for the students was the gap between the YWLS culture and the attitudes of peers in their home communities. Students reported being called "Oreos" or accused of "acting White" (Mansfield, 2014). Some were confronted with homophobic slurs due to their choice of an all-girls school. Several students reported being harassed by neighborhood peers or even having rocks thrown at them. These incidents impeded the girls' adjustment to their new school, further complicating the notoriously challenging middle school transition. Despite the highly supportive atmosphere of the YWLS, the students' comments suggest that the staff may not have paid sufficient attention to their socioemotional development, which is often neglected by the emphasis on academic performance (Polleck, 2010). Adolescents' socioemotional and intellectual development should be treated holistically.

Mansfield (2014) views education through the lens of social justice. According to Mansfield there was a glaring gap between rhetoric and practice in the school's recognition of the realities of the girls' lives outside of the school and the societal stereotypes they faced and the failure of school personnel to give sufficient attention to

the difficulties faced by the girls' regarding their cultural and sexual identities. From Noddings's (2012) perspective of caring, the teachers were attentive to the students' *presumed* needs but not their *expressed* needs. In fact, Mansfield (2014) noted that before her survey, the school did not solicit the students' perspective. The school administration was unaware of the problems the girls were having until they were "given space to speak openly" (p. 424).

According to McGee Banks and Banks (1995), equity pedagogy is transformative. Other authors agree that students should be provided with transformative learning experiences (Park, 2012; Polleck, 2010; Sampson & Garrison-Wade, 2011). Mansfield (2014) argues that schools must have transformative leaders if they are to effectively challenge inequalities and promote social justice. The YWLS is still a work in progress. Overall, the girls are satisfied with their learning experience and feel they are being well prepared for college. However, they clearly need help and support in bridging the chasm between their school and neighborhood cultures.

Teachers' Perspectives

Wilkins (2014) explored urban high school teachers' perceptions of the student behaviors they deemed important for positive teacher-student relationships. She noted that while the atmosphere of small schools is conducive to cultivating a sense of connection between students and teachers, the structure of large urban high schools is more likely to inhibit the development of close relationships between students and faculty. Indeed, this is one reason why many urban high schools have been creating small academies within the larger school. The teacher study was part of a research

project investigating the attributes preferred by both teachers and students for good teacher-student relationships. Representing 11 content areas, the participants taught at eight high schools in a district with an unduly high rate of teacher attrition (27%). The overwhelming majority of students are members of racial and ethnic minorities and more than three-quarters (79%) are eligible for free or subsidized meals.

Five teachers were chosen for detailed interviews based on students' nominations of teachers with whom they had good relationships (Wilkins, 2014). Their responses augmented an (anonymous) online survey completed by 103 teachers. Special educators comprised the largest group of respondents (25%), followed by English language arts teachers (20%) and social studies teachers (11%).Wilkins noted that the 103 represented only a fraction of the 571 teachers requested to participate. A plausible explanation is that the survey was unappealing to teachers with poor relationships with their students. Given the difficulty Bonner (2014) had in finding successful mathematics teachers their absence from the study may not be surprising.

Responses to the survey (which had been designed for the study) produced three factors: *Demonstrating engagement and interest in school work, Being respectful, rule-abiding, and cooperative,* and *Demonstrating positive social behaviors* (Wilkins, 2014). The interviews provided insight into how teachers created a classroom milieu that elicited these behaviors. The first theme, cited by four of the five teachers interviewed centers on humor, specifically: *Having a sense of humor (understanding the teacher's humor)*. Humor helped to create a non-threatening, comfortable classroom environment.

The teachers used humor to relate to their students, engage them in learning, and express their own personalities.

Showing respect was the second theme, denoting a mutually respectful relationship but still recognizing the teacher's professional authority (Wilkins, 2014). Explicitly as well as implicitly, respect for the teacher also meant showing respect to other students. The third theme to arise was *Trying hard in class,* which was also framed as mutual and reciprocal. The teachers felt it was their responsibility to create a comfortable, motivational learning environment, and they expected their students' to show effort in return. Wilkins noted that while studies have confirmed the powerful impact of teachers' caring on student learning, these teachers "expressed a strong need to feel cared for by students" (p. 66). Noddings (2012) elaborates the reciprocal nature of caring.

Students' Perspectives

Tosolt (2010) examined middle school students' perceptions of caring teachers with emphasis on the effects of gender and race. The study took place at an urban private preK-8 school serving primarily African American students from families that vary in income status. The faculty, staff, and administrators were ethnically diverse, though analysis revealed that most Black faculty members taught lower grades, thus the fifth through eighth grade classrooms that were the focus of study involved mainly Black students and White teachers. The analysis was based on the responses of 27 Black students and 19 White students. Girls comprised close to two-thirds (64%) of the sample.

The students' responses were divided into *academic caring* and *interpersonal caring* (Tosolt, 2010). Interestingly, the students' preferences defied stereotypical gender assumptions. That is, the boys preferred interpersonal caring behaviors (hugging, making eye contact, protecting, complimenting appearance) while the girls favored academic caring behaviors (explaining, answering questions clearly, complimenting academic performance). When analyzed by race, Black students were also more likely to prize academic caring. From a cynical perspective it is possible that the students value the type of caring they were less likely to receive. However, Tosolt emphasized that the students viewed *all* their teachers as caring, consistent with the school's dedication to creating strong bonds between teachers and students.

According to Tosolt (2010), caring merits further study because "a teacher's care does not take place unless a student perceives that care" (p. 150). Building on that perspective, Shaunessy and McHatton (2009) noted that students and teachers may have different ideas of what constitutes a caring classroom. Studies exploring caring from students' perspectives are scarce. Tosolt (2010) stressed the importance of understanding individual differences in how students perceive caring. Shaunessy and McHatton (2009) examined how students' status in school (general education, special education, honors education) affects their perceptions of caring teachers. The mixed methods study included 577 students in grades nine through 12 attending a large urban high school. The participants were 234 general education students, 142 special education students, and 201 students in an honors program. After the students had completed the Teacher Interactions Survey in fall 2005, a volunteer sample of students

from each group participated in focus group discussions exploring issues related to teaching, learning, relationships with teachers, life at school, and success.

The main survey findings related to punitive and supportive feedback (Shaunessy & McHatton, 2009). Special education and male students received more punitive feedback than other groups. Shaunessy and McHatton proposed that punitive feedback might have been used as a mechanism for behavioral control, though this was speculative. Compared to their White peers, Hispanic and African American students received more supportive and more punitive feedback. Similarly, special education students reported more supportive feedback as well as punitive feedback compared to honors and general education students. It is possible that minority and special education students are more sensitive to feedback from teachers. Alternately, teachers with a social justice orientation may be especially responsive to minority students and students with special needs (Evans, 2013a, 2014).

The focus group discussions revealed that teachers who appear "passionate about their work" elicit higher levels of motivation from students, who feel more responsive in class and more successful (Shaunessy & McHatton, 2009). Not surprisingly, "Teachers who conveyed passion for teaching, enthusiasm for subject content, and pedagogical expertise ignited a desire in their students to perform well, if for no other reason than to please the teacher" (p. 499). Notably, caring was mutual; the students expressed empathy for teachers who showed dedication despite challenging professional circumstances or personal trauma.

On the negative side, some students described teachers who were inexcusably cruel or apathetic in the classroom (Shaunessy & McHatton, 2009). Regardless of educational status, gender, or ethnicity, students described being publicly reprimanded, ridiculed, or belittled. Although such incidents seemed to be rare they were nonetheless disturbing and exemplified an intentionally disinviting culture (Ford, 2015). African American students surveyed by Sampson and Garrison-Wade (2011) preferred having a teacher of the same race, or alternatively, a culturally responsive White teacher. The Black and Latino/a NYCTF teachers felt their cultural backgrounds helped them connect with their students and/or their families (Evans, 2014). However, the disparity in cultural backgrounds between public school students and their teachers continues to widen, with detrimental effects on many students of color (Dorman, 2012; Douglas et al., 2008).

Douglas et al. (2008) argue that White teachers often view Black students from a deficit perspective in which preconceived notions that Black children lack the knowledge, skills, and attitudes needed for academic success preclude their ability to provide them with high quality learning experiences. The teachers in Williams's (2010) study seemed to confirm this. To gain insight into the students' perspectives, Douglas et al. (2008) interviewed eight Black students, five girls and three boys in grades 10-12 at two predominately White high schools. All participants had a minimum GPA of 2.5. Four themes arose from the interviews: *Respect: I Need Respect, Stereotypes: Don't Pass Judgment on Me, The Administrators Need to Check Themselves,* and *We Like This Environment* (Douglas et al., 2008). It is not surprising that respect should be the

dominant theme. Respect is critical for good student-teacher relationships (Noddings, 2012; Roberts, 2010; Wilkins, 2014). All the students described at least one incident where they felt disrespected; several students felt it essential to address these situations immediately (Douglas et al., 2008). Regarding stereotypes, most of the students felt that their teachers and peers judged them negatively due to their skin color, and in some cases, the way they chose to dress. A common occurrence was that the students often routinely asked their opinions on various issues "just to get a Black person's point-of-view" (p. 55). This can be a common occurrence for Black women in higher education and professional settings (Collins, 2000).

Douglas et al. (2008) had expected respect and stereotyping to be important concerns but they were not prepared for the students' powerful perceptions of school administrators, who were portrayed as out of touch, hostile, racist, lacking compassion and understanding, and unwilling to build relationships with their students. Rather than viewing school administrators as adults they could turn to for support and assistance, the students viewed school administration as "the one place a student should not go for comfort and equity" (p. 56). While Evans (2014) found it somewhat dismaying that NYCTF teachers preferred becoming administrators to classroom teaching, their social justice orientation may be even more important in their future roles as school leaders.

The most striking finding was that despite negative experiences at their present school, the students were unanimous in their belief that their current school environment was much more favorable academically and socially than the predominately Black schools they had previously attended (Douglas et al., 2008). Some participants felt they

might have dropped out had they stayed in their former schools or communities, and one student felt she might have been a teen parent like many of her former classmates. Although it was not the original intention, the students' comments highlighted the problems that lead students of color to find alternatives to neighborhood schools.

Atwater's Influence on Science Education

Parsons (2008) elucidated that the perspective and dynamics of science education as early as a few decades ago, was subjected to, and reflective of the segregation that existed during those years. During those times Mary Monroe Atwater - at the risk of losing her career – courageously entred the scene and courageously pioneered a place in science education, for those who would have otherwise been omitted.

It is noteworthy that Mary has been a defender throughout her career for parity - distinct from and fundamental to - what she termed multicultural science education. She demarcated multicultural science education as a field of inquiry, a construct, and an educational reform movement aimed at providing equitable opportunities for all students to learn quality science in schools, colleges, universities, and in informal settings (Atwater, 1996). Teachers and students have overtime utilized the visions of multicultural education, to empower themselves, in the art of art of critically arrogating knowledge existing outside of their immediate experiences in order to broaden their comprehension of themselves, the world, and the opportunities for transmuting the overwhelming assumptions about their way of life (Atwater, 1993; McLaren, 2015; Parsons, 2008).

As an individual who have accomplished many firsts in the field of science and science education, Mary Atwater continues to make strides in bringing awareness to the inequities and social justice issues regarding multicultural science education that have persisted over the years. Her fight to improve the science curriculum, bridge the gender and race gap in science education and by extension iradicate the paucity that exists in this field, has been, and continues to be ground breaking.

Mary Atwater's professional legacy encompasses three general objectives:

(a) to broaden the perspectives from which quality research in science education is conducted,

(b) to promote quality science for all with an emphasis upon culturally diverse groups, and

(c) to diversify the community of science education researchers (Parsons, 2008, p. 210).

Nieto (1993) noted that, there is no recommended blueprint for teachers or curriculum developers to follow, with regards to multicultural education or multicultural science. Notwithstanding, the actuality of science curriculum standards and justifications of what should be the core student science comprehension, the contents, models, and perspectives remain unaffected (American Association for the Advancement of Science, 1989, 1993; The National Academies Press [NAP], 1996). Atwater (2010), Banks (2004), Baptiste (1994), and Nieto (1993) concurred that Teachers should use multicultural science education curricula not just to add to the existing science content but, rather, to make structural changes in the science content and process.

The National Council for the Accreditation of Teacher Education (NCATE) has mandated teacher education programs since the late 1970s, to include multicultural

education in the pre-service curricula. The greater part of the teacher education programs however, has over the years chosen to place focus on training educators to augment the prospects and experiences of learners of color, learners from low-income backgrounds, and English language learners, but little attention has been placed on equity and social justice (Darling-Hammond, 2002; Gollnick, 1995; Lee, Luykx, Buxton, & Shaver, 2007; Lucas & Greenberg, 2008). In recent years, some multicultural teacher educators - a few among multicultural science teacher educators - continue to call for a focus on equity and social justice (Cochran-Smith, Barnatt, Lahann, Shakman, & Terrell, 2009; McDonald & Zeichner, 2009; Nieto & McDonough, 2011; Tan, 2009).

Allen, Epps, Guillory, Suh, and Bonous-Hammarth (2000) and asserted that the underrepresentation of Black faculty continues to be a persistent problem in US higher education. Even with slight improvement over the decades, studies still show that Black faculty members are less often tenured, earn less, work at less prestigious institutions, have lower academic rank, and have less academic stature compared to their White counterparts (Patitu & Hinton, 2003).

Creating a Caring Classroom

Noddings's (2012) work is often invoked in portrayals of caring teachers (Roberts, 2010; Shaunessy & McHatton, 2009; Tosolt, 2010). According to Noddings (2012), in care ethics, "relation is ontologically basic, and the caring relation is ethically (morally) basic" (p. 771). Some relationships, such as teacher and student, are inherently unequal, yet they are built on the contributions of both parties toward creating and sustaining care.

Noddings (2012) cites being *attentive* as the foremost quality of the carer. Embedded in an ethic of care, a caring teacher is invested in listening to the *expressed* needs of the student as opposed to the student's needs as presumed by the educational institution and the prescribed curriculum. This point is very important in understanding the nature of good teacher-student relationships. Teachers and students may have different conceptions of caring (Shaunessy & McHatton, 2009; Tosolt, 2010). For the student to perceive the relationship as caring, the teacher's actions must be matched with the student's needs.

The ethic of care is the basic foundation for multicultural education and the most significant aspect of commitment to students; this commitment can be a motivating factor in liberating urban public schools from prejudice and discrimination. Culturally responsive teaching is inherently a way to respond to students that builds and sustains meaningful, positive relationships, and leads to "caring for" them rather than "caring about" them. As a result learning becomes a two-way responsibility. Teachers care enough to provide relevant and thoughtfully planned learning experiences and students in turn are motivated to work hard in order to become successful in their learning. This also motivates educators at a personal level to include in their daily actions culturally relevant practices that make schools more meaningful, effective, and equitable (Pang, 2005). Although at time care centered teachers encounter difficult challenges, as culturally responsive educators they are guided by their own sense of justice to examine their personal racial, social class, disability, and gender biases in social institutions, such as schools (Pang, 2005).

According to Pang (2005) teachers must care enough to provide effective, interesting, and well-developed learning experiences, and reciprocally students must study and work hard in order to become successful in learning. The Ethic of Caring has been defined by Noddings (1992), as teachers making a moral commitment to caring for and teaching each student and to developing a reciprocal relationship with them. According to Pang (2005), caring teachers are open to addressing the painful inequities in schools and receptive to examining their own beliefs because they have made an ethical commitment to their children and to to making their schools more relevant and effective for all kids (p. 64). The foundational and fundamental beliefs about caring in education are valued by these teachers and are used for academic attainment (Pang, 2005).

Listening is important for meeting students emotional and intellectual needs (Noddings, 2012). According to Friend et al. (2011), "Black girls are expected to remain voiceless or silent because they, and their voices, are not valued in a racist and sexist educational setting" (p. 52). "Talking with an Attitude" (TWA) is a common reaction by Black girls and women who feel they are being ignored or disrespected (Friend et al., 2011; Koonce, 2012). As a transgression of traditional European gender role socialization, this assertiveness has led to the label "those loud Black girls," and is often interpreted by teachers as defiant and oppositional, resulting in discipline referrals and negative effects on grades. Noddings (2012) emphasizes that good teachers should have discretion in exercising their moral and professional judgment in responding to students'

needs. A caring relationship must be based on mutual trust and respect (Douglas et al., 2008; Noddings, 2012; Shaunessy & McHatton, 2009; Wilkins, 2014).

Noddings (2012) points out that caring has cognitive as well as emotional dimensions. Caring also means that teachers are competent. In earlier work, Noddings emphasized that teachers should be capable of drawing on all the humanities in ways that will enrich their teaching, and consequently, the intellectual, social, and cultural lives of their students. She declared that creating a climate of care and trust should be a top priority for all educators and policymakers. In response to teachers who view a climate of care as extraneous to covering the prescribed curriculum and promoting their students' academic achievement, Noddings declares that a climate of care is the foundation for good teaching. Creating and sustaining a climate of care is prerequisite for high quality teaching and learning.

Equity Pedagogy

McGee Banks and Banks (1995) elaborated the concept of equity pedagogy two decades ago as public schools were becoming increasingly diverse and achievement gaps based on race, ethnicity, and socioeconomic status (SES) gained widespread public attention. They define equity pedagogy as "teaching strategies and classroom environments that help students from diverse racial, ethnic, and cultural groups attain the knowledge, skills, and attitudes needed to function effectively and help create and perpetuate a just, humane, and democratic society" (p. 153). This definition invokes John Dewey's vision of classrooms as laboratories for democracy more than a century earlier.

Teachers who espouse equity pedagogy create classrooms based on social constructivist principles (Vygotsky, 1978). Students are actively involved in constructing knowledge and the teacher acts as a facilitator of knowledge as opposed to an authority figure who imparts knowledge on passive students (McGee Banks & Banks, 1995). One feature that distinguishes equity pedagogy from other constructivist teaching approaches is the awareness of power dynamics. For example, McGee Banks and Banks noted that while cooperative learning is a popular and effective technique, teachers must be aware of issues such as status differences among students. Without such awareness they run the risk of reinforcing stereotypes and inequities.

McGee Banks and Banks (1995) view equity pedagogy as *transformative.* They argue that it must be considered in the context of school and classroom power structures that perpetuate unequal treatment of students in the school setting. Tracking, for example, is deeply entrenched in the American school system. Indeed, tracking plays a prominent role in denying Black girls access to the advanced mathematics courses requisite for pursuing STEM education (Campbell, 2012). Teachers' stereotypical beliefs influence their recommendations of students for advanced mathematics courses to the detriment of girls and students of color. Teachers need to engage in critical reflection and analysis to transcend these beliefs (McGee Banks & Banks, 1995).

Social Justice Pedagogy

Social justice pedagogy is an expansion of equity pedagogy. Social justice pedagogy may be defined as "the teacher's commitment to equal rights for all regardless of race, ethnicity, gender, or sexual orientation" (Evans, 2013a, p. 17). Beyond

dedication to an abstract ideal, Evans (2013a) stresses that translating the rhetoric into action requires providing all students with high-quality learning experiences with special attention to expanding learning opportunities for students from traditionally underserved groups. Furthermore, a social justice orientation demands that teachers value diversity and oppose all types of discrimination.

New teachers whose teacher preparation program promotes a social justice orientation are likely to reject stereotypical assumptions that limit educational opportunities for girls, low-income students, and students of color (Evans, 2013a, 2013b). However, school leaders are the ones who set the tone for the school. According to Mansfield (2014), school leaders with social justice awareness must be aware that schools have the potential to either reproduce or resist the injustices found in the greater society. Social justice dialogue engages school leaders and educators in grappling with issues related to students' intersecting identities, including race, gender, ethnicity, and social class. Consistent with Noddings's (2012) assertion that caring teachers must be attentive to students' expressed needs, Mansfield's (2014) gives precedence to student voice in advocating for social justice.

Culturally Responsive Pedagogy

McGee Banks and Banks (1995) framed equity pedagogy within the context of multicultural education. Culturally responsive pedagogy has recently emerged as a prominent topic (Roofe, 2015; Rychly & Graves, 2012; Sampson & Garrison-Wade, 2011). Culturally responsive pedagogy is distinguished from multicultural education in

that culturally responsive education must be relevant to the cultures of students who populate the particular class (Rychly & Graves, 2012).

Schmeichel (2012) credits Ladson-Billings (2009) with bringing the concept of culturally relevant pedagogy to the forefront of theory and research on education reform. The teachers interviewed in Ladson-Billings's classic work *The Dreamkeepers* promoted high academic achievement in their African American students while creating a learning environment that respected their cultural integrity.

However, Schmeichel (2012) cautions that however positive the intentions, culturally relevant teaching can work to perpetuate cultural stereotypes that inhibit the full participation of students of color in education. At the center of culturally relevant teaching is the idea that children of color are "culturally different" from White children who remain the standard for gauging behavior (p. 223). In fact, Schmeichel's (2012) critique of culturally relevant pedagogy parallels arguments against separating students by gender (Eliot, 2013; Patterson, 2012). To Sampson and Garrison-Wade (2011), the challenge for educators is integrating culturally relevant lessons into the classroom curriculum in ways that appeal to all students. To correct inequalities teachers must be aware of individual differences. Within-group differences consistently surpass inter-group differences; there is much greater overlap in the learning preferences of children of different racial, ethnic, and gender groups than there are differences between groups (Eliot, 2013; Schmeichel, 2012).

Student teachers often have difficulty translating the knowledge they gain in coursework on culturally responsive pedagogy to actual classroom practice (Roofe,

2015; Stairs, 2010). Roofe (2015) advocates *context-responsive* teacher education to prepare prospective teachers for teaching in urban schools. That is, teachers must be prepared for the schools in which they begin their teaching careers. This is especially critical for teachers whose backgrounds are vastly different from those of their students. According to Roofe, preservice teachers must have knowledge of the demographics, historical background, and sociopolitical climate of the schools in which they will probably teach and be equipped with a large repertoire of strategies for context-responsive teaching. Moreover, she asserts that student teachers need *transformative* learning experiences, which entails engaging in "a continuous process of reflection that brings together their past and present experiences" (Roofe, 2015, p. 16).

Rychly and Graves (2012) outlined four teacher attributes that are critical for enabling teachers to successfully design and implement culturally responsive pedagogy. First, teachers must be caring and empathetic. To Noddings (2012), these qualities are essential for all good teachers. Second, teachers are reflective regarding their beliefs regarding people from other cultures (Rychly & Graves, 2012). Third, teachers are reflective about their own cultural perspective. Fourth and finally, teachers must be knowledgeable about other cultures.

Culturally Relevant Caring

Care theory and critical race theory (CRT), drawn primarily from the works of Noddings (2012) and Ladson-Billings (2009), served as the theoretical framework for Roberts's (2010) phenomenological study of teachers' caring for African American secondary school students. The study was also inspired by the practices of African

American teachers who combine culturally relevant teaching with unwavering high expectations for student achievement. An important aim of the study was to develop a theory of culturally relevant critical teacher care.

The participants were eight African American teachers from two high schools nominated by their principals for being "exceptionally successful in helping African American students achieve academically" (Roberts, 2010, p. 456). Both high schools were predominately African American (96%) but one was lower-income and one was middle-income. Eleven themes emerged from the interviews, in which the teachers described behaviors that addressed the presence of racism in the students' lives, reflected elements of CRT, and paralleled the empirical literature on African American teachers before and after the *Brown* decision. Roberts focused on the two most common themes: *political clarity/color talk* and *concern for students' futures.*

According to Roberts (2010), color talk is closely linked with political clarity and occurs when teachers of color inform students of the same marginalized culture of the challenges and issues relevant to being a member of that culture in American society. Political clarity refers to conversations between a student and teacher or teacher and parent that in which the teacher acknowledges the influence of race on everyday realities and critiques racialized or stereotypical assumptions based on recognition that "race does make a difference" in experience (p. 458).

Friend et al. (2011) noted that African American families continue to face inequities in educational opportunities for their children, but that does not deter their belief that educational success is the key to upward mobility. Parents often employ

racial socialization techniques to help children develop competencies that will help them overcome the inequities inherent in the educational system (Brittian & Gray, 2014; Chavous et al., 2008; Dotterer et al., 2009; Friend et al., 2011; Thomas et al., 2009). Most studies find positive benefits for racial socialization and some studies suggest that strong racial identity may be more advantageous for girls.

The teachers interviewed by Roberts (2010) tried to guide their students toward activities that would offer them a better future and cautioned them against actions that would damage their future academic and economic prospects. A common theme involved discussing career opportunities with students to expand their knowledge of careers that did and did not require a college degree.

Students of color are notoriously underrepresented in gifted education programs. Although gifted education is beyond the scope of this study, an ideal classroom is based on the belief that all students have gifts and talents they should be encouraged to fulfill. Annemarie Roeper pioneered understanding of the unique social and emotional needs of gifted children (Scott, 2012). From the perspective of adolescent development, Polleck (2010) points out that cognitive and socioemotional growth cannot be separated. However, the current emphasis on academic performance has downgraded attention to young learners' socioemotional needs. According to Scott (2012), this is especially true of gifted Black children, where the focus on countering their underrepresentation in gifted programs emphasizes cognitive and academic development to the detriment of socioemotional issues. Whether in gifted or regular education, acknowledging

socioemotional development issue involves attention to race, ethnicity, gender, class, and other personal characteristics (Park, 2012; Polleck, 2010).

In making a case for the need for culturally responsive gifted education, Scott (2012) drew on the work of Ford (2015) who has been a consistent advocate of culturally responsive gifted education. Ford, in turn, drew on Purkey and Novak's concept of *invitational learning*. Invitational learning has four basic dimensions: respect, trust, optimism, and intentionality. Invitational learning is not limited to gifted education, but rather has the potential to correct inequities and create an optimal learning environment for all students.

Respect denotes recognition that all students are capable and valuable and should be treated accordingly across sociodemographic characteristics and backgrounds (Ford, 2015). Mutual trust and respect are essential elements of caring classrooms (Noddings, 2012). In the context of invitational learning, trust implies that education "should be a cooperative and collaborative experience, whereby students share equal status" (Ford, 2015, p. 68). Students trust educators to be caring and professional, and educators must trust that their students can perform at high or higher levels despite challenges and cultural differences. Optimism is framed as high expectations for students of all groups.

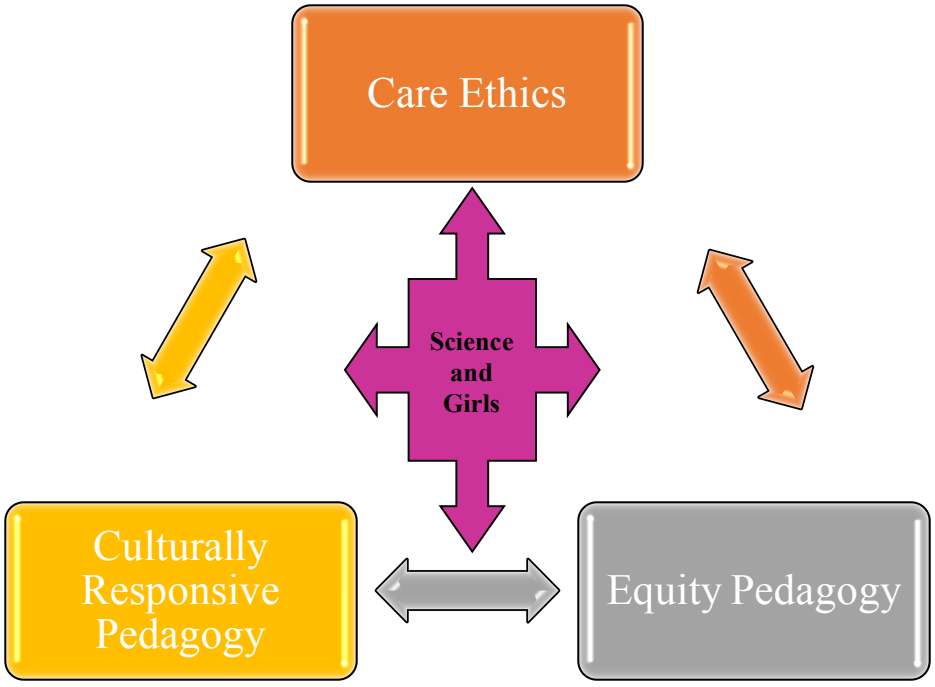

Figure 1. Conceptual framework for successful school science teachers in an urban girls' school.

Intentionality is more complicated than the first three features, which are characteristic of good teaching in any setting. Intentionality draws on what Purkey and Novak called the "5 Ps": people, places, policies, programs, and processes (Ford, 2015). Intentionality refers to the deliberate deployment of people, places, policies, programs, and processes to help students realize their full potential. Schools, classrooms, and programs that are intentionally inviting are staffed by educators who have an expansive knowledge base and unconditional respect for students and their families. Teachers convey messages that contribute to students' sense of self-worth and self-confidence, which promotes optimal development, defined by Ford as the foundation for a healthy,

productive academic self-concept and racial identity, which promotes and sustains achievement.

Indeed, Byrd and Chavous (2011) found that a school climate that fosters a strong, positive racial identity (that is, teachers and staff convey positive message about race) enhances intrinsic motivation to learn among African American adolescents. A New York City study found that African American girls who had a strong sense of racial heritage and identity, were happier, more committed to their academic work, achieved higher grades, and had higher educational aspirations than their less "Afrocentric" peers (NWLC & LDF, 2014). Moreover, the Afrocentric girls also expressed more confidence in achieving their goals and reported better relationships.

Other studies have found that a strong racial identity can protect Black adolescents against the harmful detrimental effects of discrimination on academic achievement (Chavous et al., 2008; Dotterer et al., 2009; Thomas et al., 2009). Strong peer support has a similarly protective effect (Brittian & Gray, 2014). However, the focus of these studies was on discrimination Black students experienced *at school* by teachers and peers. From the perspective of invitational learning, these school environments were *disinviting,* intentionally or unintentionally. In schools, programs, and classrooms that are intentionally disinviting, teachers deliberately convey messages that portray students as incapable, irresponsible, unimportant, and worthless. They are fully aware that their actions degrade and demean students. In settings that are unintentionally disinviting, educators are unaware of their actions and their negative impact on students, but the environment is detrimental to students nonetheless. In fact,

unintentionally disinviting educational environments may be especially insidious. Unfortunately, low-income girls of color are often taught in disinviting schools and classrooms, where their sense of self-worth is assaulted by the dual effects of race and gender stereotypes (NWLC & LDF, 2014).

Cultural Influences

In a follow-up to his research on NYCTF teachers' attitudes toward teaching mathematics to students from underrepresented groups and female students (Evans, 2013a, 2013b), Evans (2014) interviewed four new NYCTF teachers and an adjunct faculty members who taught an elementary mathematics and a special education course to NYCTF candidates about how their views on ethnic background influenced their teaching. NYCTF deliberately recruits teaching candidates from diverse groups. The participants were a Black female teacher in her second year teaching, two Latino male teachers in their first and second years of teaching, a 60-year old Black man who had just begun the program after a Wall Street career, and the teacher educator, a Latina who had been a Teaching Fellow for six years before becoming a faculty member. Two of the teachers had been paraprofessionals before beginning the program and two career changers had mentored young learners in the community. All taught special education classes.

Although the teachers felt their own backgrounds helped them connect with their students (Evans, 2014), this was less true of the older Black man, who taught very low functioning autistic students, who were very difficult to reach. Nevertheless, he felt his ethnicity helped him build relationships with their parents, particularly those who shared

his Caribbean heritage. Indeed, he found his good relationships with parents especially rewarding. This stands in marked contrast to the difficulties of many White teachers in building collaborative partnerships with Black parents (Wallace, 2013). Most of the themes were unrelated to the teachers' ethnicities, but rather reflected the challenges they faced in teaching students with special needs and behavioral problems in schools with inadequate resources (Evans, 2014). Despite this, the teachers were dedicated to helping their students develop critical thinking and problem solving skills as well as life skills that would help them become independent adults. They found it rewarding to see their students thrive academically despite their limitations.

Despite the generally high rates of retention among NYCTF teachers, Evans (2014) noted that only one teacher desired to stay with classroom teaching; the others aspired to become school administrators, teacher educators, or switch to another area of education. The importance of having teachers who embrace social justice in these positions should not be downgraded. However, the loss of dedicated, caring classroom teachers is especially detrimental to low-income and minority students who have the most urgent needs but are often taught by the least qualified teachers (NWLC & LDF, 2014).

Using the Cultural Awareness and Beliefs Inventory (CABI), Williams (2010) explored the attitudes and perceptions of middle school teachers toward African American students. Notably, some teachers were resistant to taking the survey, preferring to view themselves as "colorblind." Many responses indicated that the teachers viewed students of color through a deficit lens, which has historically framed

interactions between White teachers and minority students to the detriment of the students' academic and social development (Schmeichel, 2012).

Middle school can be notoriously challenging for students and teachers alike, and many teachers expressed negative perceptions of the middle school culture, climate, and learning environment (Williams, 2010). Much of it seemed to arise from a mismatch between the teachers' and students' cultures. Williams noted that the study took place in an award winning urban district with high expectations for improving student achievement yet African American students still lagged behind their White peers academically. According to Williams the teachers use their deficit perspective to rationalize achievement gaps, which only perpetuates inequities and impedes the academic progress of students of color. Consistent with Brown and Benken (2009), Williams (2010) recommends culturally responsive professional development.

Culturally Relevant Instruction

Sampson and Garrison-Wade (2011) examined whether African American students preferred culturally relevant American history lessons in a study entitled "Cultural Vibrancy." According to the researchers this title was inspired by the "vibrant faces" first author Sampson observed in African American children enthralled by a culturally relevant history lesson. To Sampson, the students' interest, the degree of camaraderie between the teacher and students, and the children's sense of connection to the curriculum were "exceptional" (p. 281). Sampson and Garrison-Wade were dismayed to find that such lessons were unusual, declaring that, "Allowing students to connect with their culture while achieving academic success should not be a matter of

cultural conflict for them; rather, it should be the standard upon which learning and cultural connection is based" (p. 281).

CRT and Racial Identity Development served as the framework for the study (Sampson & Garrison-Wade, 2011). The mixed methods study took place in an ethnically diverse mixed grade (9-12) American History class in a large urban high school (Sampson & Garrison-Wade, 2011). The culturally relevant lessons included oral traditions, music, historical connections, and a field trip, taught by Dr. Sampson, a Black female. The regular classroom curriculum provided the non-culturally relevant lessons. The regular classroom teacher was a White male.

The culturally relevant field trip included elements of both African American and Latin American history and was widely popular (Sampson & Garrison-Wade, 2011). Out of school learning experiences provide an excellent vehicle for expanding learning opportunities and career aspirations for minority and female students (Adams et al., 2014). In particular, the students enjoyed learning about their histories in their own community (Sampson & Garrison-Wade, 2011). The field trip also enhanced the students' sense that they had a teacher who cared for them, given the time and effort Dr. Sampson spent in organizing the trip.

Indeed, the students' comments reinforced the findings of Shaunessy and McHatton (2009) that students respond positively to teachers who display passion, excitement, enthusiasm, and expertise in their work and genuine interest in their students. According to Sampson and Garrison-Wade (2011), the preferences of African American students were best summarized by one girl who declared, "We just want to go

to school and believe our teachers like us" (p. 295). The researchers observed that many African American students expressed anxiety about being liked by their teachers. Above all else, they wanted to be liked and thought of as intelligent and capable. The students concurred with the teachers surveyed by Wilkins (2014) that humor was important for creating a comfortable classroom (Sampson & Garrison-Wade, 2011).

For students from groups from traditionally marginalized groups, culturally relevant lessons serve as a source of empowerment. However, some African American students were ambivalent about the place of culturally relevant lessons in an ethnically diverse classroom. This led Sampson and Garrison-Wade (2011) to call for future research on how culturally relevant lessons can be seamlessly integrated into the regular classroom curriculum. They recognize the importance of sensitivity for discussing issues with powerful social and political implications. Notably, the African American students expressed a preference for a teacher of the same race, but were also positive toward a White teacher who validated their culture. Sampson and Garrison-Wade proposed that Black teachers could mentor White teachers. Beyond culture, the students favored active, experiential learning experiences led by passionate, caring, creative teachers—a preference that transcends race, ethnicity, and gender.

Social Support, Self-Esteem, and Discrimination

The previous finding reported by Spilt et al. (2012) is especially disturbing given that middle school often marks a decline in academic engagement and performance. Entering middle school setting can be challenging for all students in view of the school's typically larger size, social competitiveness, and declines in close relationships with

teachers due to the school's different organization and subject matter specialization (Brittian & Gray, 2014). Despite being carefully designed to create a supportive learning environment, even the YWLS did not adequately support the girls' transition to middle school (Mansfield, 2014). According to Brittian and Gray (2014), the school transition may be complicated for Black students who are subjected to discriminatory treatment by teachers.

In contrast to other studies (Chavous et al., 2008; Dotterer et al., 2009; Thomas et al., 2009), Brittian and Gray (2014) did not observe a protective effect for strong ethnic identity. However, they found that peer social support had a beneficial effect. Perceived discrimination was only detrimental to the academic performance of African American students who did not enjoy strong peer support. Wang and Eccles (2012) found that prosocial support from peers exerted a more powerful influence on middle and high school students' compliance with school than teachers' social support, while teachers' support had a stronger influence on students' identification with school.

McMahon, Felix, and Nagarajan (2011) investigated how social support and neighborhood stressors related to economic disadvantage influence the self-worth of urban African American youth. The participants were in grades six through eight in two Chicago public schools. The researchers approached the topic from a network perspective that recognizes various types of social support and their different effects.

Notably, female family members (mothers, grandmothers, sisters, aunts) were consistently cited as important sources of social support (McMahon et al., 2011). Mothers were the most prominent source of emotional, tangible, and informational

support, while friends were key sources of emotional and instrumental support. Teachers were the primary source of informational support. McMahon et al. acknowledged that this is consistent with their role as educators, but they proposed that teachers also serve as important role models. Based on studies documenting the impact of teachers on children's social, emotional, and academic development, McMahon et al. had expected teachers' support to influence the students' sense of self-worth, but no significant link was found. Rather, the findings supported the benefits of extended family network support on the self-worth of urban African American youth. One implication of these findings is that teacher education and professional development programs should be designed to prepare urban teachers to establish collaborative partnerships with urban families and communities (Warren, Noftle, Ganley, & Quintanar, 2011).

Support and Resilience

The type of self-enhancing messages that Ford (2015) describes foster resilience and counter negative stereotypes and discrimination based on race, ethnicity, gender, and social class (Adams et al., 2014; Morales, 2010; NWLC & LDF, 2014). According to Evans-Winters and Esposito (2010), studies examining positive adjustment and school resilience among Black female students are scarce, possibly because many scholars are unaware of the high proportions of Black girls who succeded academically despite obstacles posed by social and economic disadvantage. In a three-year study Evans-Winters found that the most resilient Black adolescent girls received the combined support of families, school, and communities (Evan-Winters & Esposito, 2010).

In a study exploring the factors that contribute to the success of high-achieving minority college students from disadvantaged backgrounds, Morales (2010) found that the students' responses fell into two distinct but interrelated categories. Students in the first group were characterized by willingness or desire for upward social mobility; caring, supportive K-12 staff; caring, supportive college personnel; sense of responsibility to one's race or ethnicity; and strong future orientation. Students in the second cluster exhibited a strong work ethic, high self-esteem, internal locus of control, attended a school outside of their neighborhood, had parents who conveyed high expectations, and a mother who modeled a strong work ethic. The overarching implication is that external support (families, school, and communities) help students from marginalized groups develop internal resources that enable them to overcome challenge and obstacles to achievement.

Mariano, Going, Schrock, and Sweeting (2011) added another "P" to the equation: purpose. According to the researchers, purpose involves planning and moving forward with plans, positive identity, prosocial intention and behaviors, and personal meaning and engagement in activities. Purpose in adolescence is associated with healthy development. In a study involving an ethnically diverse group of teen girls, Mariano et al. (2011) observed a connection between the perceived support of parents, teachers, close friends, classmates, and school and sense of purpose. Close or strong bonds with important figures, including parents, teachers, and peers are powerful sources of support for children and adolescents, which once again contribute to resilience in the face of adversity.

Conclusion

Girls of color are disadvantaged by the intersection of gender and race, and given the overlap of minority and low-income status in American society, by social class as well. Most educational studies examine race and gender in isolation. The superior performance of Black girls compared to boys of the same race masks their lower achievement compared to White girls and boys. Much of the research on girls is on their limited presence in STEM education (often with marginal attention to race, ethnicity, and social class) while studies focused on race are most concerned with the "at-risk" status of Black boys. This narrow perspective renders Black girls virtually invisible (Evans-Winters & Esposito, 2010; Rollock, 2007).

Single sex education has emerged as an increasingly popular option for improving the academic performance of disadvantaged students. Research on their effectiveness is mixed (Hayes et al., 2011; Hoffman et al., 2008). Critics argue that single sex schools have the potential to reinforce rigid stereotypes that have traditionally impeded the progress of girls and students of color (Goodkind, 2013; Patterson, 2012). There are case studies of outstanding schools such as the Young Women's Leadership School (Mansfield, 2013, 2014). However, rigorous studies are few. Undeniably, some girls do benefit from single sex classrooms, but others may be further marginalized. Teachers who create a caring, supportive classroom environment committed to equity and social justice will provide all students with optimum learning experiences regardless of setting. To accomplish this, teachers need educational preparation and professional

development in culturally responsive pedagogy infused with committment to social justice.

CHAPTER III

METHODOLOGY

Introduction

For this research four Science teachers in an urban school district were selected from an all girls school. I assigned a pseudonym in place of the actual name to each participant. The metaphorical pseudonyms for the particvipants were derived from the observational notes and interview data collected. Each participant was asked selected questions from the interview protocol that was established in advane(see Appendix). The focus of this research was found within the compilation of the data. The participants' experiences in this qualitative research were articulated through verbal or oral language with the intention of providing an insight concerning a phenomenon. The study used the actual words of the teachers and the narrative of the teachers incorporated time and place and allowed for inclusion of reasons for the teachers actions and the causes of happenings (Sarbin, 1986). As the researcher, my positional and personal experiences as a teacher and administrator effected the design of the research and interpretation of the result base of what I studied.

Consequently, I considered interpretive qualitative as the most appropriate design for this study. Interpretive qualitative design according to Orlikowski and Baroudi (1991), 'assumes that people create and associate their own subjective and intersubjective meanings as they interact with the world around them, thus attempt to understand phenomena through accessing the meanings participants assign to them' (p.

5). With this approach the researcher can gain a better understanding of significant issues by reducing the distance between the researcher (Ponelis, 2015) and the voices of science teachers in an urban single gender girls' school. The aim of interpretive qualitative design is to interpret the whole experience from the participants' perspective (Leininger, 1985). Essentially thus profundity and details are important for conducting an interpretive research (Bogdan & Biklen, 2007; Creswell, 2005; Gall, Borg, & Gall, 1996).

The School

The selected school serves over 600 female students in midtown Houston, near the historic third ward. The area has been experiencing demographic shifts in the recent years and is undergoing re gentrification. The school housed an alternative campus for over aged students and teen mothers until May 2011. The school opened in August 2011 with students in grade 6 and 9 and has grown each year and had the first graduating class of 12th grade leave for college in May 2015. It is now a 6-12 school.

The school has met all standards on the state accountability rating every year since it opened. The campus received distinction on Reading ELA, Math, Social Studies, post secondary readiness and was in the top 25% category in closing performance gaps. The scores have been consistent every year. The student population at this girls school comprised of 54% African American, 39% Hispanic, 3% Asian, 2% White and 1% other. 70% of the student population is on free and reduced lunch. Thus this is predominantly a campus with girls of color with majority of the students from

economically disadvantaged backgrounds. 1.3% students are classified as English Language learners and 1.3% are Special Education students.

The school has a project based instructional approach with rigorous coursework as evident from this statement on their website. "There is no better way to learn than by doing. At the Young Women's College Preparatory Academy, our students are engaged in rigorous courses at the Pre-Advanced Placement (Pre-AP) and Advanced Placement (AP) levels. Our Advanced Placement Program prepares our high school students for postsecondary academic success while allowing them to earn college credit before graduation."

Since it is a magnet school with no attendance zones, students who attend school here are from all areas of Houston with no one major geographic location or neighborhood represented as a majority.

Epistemological Framework

This study investigated successful teachers' beliefs about the ways through which they created learning opportunities for their female students. It was constructivist, or interpretivist, in nature and the terms are often used interchangeably by various authors or researchers. Creswell (2007) observes that this paradigm allows researchers to inductively construct meaning through the multiple experiences and contexts in which people live and work. They develop subjective meaning of their experiences. The meanings are varied and multiple, leading the researcher to look for the complexity of view and often these subjective meanings are negotiated socially and historically.

With much of the national conversation involving girls and student achievement focused on standardized assessment, the work of narrative provides a valuable voice for teachers of female students as focus is placed on classroom learning opportunities. This study gives voice to this group of teachers that work in an urban school district predominantly populated by low income earning families. Through this framework, I was able to understand, construct knowledge and interpret meaning pertaining to female students' learning opportunities in the classroom by interacting with the teacher participants.

Narrative has to do with how protagonists interpret things (Bruner, 1990) and because it lends credence to human agency and imagination it is well suited for studies on subjectivity and identity. According to Lindlof and Taylor (2010), narrative may be a way to adjust the gaze of the dominant culture to see a different viewpoint that has been there all along, but overlooked. Narrative gives 'voice' to the marginalized 'other' through storytelling/counter-storytelling, dialogue, autobiography, and parables. Unlike quantified research which is based on objectivity, narrative provides a platform for research on experiential knowledge and context for understanding, feeling, and interpreting of events (Ladson-Billings, 1995).

Purposeful Sample

The sample selection of participants in this study represented a purposeful rather than random sample. Purposeful sampling attempts to include participants who have experienced the phenomenon under consideration and from those whom the researcher can learn the most (Bogdan & Biklen, 1998; Merriam, 1988). Patton (1990) notes that

the logic and power of purposeful sampling lies in selecting information-rich cases for conducting the study in depth and thus learning a great deal about issues of central importance to the purpose of the research. (p. 169). Purposeful sampling and emergent design are impossible to achieve without interaction (Lincoln & Guba, 1985).

For this study, I interviewed four Science teachers in an all girls' school in a large urban school district. The breakdown consisted two female and two male teachers at the middle and high school level. Each participant was assigned pseudonyms. For the sake of this study, the term successful urban school shall be defined as demonstrating sustained improvement in closing performance gaps and being cited as an exemplar all girls school in various media sources, based on several accountability factors.

The data sources available for this campus indicated that despite the high percentage of students meeting low-income criteria, the school was among the highest achieving schools in the district. The teachers selected had been employed within this school for three years and the school had earned a met standard rating and had obtained five distinctions out of the seven that it was eligible for. 90% of students had met the satisfactory standard in Science Math, Reading and Writing in the 2014 and 2015 state assessment.

The purpose of selecting the participants from different levels in this 6-12 secondary school was to discover if any trends would develop from the information obtained. The criteria for the selection of participants was as follows:

- Science teachers;
- Served in Science teacher role for at least three or more years;

- Have been or is presently serving in the capacity of teacher at the all girls school; and
- Have discovered an evidenced impact on their students' academic performance as a result of their teaching.
- Principal's recommendation

Instrumentation

The researcher or human is the primary instrument in a qualitative study. Lincoln and Guba (1985) have noted that the human instrument builds upon his or her tacit knowledge as much as, if not more than, upon propositional knowledge and uses methods that are appropriate to humanly implemented inquiry: interviews, observations, document analysis, unobtrusive clues, and the like (p. 187).

I served as primary instrument in this study. The interviews in turn provided the primary source of data from the participants' perceptions on the development of the teacher persona and their teaching practices that ensure that the female students they serve are achieving success academically. The interview protocol was created following a review of literature, while other questions were derived from my own experience and inquiry that informed the study and determined its purpose.

I employed an interview guide approach to naturalistic interviews. First, I created a list of major issues or concerns that each participant would address, while allowing other topics or challenges to come to light. To prevent the chances of predetermined responses when collecting data, I would craft open-ended interview questions. The interview guide in this study was comprised of three primary concerns: 1)

personal information; 2) teacher quality/effectiveness and, 3) impact on student outcomes. The questioning protocol was created before the interviews and followed a conversational style with the opportunity for formulating new questions during the interview without breaking the flow. I requested subsequent interviews after reviewing the interview transcripts to solicit further explanation, elaboration, or verify certain information. Therefore, I used semi-structured interviews which gave me the flexibility to explicate important information that was gathered as a result of previous interviews or elicit specific information that provided comparable data across subjects.

In each case, an initial interview was conducted with the participants to gain insight into their self-perceptions in terms of their teaching effectiveness. The interviews were conducted during summer school in the classrooms of participants, or the dean's office, as it was quieter, or at a teacher's home or nearby restaurant. which provided a quiet location for conversation. I interviewed each participant at least twice with most of the interviews ranging from one to one and a half hours in length. In order to prevent the possibility of postponements, cancellations or schedule conflicts, I scheduled the interviews ahead of time. Immediately following each interview, notes that were accumulated during the interview were organized. Organizing and reviewing of the notes was done immediately following the interviews which allowed me to capture and record other notables when they occured. Audio taped interviews had rough-draft transcripts that Iedited and typed in final form.

Each interview conducted was handwritten and recorded on audiotape with consent from the participants. The handwritten notes helped me capture details of the

conversation, and afford me the chance to make certain notations unknown to the interviewee. Additionally, note taking gave me the flexibility to highlight important information without memorization for review at a later time. Conversely, utilizing a tape recorder also had many advantages, such as assuring thoroughness, and affording the opportunity to review as frequently as needed, so I could gain a better understanding. Tape recording my interviews provided me an opportunity to capture the nonverbal cues such as voice pitches and pauses, as well material for reliability checks. Furthermore, transcriptions were transcribed by myself and verified through comparison with the audio taped version. My participants received a copy of all transcriptions for further verification and revision.

The data collected for this study involved four narrative sets of individual lived experiences. As a result of the questions being open ended, the individual participants were be able to be completely focus on the details about their experiences they deemed pertinent to their teaching effectiveness. This was evident and noticeable in the narrative sets of the participants.

Data Collection

According to Merriam (1998), interviews are the preferred mode of data collection among the various data collection techniques. The events, beliefs, and perceptions that shape the phenomenon under study were explored via in-depth, open-ended interviews, and semi-structured face-to-face interviews. I included other sources of data such as audio-taped interviews, recorded field notes, non-verbal cues, and participant observations, for the purpose of triangulation, Non- verbal cues were used

with the goal of gaining information through unspoken words. The field notes comprised of a written account of observations, conversations, experiences, and descriptions of the participants and the events that would directly or indirectly affect their way of teaching. Observations as defined by Marshall and Rossman (1989), "are the systematic description of events, behaviors, and artifacts in the socialsetting chosen for study" (p. 79), and can range from very focused to unstructured forms.

Observations were scheduled with each participant prior to my arrival. A human subject form was submitted prior to the interviews, and participants received assurance that all personal information would remain confidential.

Research Design

This research study operated as a qualitative study and thus I adopted the qualitative research framework to gain an understanding of how these science teachers in an all girls school exercise and (re)interpret (Dillard, 1995) their teaching. The intent of my study was to broaden the limited research base relating to the lived stories and experiences of the science teachers in all girls schools and from these voices inform others about pertinent issues of teaching science to girls. In order to develop a comprehensive understanding of the teachers' perceptions about their teaching as it relates to student academic performance, this study investigated and constructed meanings of the relationship between their lived experiences and the way they teach, by employing the interpretive lense.

I utilized qualitative research methods for this study to gain an in-depth look at the personal and professional characteristics, perceptions on ways of teaching, and

approaches to academic student success for the four science teachers in an all girls urban secondary school selected for this study. As per research qualitative methods are more natural and adopted easily for the human-as-instrument. Qualitative methods are stressed within the naturalistic paradigm (Lincoln & Guba, 1985). In other words the human-as-instrument tends to gravitate more toward methods that are extensions of normal human behaviors, such as observing, listening, speaking, and reading. In this study for me as the researcher, one of the most valuable sections was the experience of listening to the stories from the teachers which validated my belief in effectiveness of teaching science to all girls and the possibilities for academic success.. Their stories also confirmed my belief that effective science teachers in all girls schools often will do what it takes so that their students can be successful, as they genuinely strive to make connections with others, and believe in and love children of all ethnic backgrounds. I also learned more about the lived experiences of science teachers who put in great effort towards providing a place where all students could achieve academically.

Qualitative research is based on an interpretivist epistemology where the social reality is seen as a set of meanings that are constructed by the individuals who participate in that reality. The major purpose of my study was to discover the nature of those meanings. I covered several forms of inquiry that would help explain the meaning of social phenomena with as little disruption of the natural setting as possible. The focus of my study was on interpretation and meaning. Characteristics of qualitative research as explained by Merriam (1998) include an overarching interest in understanding the meaning people have constructed, and an inductive approach to knowledge generation.

In my research, I was be the primary instrument for data collection and analysis, and my end product is narrative and descriptive.

In their own words, my participants described how they contributed to the success of their students in science. Developing an understanding of how these teachers were contributing to the achievement of their students was dependent on techniques employed by qualitative methods, specifically interviewing. Interviewing allowed the interviewees to tell their own stories. In addition, the interaction between the interviewees and myself was a very natural and comfortable situation for me. I attributed this feeling of comfort to my experience as an educator in an urban school district as well as to my respect for teachers who work so diligently toward the success of their students. The comfort felt during interaction of the interviews aided in my absorption of the shared information.

Data Analysis

Qualitative research is grounded in the assumption that features of the social environment are constructed as interpretations by individuals and that these interpretations tend to be temporary and situational (Lincoln & Guba, 1985). According to Marshall and Rossman (1989), it is not possible to understand human behavior without understanding the framework within which participants interpret their thoughts, emotions, and behavior. Denzin and Lincoln (1994) asserted that qualitative research is multi-purpose in its focus, and involves an interpretative, naturalistic approach to its subject matter. Thus qualitative methods enabled me to understand, from the perspective of the participants, the complexity of their situations as well as the process and meaning

of the events of their personal and professional lives. The importance of setting, context, and the participants' own frame of reference was emphasized as they allow the emergence of constructs, which contribute to theory generation (Marshall & Rossman, 1989). In addition my research attempted to value subjective, personal meaning and definition, as well as commonalities in the voices of the marginalized groups.

Lincoln and Guba (1985) noted that data analysis in a naturalistic inquiry is open-ended and inductive. Data analysis in my study will began during the data collection process, and continued after the collection was complete. The data in my study was derived primarily from the interviews, observations, and field notes. My interviews were written and audio taped. I transcribed the interview notes verbatim after each interview, and rechecked them for accuracy. Analysis of the data occurred immediately after each interview and observation. Analytic conclusions were formulated by unitizing, coding, and then categorizing ideas or statements of experiences from the data to ensure that the important constructs, themes, and patterns emerge.

As I was the researcher and served as the primary instrument for both data collection and data analysis, I operated within the interpretive theory. I was able to share in the world of the researched and interpret what I experienced there. It was necessary thus that I make the best means of making sense of the data to begin understanding the phenomenon studied. I used the elements of categorizing to analyze the data. The method of constant comparison was my guiding method.

Unitizing data was considered as the units of information that served as the basis of defining categories. Categorizing, however, would outline categories of the index

cards that apparently relate to the same content. Categorization, according to Lincoln and Guba (1985), can be accomplished most efficiently when categories are identified in such a way that "they are as heterogeneous as possible" (p. 349). Thus, as the researcher, I examined, broke down, compared, conceptualized and categorized the data. The categorizing process for this study began with a search within individual narrative sets for data concerning broad topics, while I re-examined the categories for overlapping. The set of categories helped explore possible relationships among other categories. The first categorical topics were the participants' personal, educational and employment background. The discussion of teacher qualities and effectiveness was the next topic categorized, with the impact on student academic achievement being the last of these topics. Consequently, through this methodology, the steps in data collection, the categorizing method, and the analysis previously described were ncluded in the organization of the ideas emerging from data analyses into a multifaceted and integrated theory.

Complementary Data Gathering Techniques

In order to gather additional data, several other strategies and techniques were employed. The purpose of these techniques is to enhance the collection and interpretation of the data. The use of tape recording, field notes, and non-verbal cues were discussed in the next section.

Tape Recordings : A digital tape recorder was used to tape interviews with the participants. The transcriptions was reviewed and corrected by the researcher.

Field Notes : The main reason I recorded my field notes was to compose a written document of the observations, dialogue, experiences, and descriptions of the participants and the events that affected them directly or indirectly. My field notes also served the purpose of recording certain feelings, and thoughts about the investigation, as well as a place to record follow-up interview sessions that needed to be scheduled with the participants.

All of my field notes were kept in one notebook. This notebook consisted of the interview records and observations that were made during the taped interviews with the participants. Following each observation or interview, I transcribed the field notes.

Non-verbal Cues : The non-verbal techniques in my study included: body movements (kinestics), spatial relationships (proxemics), use of time as in pacing, probing, and pausing (chronemics), volume, voice quality, accent and inflectional patterns (paralinquistics), and touching (haptics) (Lincoln & Guba, 1985). I made use of these non-verbal communication techniques to obtain information through non-verbal signs. I asked additional questions during the interviews so that I could gain a clearer understanding of certain nonverbal cues. These non- verbal cues were be recorded in the field notes.

Trustworthiness and Credibility

The process of building trustworthiness in naturalistic inquiry is critical (Lincoln & Guba, 1985). The criteria for building trustworthiness are credibility, transferability, dependability, and confirmability. In order to enhance trustworthiness and credibility in this study, I used an audit trail that reflected triangulation of the data through the use of

interviews, observations, recorded field notes, and follow-up individual interviews. This procedure helped me preserve the data in an understandable and retrievable form. In addition, in an effort to meet ethical standards, I assured my participants privacy, confidentiality, and inclusiveness. I also encouraged my participants to engage in on going member checks to review and clarify constructions developed by myself, and if necessary, to revise these constructions.

Member Checking

Member checking, according to Lincoln and Guba (1985), is the most crucial technique for establishing credibility. It is a process which involves participants verifying data and interpretations collected through the interviews. There are multiple benefits of member checking which could be either formal or informal. One of its many benefits is its provision of assessing intentionality. Other benefits consist of providing my participants an opportunity to share additional information, correcting errors and interpretations, and providing them an opportunity to evaluate the overall adequacy. The participants in this study received a copy of the interview transcripts for review, clarification, and suggestions.

Transferability

Transferability has been recommended as the qualitative counterpart for external validity by (Lincoln & Guba, 1985). They also stated that "if there is to be transferability, the burden of proof lies less with the original investigator than with the person seeking to make the application elsewhere. The original inquirer cannot know the sites to which transferability might be sought, but the appliers can and do" (p. 298). In

other words, though the researcher seeks only to describe one specific situation and the meaning of that particular situation for the participants of the study, the reader of the research report can apply the findings of the research to similar situations in which he or she is involved. It is my hope that my readers be able to transfer different aspects of my study to situations in which they are involved. However, as Lincoln and Guba (1985) stated, the transferability will depend upon the situation to which the reader applies the findings of my study.

Lastly, Lincoln and Guba (1985) stated that "the naturalistic cannot specify the external validity of an inquiry; he or she can provide only the thick description necessary to enable someone interested in making a transfer to reach a conclusion about whether transfer can be contemplated as a possibility" (p. 316).

Dependability and Confirmability

Dependability, which is the naturalist's substitute for reliability, can be demonstrated by "taking into account both factors of instability and factors of phenomenal or design induced change" (p. 299), according to Lincoln and Guba (1985). To establish dependability, it was necessary that I examine the records for accuracy and substantiate all documents.

Confirmability, or objectivity, was utilized during the data collection and analysis phases to verify and construct findings that may be important to increase what was already known about science teachers in all girls schools verse female educational leaders. To demonstrate confirmability, I maintained a record of the inquiry process, copies of each taped interview and discussion, notes from interviews and discussions,

and hard copies of all transcriptions. In addition, I made these records available upon request.

Summary

Qualitative research methods were chosen and utilized for my study due to the nature of the study, the setting, and my personal interest. I took steps and followed procedures so as to provide an in depth look at the science teachers' perceptions on teaching as it relates to student academic performance. I also investigated constructed meanings of the relationship between their lived experiences and the way they taught by employing interpretive lenses. More importantly, I emphasized the naturalist inquiry which is an approach that investigates the lived stories and experiences of their teaching. It is from these teachers' voices that others can be informed about pertinent issues of teaching science in all girls' schools.

CHAPTER IV

FINDINGS

Introduction

In this research study, I investigated the lived experiences of four successful science teachers in an urban, single-gender girls' school and their teaching styles. In my role as researcher, I utilized the actual words of the participants to tell their stories, with the intention of offering a robust and accurate description of the thoughts and ideas presented by each teacher. I aimed to tell each teacher's story using a combination of data collected from interviews, observations, and audiotapes. In order to meaningfully interpret the data, I have organized this chapter in the following order: (a) a description of the school, (b) background information on each participant, and (c) a review of each participant's interview responses. To protect the identity of the participants, pseudonyms were used. Data analysis of emerging themes and a discussion of the findings from the interviews conclude this chapter.

The School: College Prep Girls' School

The Houston Independent School District opened the Young Women's College Preparatory Academy (YWCPA) in partnership with the Young Women's Preparatory Network (formerly the Foundation for the Education of Young Women) in August 2011. Initially, the school opened with Grades 6 and 9, then added Grades 7 and 10 in 2012, Grades 8 and 11 in 2013, and Grade 12 in 2014. The student population at this girls school comprised of 54% African American, 39% Hispanic, 3% Asian, 2% White and

1% other. 70% of the student population was on free and reduced lunch. Thus this was predominantly a campus with girls of color with majority of the students from economically disadvantaged backgrounds.

The Young Women's Preparatory Network has opened eight other schools in Texas that share the mission of offering distinctive high school leadership programs to girls in urban schools. The YWCPA campus is located in midtown Houston near the Texas Medical Center, the Museum District, the University of Houston, Texas Southern University, and Rice University, centering it in a dynamic educational environment. The staff of the school includes approximately 46 employees and 600 students.

According to information on the school's website and brochure, the curriculum emphasizes learning by doing. As part of this mission, the college preparatory curriculum allows students to engage in many rigorous courses at the Pre-Advanced Placement (Pre-AP) and Advanced Placement (AP) levels. The advanced placement program prepares high school students for postsecondary academic success while also allowing them to earn college credits before graduation. Taking AP and dual-credit courses gives these students an advantage by developing their college-level academic skills, saving them money and time as they work towards a degree while still in high school. In addition to its standard curriculum, the YWCPA offers students STEM-focused opportunities through a partnership with the Independent Petroleum Association of America (IPAA). Thus, there is a conscious, intentional focus on exposing girls to the world of science and technology and preparing them to be successful in STEM fields.

The school's website also stated that its students enjoy the benefits of learning in an environment where everyone is focused on preparing them for success in college and beyond. Beginning in the sixth grade, the teachers provide academic preparation and mentorship and the administration provides guidance and support in preparation for college. Each student is introduced to an array of college choices nationwide, taken on campus tours, and offered specialized career-strand courses that best match their intellectual strengths and interests. The students have access to individualized assistance as they navigate the college application process, financial aid applications, and college course selection. In May 2015, YWCPA graduated its first class of seniors. These 44 young women received over $6 million in academic and merit scholarships and awards, and were accepted to over 53 colleges and universities.

As I drove up to the school's parking lot after several years without visiting, its appearance was much the same as my last visit. The cafeteria, teachers' parking lot, and the outer appearance of the building appeared unchanged. However, construction workers were busy at the back of the school adding a new science wing with state-of-the-art science labs. Upon entering the building, I was swept off my feet by the warm welcome and immediate sense of belonging. I noticed college flags and pennants decorating the walls, as well as posted honor roll lists for each grade level. The celebration of academic excellence was evident through these displays, with pictures of girls visiting colleges on one of the bulletin boards reinforcing the college-bound culture.

The main office secretary welcomed me with a warm smile and many friendly teachers greeted me in the hallways as I made my way towards the classroom of the first

interviewee. As we walked down the hallway, I noticed posters that displayed the accomplishments of the students along with student pictures. Although I was visiting during late summer, there were still several students taking classes to make up or get ahead on their credits. In the teachers' lounge, I could hear teachers laughing and sharing stories while eating lunch with one another. I saw some teachers talking and eating with their students in the cafeteria—a sight that touched me personally. It reminded me of my own experience visiting my children during their school lunches, albeit once a year, but it is a memory they cherish to this day. These teachers took it upon themselves to spend additional time with their students, building trust and a caring relationship with the girls. There was an overwhelming atmosphere of cheerfulness and ease among the faculty and students.

Experiencing such a heartfelt reception and observing the closeness between the teachers and students, I immediately felt like I was part of their tight-knit community. My experience echoed the message on the wall at the school's entrance, "Welcome to the *Responsible Organized Sisterhood of Excellence.*" It was not long before I became aware that this welcoming attitude was part of the school culture. The principal was warm, friendly, and welcoming, and put me immediately at ease by giving me an affectionate embrace. Overall, the campus environment was one of care and joy, with very passionate and committed adults. The close-knit sense of community was so infectious that it inspired me to replicate the same atmosphere on my own school campus. Table 1 shows the profiles of the participants with their ethnicity, years of experience, education, annual performace appraisal, and student performance data.

Table 1
Participant Profiles

Participant	Ethnicity	Years of experience	Undergrad major /degree	Annual appraisal rating	Avg student performance scores on standardized tests (2013-2016) tea.texas.gov
Believer Ben	African American	10+	Microbiology/M.Ed	Highly Effective	>87%
Chemist Camilla	Asian Indian	20	Chemistry/Ph.D.	Highly Effective	100%
Scientist Susan	Asian Indian	25	Biology/Ph.D.	Highly Effective	>99%
Explorer Eddy	Caucasian	13	Geology/M.B.A	Highly Effective	>85%

Believer Ben

Context

Believer Ben was a 58-year-old African American male who started his teaching career as a science teacher at a different high school. He was the seventh-grade science teacher at YWCPA, with an undergraduate degree in microbiology, a master's degree in education, and a background in virology and environmental chemistry. He had taught for a total of ten years, six of which were in a coeducational public high school, where he taught general biology, pre-AP biology, and AP biology. His interviews were held in the months leading up to his fifth year of teaching at YWCPA. Two interviews were

conducted with Believer Ben. The first was conducted in the dean's office and the follow-up interview was held off-campus during the summer break closure.

Believer Ben Story

The calming tone of Believer Ben's voice was relaxing and immediately put me at ease. I walked through his classroom prior to the interview and found that it was neat and orderly, with science lab equipment and supplies organized around the room. There were posters on the wall describing the scientific method and the 5E instructional model, along with others displaying inspirational quotes. Science fair awards from past years were also on exhibit, exuding school pride.

Prior to the beginning of the first interview, I placed a do not disturb sign on the door of the dean's office, which the dean had given me permission to do prior to scheduling the interview. Since the interview was conducted during the school day, holding it in the dean's office ensured minimal distractions or interruptions—an environment conducive to the first part of the interview. Since the interview took place during the school day, Believer Ben and I agreed that if the interview lasted until hall duty, we would stop the interview so that the participant could fulfill his responsibility. If necessary, we would continue the interview later at a location that was convenient for him. A follow-up interview was subsequently conducted at the residence of another teacher.

Believer Ben had a background in industry and management before becoming a science teacher, and he used this experience to help his students become more engaged in their coursework. Instead of focusing on purely academic goals like passing

standardized tests or memorizing facts, he talked about his concerted effort to emphasize "practical science" and "learning by doing" in his classes. In regards to applying his industry background to teaching, Believer Ben said, "I take that same philosophy to the classroom. Where I take that academic knowledge, and try to bridge it over something practical, so that the kids can say, 'Okay, I see now why I'm learning this.'" His industry experience enabled him to make connections for his students between their science coursework and real-life situations and careers. His time as a manager also translated into effective teaching strategies because he knew how to manage a group and keep everyone moving forward: "Managing is a different thing. You have to coach your people, you have to make sure they're successful. Because if they're not successful, you won't be." He acknowledged that getting control of the classroom is not always easy for new teachers and that his past managerial experience helped him deal with this obstacle, stating, "You're not gonna get any transfer of knowledge if you don't have control of that class." He elaborated, "First thing I do is let them know that I'm in charge, and this is the way we run this class, okay… I establish expectations up front."

He also emphasized that in order to be an effective teacher, it is necessary to have a passion for teaching. According to Believer Ben, "If you don't like teaching, you shouldn't be in it." This opinion was not surprising considering the amount of outside resources and time that Believer Ben put into making his science classes hands-on for the students. He personally took on much of the cost of lab consumables despite the fact they can be "astronomical," as he put it, because he believed they were necessary to teach science well and adhere to his teaching philosophy of "learning by doing." It was

clear that Believer Ben had a passion for both teaching and science, which was evidenced through his actions and his words, “I love teaching science, I wouldn’t do it if I didn’t love it. I love doing the labs, the practicals.”

Believer Ben highlighted the importance of parental involvement in students’ education as a key to learning success. Previously, his experience was, “the higher you go up, the less parents you see,” but at YWCPA he observed much more parental involvement. In fact, he often had casual conversations in the hallway with parents, “I have the type of relationship with parents, if I see them in the hall, ‘hey, let’s talk.’ [Laughter] If they see me in the hall they do the same things.” He also praised the school’s Parent Teacher Organization (PTO) and said that they often come by to offer help and ask if he needs anything.

Believer Ben also commented on the need for teachers to have patience with their students and base their level of teaching on their students’ current knowledge. Because students come to the school from a variety of backgrounds, their knowledge levels can differ wildly, and Believer Ben believed that the most successful teachers were those who could discern where their students were and go from there; “You don’t want to start at a level above the kids’ heads, so you need to look at the prime knowledge. You need to have patience for those who are not quite there.” In addition to being patient with students who come from a multitude of educational levels, Believer Ben emphasized the need to employ multiple teaching strategies to adequately reach all learners:

> I know some students like to read. I’m the type of student, give me a book and I’ll read it. Give me the test, I’ll take the test and pass it. There’s some students

you can do that with. Then, there are some students that you give them the book you read it to 'em and then you show them a picture and then they get it, so I incorporate that aspect. Then, there's some students that you got to show them the picture, you got to read it to 'em, and then they got to do it, and then they get it. [Laughter] I try to incorporate a number of different pieces in to my learning cycle.

Furthermore, Believer Ben highly valued his professional development opportunities and emphasized how they have enriched his teaching strategies in his classes. Each year he took the required six hours of professional development training, but also took advantage of additional development opportunities, such as the American Science Teachers Conference and the National Math and Science Initiative (NMSI). He expressed that the NMSI had been extremely valuable to him, as he had incorporated the organization's materials and assessments for AP classes into his teaching resources.

While he shared his background, Believer Ben attributed his work ethic to his father, saying, "My dad used to tell me you need to give an honest day's work for an honest day's pay. When I come to work, I come to work." His upbringing as an inner city kid also allowed him to relate better to his students, many of whom experienced similar challenges in their daily lives: "I'm able to relate to the kids. I grew up as an inner city kid… I know some of the pains that they're goin' through right now as teenagers. I try to make it fun… They call me grandpa now." It was this shared experience that created a connection between Believer Ben and his students. His own parents did not attend college and he had the unfortunate experience of people telling

him that he should not pursue his love of science, "I've actually had people – and I know this is a different time in America, they don't do that anymore, but I've had people tell me that these types of jobs are not for you." This experience, and his success in both industry and teaching, made Believer Ben a particularly important role model and example for his students in pursuing STEM education.

Interestingly, Believer Ben shared with me that he did not initially want to work at a girls' school. While he was intrigued by the idea of single-gender education, he was interested in teaching at a boys' school because he thought that teaching positions at YWCPA were limited to female instructors. He even turned down two attempts by a colleague to get him to interview for a position at the school. Since then, he has found a very rewarding teaching environment at YWCPA. He fully believed that "girls are just as good as boys, I really do… in fact, in some cases smarter" and "I don't think gender has anything to do with brilliance, I really don't. I don't think men have the monopoly on brilliance in science technology and engineering… I wouldn't be at a girl's school if I believed that." In his experience teaching at both single-gender schools and coed schools, one of the distinct advantages of a single-gender education for girls was that it allowed them to take more leadership roles. Believer Ben observed that at "coed schools, it was always a fight" in group projects between alpha personalities, which typically belonged to boys, and less dominating personalities, which typically belonged to girls. "Here you don't have that situation… I encourage girls to do well in science. I've seen girls do well in science here." Believer Ben even had students who had never considered majoring in science change their mind because of his class, "I have girls who say, 'hey I

didn't think I would major in a science until I took this course.' I think I've had an impact on some of the young ladies."

Chemist Camilla

Context

Chemist Camilla was an Asian female who had always known that she wanted to be a chemistry teacher. Chemist Camilla shared with me that she often played school as a child and decided during her senior year in high school that science was the subject she most enjoyed. She excelled in her college science courses and her professors encouraged her to become a science professor. She had approximately 20 years of teaching experience at the high school and college levels, and had taught chemistry for three years at the middle and high school levels at YWCPA. She initially taught in India, where she also received her PhD in chemistry, and she had moved to the United States in 2003. She taught in mostly urban schools in the U.S., and YWCPA was the first single-gender school in which she taught.

Chemist Camilla Story

Chemist Camilla believed that to be a successful teacher, one needed to have a passion for their discipline. "I love science and especially the life sciences," she declared. She identified her love of science as one of her main motivations to pursue a career as a science teacher. By teaching science to her students, she felt she also taught them to be curious and inquisitive in other areas as well:

> I like teaching science because, to me, science teaches you to explore, to know more about the world around you, and also you can test it. You can perform

> experiments in the classrooms and understand it in more in detail, and through the projects, it can take it to the higher level.

To encourage curiosity in her students and address a variety of learning styles, she created hands-on lesson plans and incorporated experiments into her classes. Chemist Camilla felt that "students learn by doing" and that science, in particular, was an "engaging" subject that could motivate students by providing many opportunities for hands-on activities and labs. She extensively used real-world applications to teach science concepts and focused on increasing the students' science vocabulary on a daily basis.

In addition to hands-on learning, Chemist Camilla found that her students benefitted from her emphasis on organization, discipline, and routine. She communicated her high expectations to her students from the very beginning of the school year and let them know that failure was not an option in her classroom. She admitted that the beginning of the school year was usually tough for many of the students in her classes because of the high expectations. However, after about three weeks, the students usually adjusted and enjoyed her class as much as she enjoyed teaching it. Establishing expectations for the students in her classes was paramount to helping them succeed and, at times, this calm classroom environment was essential to meeting the needs of students with learning disabilities. Chemist Camilla shared a story about an autistic student whom she taught for two years. This particular student required a very calm, structured classroom environment to keep her focused because she could become "excited really quickly and disruptive." Incorporating multiple hands-on

activities and labs was also helpful in addressing the needs of this student: “Every day, we are working on lab. That excited her so much, and that would keep her engaged and challenged at the same time.”

Chemist Camilla emphasized that it was important for students to feel that their teachers cared about them and their success. For her, trust between teachers and students was essential in order for the students to learn effectively. She stated that, “I feel that is also in my teaching, also in my behavior, also exhibited, that I’m firm. At the same time, I’m very caring also. My students know that ‘my teacher cares for me and she’s responsible.’” This led many students to come to her and share the “difficulties they have,” even when this trouble occurred in subjects that she did not directly teach, such as math. Chemist Camilla’s caring attitude for her students was further evident in her generous time commitment to ensure their overall success, “They also feel that if they have a weakness, if they need help, I’m always there to help them. They can stay after school. They can come on Saturdays.” She also maintained constant contact with the parents to share the successes and challenges facing the students and further encourage trust in the classroom.

Chemist Camilla was happy with the professional development she received from the administrative staff at YWCPA, “Any resources we need, they always try to provide us. Any lab materials we need. They always arrange for professional developments.” She had access to many teaching resources by working at YWCPA, including Laying the Foundation, Adaptive Curriculum, and University of Texas online homework. Because all of the students at YWCPA had a laptop for school use, these

online resources for classroom activities and homework assignments were extremely useful. Such technology was particularly helpful for Chemist Camilla to overcome limitations in lab materials and equipment, "If we do not have enough equipment, we can do the experiments online and get the same concept." She also attended state level science workshops and received AP training from Rice University to incorporate best teaching practices into her classes. She believed that collaboration within the school was also key, and she therefore collaborated with her colleagues and discussed ways to align the science standards and curriculum vertically across the campus.

Reflecting on her path to teaching science, Chemist Camilla shared that she had attended a girls' school as a child and that this influenced her decision to work at YWCPA:

> I grew up in a country, in a place where we used to go to gender school. Until my high school, I studied in a girls' school… I used to feel more comfortable going to that school, but there were some things that I always used to think – they should be more than that… So I thought in the girls' school, I will be able to do a few things like experimenting, using technology, and maybe motivate them.

She did not see any difference in the way that students learned at a single-gender school compared to a coed school, "I feel that students learn the same way whether it's mixed community or single gender like [the] girls' school." However, one significant difference she noticed at YWCPA was that "they [the girls] share more with the teacher when in single-gender than mixed gender" classes. In her experience, the girls were "more comfortable sharing" and "don't hesitate asking questions" when in single-gender

classrooms. Thus, she believed that a single-gender classroom empowered the girls to speak up more than they would otherwise.

Chemist Camilla stated that she firmly believed "every student can learn" and it was this belief that "empowers us [teachers] to design a lesson, to design a lab, and to design a worksheet even that helps them [students] understand the concept, so that everybody feels that they can do it." Her own educational background demonstrated how much she cared about the value of higher education, something she said she tried to convey to her students, "I always value the education. To me, education is the key… to achieve your goals… I try to motivate them to learn, to study, to graduate, so that they have a brighter future, and they can achieve what they want." She felt that her PhD in chemistry gave her the content knowledge necessary to take science topics "to any higher level" during her lessons.

Chemist Camilla expressed her support for standardized tests, saying, "to some extent, teachers should be held accountable." She was encouraged by her students' high scores, which made her feel "motivated… successful… accomplished," but she also recognized the pressure of standardized tests for students who "do not see that much value in it. They do not put enough effort [into the test]." She also noted that the other downside to frequent standardized tests was the significant amount of class time it took away from teaching. She suggested that both formal testing assessments and informal assessments that incorporated a student's daily effort should be considered. She was very proud of the success of her previous students and shared that "when they graduated, all of them got admission in college."

Scientist Sheela

Context

Scientist Sheela was an Asian (Indian American) female teacher approximately 48 years of age. She was the third of four children and had grown up in a large community around many people. She always found joy in helping others and engaging in social service, which was one of the reasons that she decided to teach. She had a PhD in entomology from India and over 25 years of education experience teaching science. She was a middle school science teacher for 14 years and a high school biology teacher for more than 12 years. Six years prior to the interview, she had been awarded the Science Teacher of the Year award for her school district. She had taught at YWCPA since it opened in 2011 and currently served as the science department chairperson. The following information was compiled after two interviews with Scientist Sheela.

Scientist Sheela Story

Scientist Sheela had extensive educational experience because she had taught science to Grades 6 through 12 for over 25 years. She described her love of biology by saying, "Basically I breathe, I eat, I do biology." Her passion and curiosity for the subject matter she taught, and for science in general, was evident from the moment the interview began. When I asked her to tell me about herself, she did not start by stating her education and teaching qualifications, but instead said, "I'm a very curious, enthusiastic, and dedicated human, and later transformed into a professional. Besides learning, exploring is my passion." This made it immediately clear that Scientist Sheela considered herself as a scientist first and an educator second. She also described herself

as persistent, which is valuable in a biology teacher since so many students can struggle with that subject. She was also resilient, which was evident in her explanation of how she became a science teacher. Her determined demeanor was clear as she spoke in her teacher voice to describe specific lessons that she had taught and the success of her students.

Scientist Sheela approached the interview questions in much the same way that she described her teaching style: "stepwise." Her answers were very thorough and she described her teaching approach in detail. According to Scientist Sheela, the first and most crucial step to successfully teach science was to convince the students that science was relevant in their lives.

> First thing is I try to convince them that science is needed for you. You will need it, definitely. You're going to use it. Either for your life or for your applications in anything that is needed for life. I make it very clear to them that this is really important and you need to learn it in some way that you will be successful using this. It will make you successful if you use this in your future.

To accomplish this, Scientist Sheela used real life examples in her classes, like "what kind of toothpaste is good?" or which shampoo is best?

> When you go for buying some shampoo, if you have a little knowledge of the chemistry, which kind of pH you would need, you would look for that pH instead of hurting your hair. Now you see, a little knowledge of science is going to help you throughout your life. Even if you buy shampoo for your daughter, you will

> remember this knowledge and you will apply this knowledge. Science is everywhere in your life. It's not just in the classroom, in the textbook.

Once Scientist Sheela convinced her students that science was relevant to their daily lives and future success, she moved on to the second part of her teaching strategy: engage the students.

> Once they see the relevancy and they develop a little interest by that engagement process, then they are themselves interested in learning… they take all the authority and they start doing. I'm just standing there guiding them like a facilitator.

At this point in the process, Scientist Sheela monitored her students and assessed their progress while trying to "encourage them, motivate them, never give up. If the experiment goes wrong, we have the chance of redoing it." She thought that this step was especially important to the success of her students because it enabled them to choose the activities best suited to their style of learning. She explained, "All the students could not be assist just by using one technique. I use various resources for the formative assessments too… I work according to the needs of the students."

Scientist Sheela also said that she often works backwards by presenting her students with a question, having them do some research, and then explaining the fundamental scientific concepts underlying the explanations they find. For example, she once asked her class, "Why does the food get cooked quickly in the pressure cooker?" No one had an answer, so she told them to come up with an answer as their homework assignment. The next day, multiple students knew why it was called a pressure cooker,

and from there she explained the relationship between pressure and temperature as described by Boyle's Law. By jumping right into the application of the scientific law instead of making her students memorize the material first, she created a memorable teaching moment. She even planned her lessons in a similar manner. First, she identified what she wanted to achieve by the end of a class and then she worked backwards to develop a plan to reach that goal. Scientist Sheela also stressed the value of getting her students to ask questions about science, "Science starts with curiosity… To ask questions more and more. That's my motto. I start my class with asking questions. I end my class with asking questions. The same thing I expect from my students."

Her background in teaching and research gave her the ability to plan multiple activities for her students to address their different needs. "Everyone is not doing the same thing… I have a kind of checkerboard. For most of the activities, I have a series. I have a set of activities, not just one activity to teach one topic… They pick their own activities, their own styles." She explained:

> Some learn through games. Some learn through hands on. Some learn through doing. Some learn through manipulatives. I just give them different kinds of resources. The diversity is handled by diversity. I first assess their needs, their strengths and weaknesses, and then move accordingly.

This differentiation in class activities was a strategy she learned during professional development workshops, which she saw as essential for a successful teacher. "I'm a continuous learner. I believe in growing professionally all the time.

Because the technology, everything is being updated every day, if I'm not updated, I wouldn't be able to teach the way the students want to learn."

Scientist Sheela said she added variety to her classes by incorporating cutting-edge websites, online lessons, and other web-based tools and technologies that facilitated learning. She understood the importance of using virtual science labs, manipulatives, and models that were readily available to the teachers, and she emphasized writing as a critical tool for her students to communicate science. This allowed her to support them in other content areas by incorporating literacy strategies into her lessons.

Scientist Sheela was happy with the support she received from the administration and the overall positive feedback regarding her teaching. The school principal bought the necessary science kits that Scientist Sheela needed for her hands-on activities, and the availability of online homework and assessment tools simplified certain tasks. However, she did acknowledge that sometimes the administration did not understand the need for field trips because they did not have a science background and "You have to convince them." She had dealt with minor communication issues with students in the past, which she attributed to cultural miscommunications and misunderstandings, but she regarded these incidents as learning opportunities for both her and the students. Scientist Sheela participated in daily meetings with her teaching department to discuss challenges and coordinate their curricular topics. She was also a member of Teachers Teach Teachers, had attended all the NMSI trainings to date, and stated, "I want to become techno savvy because this current generation is very techno savvy."

Scientist Sheela thought that parental support at YWCPA was good, with "95 percent [of] parents very cooperative" and felt that "parents should play a very good role in the upbringing of the kids… I think some of the parents do not understand their extent, up to how much they should interfere." She believed that increasing the amount of communication between herself and parents over time helped her students do better overall, "Now, whenever I have a problem, I just communicate with the parents. I try to motivate the kids. I ask for their cooperation. That has helped me a lot. I see a change. Now everything is clear."

Scientist Sheela supported standardized test scores to evaluate teachers, saying that it held teachers accountable for doing their jobs:

> Yes, it's a very good idea because it is ultimately a reflection of what they have been taught. The teachers are responsible for teaching. Even for inculcating their motivation, inculcating their interest, the teachers are responsible. Teachers do not realize that most of the time. They think their job is only to teach… We have to reflect on ourselves also. Most of the time, at the end of the lesson, we should reflect on our teaching.

However, she also believed that there should be checkpoints throughout the learning process to evaluate how students are doing in a holistic way: "A whole series of formative assessments gives you the real picture of the success, whether the student is learning or not. To me, high-stake testing is not a viable answer." In her own classes, she utilized written lab reports, charts, and diagrams made by her students to assess their progress, and she also observed their level of engagement in daily activities. All of her

biology students passed the end-of-course test for the state; notably, no other subject had that much success.

Scientist Sheela saw no real difference between teaching science in a single-gender class and teaching in a coed class, but commented that she thought the girls behaved differently in a single-gender classroom. “Sometimes the girls get more curious… They are ready to explore more, devote more time. They take it seriously, the learning.” She also commented that in general, the girls seem to be “very careful” about their projects and grades, more so than the boys she had taught previously.

Explorer Eddy

Context

Explorer Eddy was a Caucasian male with an undergraduate degree in geology. He was originally from New York, attended the University of Miami, and moved to Houston in 1980. He worked in research, first at the Core Lab and then with an oil and gas company that was later bought out by BP. He was laid off in 1986 during the economic downturn and returned to school. He received an MBA from the University of St. Thomas and owned his own business for about six years. It was an outdoor store that specialized in camping, backpacking, climbing, canoeing, mountaineering apparel, equipment, and supplies. Unfortunately, after September 11, 2001, travel across the U.S. diminished and his store was no longer profitable. He returned to school again and received a master’s degree in education, specifically science, from the University of Houston.

He had taught science for 13 years. He began at a high-performing, vanguard middle school in the district where the students were very self-motivated and the parents very involved. He was selected to participate in the Rice Model Science Lab for a year, a specialty training program for science teachers. Explorer Eddy was one of the six teachers in the year-long program that held special workshops on research, labs, and curriculum and instructional design. He realized he wanted to teach high school science, specifically earth and environmental science, and proceeded to teach space and environmental science at a private school in the city. He later returned to public school and taught high school geology and middle school science. He was the eighth grade science teacher at YWCPA and also taught his favorite subject: high school geology. In addition, he taught a nighttime geology class at the local community college. I visited his classroom in the summer and the interview was conducted at a nearby restaurant.

Explorer Eddy Story

Explorer Eddy had taught at YWCPA for three years, at both the middle school and high school levels. He described himself as a "lifelong learner" who continued to take classes whenever he could and incorporated that knowledge into his teaching. He felt this quality was especially important for a science teacher because "there's always these things that are happening in science that you can keep up with. It's constant change." Every summer he took field trips that gave him "a whole bunch of stuff that I can then put into my curriculum," including pictures of himself and other students. He believed that this kind of personal connection struck "a chord with students if you can show pictures of even myself or students they recognize and know in those pictures in a

presentation, I think it makes more of an impact." He also felt that being "passionate about the subject you're teaching" was necessary to be a successful teacher, and that he "never understood why a teacher is teaching a subject they don't like." In describing himself, he said, "I love the outdoors. I like science. I always liked field work."

Explorer Eddy emphasized the importance of field experiences when teaching subjects like earth science and geology: "what's so important about teaching earth science and geology is to see it." This was why he had applied for external grants and funding sources to take his students on summer field trips to geologically important sites:

> You know we teach geology backward. A student, a college student, you take three years of classes and then you finally take your field trip in your next to last summer in school. That's when we have those all those ah-ha moments because all the stuff you've been learning about, all the stuff you see in the field and it's like, oh, that's what you meant by whatever it is you're looking at… That's why I think it's important for me and for students to be in the field, so they get a true experience of what's going on and what they're looking at, instead of just reading about it in the books.

He also found that it was usually easy to engage his students on the subject matter in his earth science and environmental classes because these topics were in the news daily. Of environmental science in particular, he said:

> It's a fun class to teach because it's current. It's important to them. I mean we have to vote on issues, a lot of plans that have to do with water, for example, is gonna be a future point all the time. It's real to them, they see it.

Students immediately recognized the relevance of that science class to their daily lives.

Explorer Eddy decided to teach at YWCPA not because it was a single-gender school, but because they wanted him to teach the subjects about which he was most passionate: geology and environmental science. He did note a difference in the behavior of the girls in the single-gender classes compared to his experience in coed schools, saying, "you don't have the boy issue, because there are uniforms, there's no competition with what they're wearing… I would say that's a difference." Ultimately, he stated that because the single-gender classrooms held less distractions for the girls, that "probably does help their learning."

Explorer Eddy shared that it was one of his own high school science teachers who inspired him to pursue chemistry in college before he later switched to geology: "a really good science teacher who turned me onto science when I was in high school. 'Cause nobody in my family is a science anything." His personal experience of being motivated by a good science teacher clearly influenced his own career choices and teaching style.

One of his biggest concerns as a science teacher was the old building in which he taught and the occasionally large groups of students in a single class. That combination made for very crowded classrooms in which lab activities were difficult to conduct while also maintaining a safe environment. Often, he resorted to doing "speed labs in the

hallway" because he "couldn't do labs in the room. It was just too small. It wasn't safe." The lab resources for certain classes, however, were plentiful and he had no complaints about the supplies or equipment budget for his class needs. He provided much of the geology equipment himself:

> Everything I do, I have all my own—I musta spent probably $3,000.00 on supplies that I travel with wherever I go. Every day I have to bring 'em in and bring 'em home because I bring 'em to my night class as well.

However, he did not mind this since geology was his personal hobby as well.

Explorer Eddy said that he enjoyed being able to meet with his students one-on-one to determine what their specific learning needs were: "Once you understand what they like and don't like or understand and don't understand, you can tweak the way you present stuff." He wanted to incorporate more engaging stories to grab his students' interest in future classes and planned to look for more resources to accomplish this, such as videos, songs, and challenge questions. He said that he loved when his students "ask[ed] really good questions and they d[ug] deeper into the subject matter than what [was] being presented," because this usually elevated the level of the entire class. Another technique he used daily was to create a clear objective for the students, which he wrote on the board so that they knew what to expect for that class. Finally, he stressed to all his students from day one that they needed to "Read the question three times. Read the answers three times. Make sure you understand what they're asking."

Explorer Eddy also appreciated the level of administrative support and professional training he received as a teacher at YWCPA. He obtained the additional

books that he requested for his classes and supplies for lab activities. He also attended the American Science Teachers Conference and NMSI trainings, which he gave him "a lot of good stuff to take back to the classroom." He had regular meetings with other teachers and the department chair to share teaching strategies and address any challenges they faced. He did not think the training during the first two weeks of school was useful, however, because it was repetitive and "a waste of time." In regards to that training, specifically, he would have liked it to be more responsive to the needs of the teachers by addressing more practical topics, such as emerging technologies and the different study habits of students.

A serious concern for Explorer Eddy was parental involvement, specifically at the middle school level. In his experience, parents often blamed the teacher for the lack of communication between themselves and their child: "If there's no communication at home with the child and the kid is lying straight to their face because they have access to the grades, they know exactly why they're failing, ask your kid first." However, he acknowledged that "of course you have the parents that are really good and you don't have enough of them" and that he thought that "parenting is definitely harder today than it was" in the past because of all the technology available to children. Ultimately, he believed that "parents have to get more involved in what their kids are doing and there's only a few of them that are. Usually it's the parents that have good students."

Explorer Eddy felt very strongly that teachers should not be held accountable for standardized test scores because it can lead to "teaching to the test." In his experience, students were often interested in topics that were not covered on standardized tests, and

he believed that it was important to teach them about these subjects for their own knowledge: “It’s important. Because it’s not in the curriculum, oh sorry, can’t talk about that? No.” Instead, he suggested employing end-of-course testing to determine how students had advanced throughout the year, “give them a test at the beginning of the year. Give them a test at the end of the year. What did they learn? Did it change?”

Analysis of Findings

Based on the analysis of the transcribed interviews, I found that collectively, these science teachers: (a) expressed that they valued education and recognized the capability of all individuals to learn, and (b) operated from a culturally responsive pedagogical framework. The supporting themes that emerged from the interviews included: (c) that teachers had a genuine passion for science and teaching, (d) the recognition that girls *can* excel in STEM fields and that the single-gender learning environment has a positive impact on them, (e) the importance of parental involvement to student success, (f) the effectiveness of professional development opportunities and the need to modify teacher trainings to address teacher feedback, and (g) the key teaching strategy of showing the real-life applications of science concepts. Each of these themes is discussed in detail below.

Value of Education

All four teachers expressed that they valued education and recognized the capability of all individuals to learn. Chemist Camilla stated that she firmly believed “every student can learn” and it was this belief that “empowers us [teachers] to design a lesson, to design a lab, and to design a worksheet even that helps them [students]

understand the concept, so that everybody feels that they can do it." They had all pursued advanced degrees in a science or education field, clearly demonstrating that they themselves valued higher education. Chemist Camilla stated that higher education was "how I reached my goals" and that was why she tried to motivate her students to graduate and pursue higher education.

Every participant wanted to translate their love of learning and communicate the value of education to their students, regardless of the student's individual learning style or challenges. They strove to achieve this goal in the classroom by implementing a variety of creative teaching strategies and hands-on activities in their lessons, from group projects and presentations to a wide range of activity options that enabled each student to customize their learning experience. Believer Ben did not reuse previous lab activities in order to ensure that the students had a unique learning experience every year, and Scientist Sheela made multiple activities available on a given topic so that each student could pick and choose their preferred learning method. This type of preparation takes significant additional time and planning on the part of the teacher, and shows just how much these teachers wanted to adequately address and engage all of their students.

A noteworthy finding from the present research indicates that all of the teachers were extremely passionate about the subject they taught. Scientist Sheela stated, "Basically I breathe, I eat, I do biology." While the other teachers were not so descriptive of their passion for their subject matter, they all stated that they loved their subject and that this was essential to their success in teaching. Believer Ben said, "I love science, I love sharing my knowledge with kids," Chemist Camilla said, "I love science

and especially the life sciences," and Explorer Eddy said, "I think the most important thing is that a teacher teach what they love."

Culturally Responsive Pedagogical Framework

The teachers operated from a culturally responsive pedagogical framework. As revealed by one of the male teachers, the fact that the teacher himself came from a similar background as many of the students resulted in an increased sense of association with the class. Such teachers were found to be more aware, responsive, and empathetic to the varied needs of such students. According to Believer Ben,

> As far as the attributes that I think make me successful, I'm able to relate to the kids. I grew up as an inner city kid, and I know some of the pains that they're goin' through right now as teenagers. I try to make it fun, it's not always fun to learn science, and I try to relate to them on their level. They call me grandpa now.

This similarity was echoed again when Believer Ben commented on witnessing a "failure chain," wherein a student's family history of illiteracy or minimal education due to social deprivations during childhood can negatively affect them. "Their parents didn't go to college, a lot of 'em may not have finished high school, or didn't do well in high school. They're looking at their children to get educated… they believe education will get them out of poverty," said Believer Ben. "I've lived that. My dad couldn't have had more than an eighth grade education. My mom didn't go to college. I far exceeded their expectations."

The teachers acknowledged the lack of emphasis put on the value of education, especially among the African American students, as a major challenge. While this was not always the case, teachers commented on this pattern in the demographics. “I’m noticing the African American students, not as a whole, but there’s a small majority there that not quite getting the value of this education. Especially, in this environment. This all girl school,” said Believer Ben. Similarly, Scientist Sheela noted, “Now I see the African American population is not–the students are not very serious, but the parents are more involved.” However, the students coming from Mexican American and other Latino backgrounds were a notable exception, exhibiting an earnest desire to learn and excel. Ultimately, the teachers attributed this pattern of undervaluing education among African American students to the concept of the failure chain, in which the value of education was not fully understood by the students because their parents were undereducated. Believer Ben commented, “I think, it’s a cultural thing. You have those students, again, they’re in that cycle where their parents haven’t gone to school, so they don’t understand that value. They don’t have that role model at home.”

This study also revealed that the teachers understood the significant differences among the students’ background knowledge and learning styles. They recognized that these differences could not be addressed using a single teaching technique and they thus used a variety of different strategies to cater to their students’ needs. These differences in teaching methods even addressed the educational needs of disabled, special education, and disadvantaged students. Scientist Sheela addressed the different needs of her students by making multiple activities available on different topics so that the girls could

pick and choose their desired learning method, realizing that "All the students could not be assist just by using one technique. I use various resources for the formative assessments, too. Especially for the gifted kids, for the special ed kids, I use those things."

These findings highlight an important point for understanding the concerns of science teachers: inequality was a major concern for each of them. The teachers each expressed in different ways that it was critical for them to make sure that all of their students started from a level appropriate to them, because they did not all initially start from the same point. Scientist Sheela said, "Then finally, I try to get them to the same point and achieve success, no matter in whatever topics I teach, whatever experiments or whatever lessons they are learning." Believer Ben pointed out that teachers "don't want to start at a level above kids heads, so you need to look at the prime knowledge. You need to have patience for those who are not quite there." The teachers used several techniques to help students learn based on their diverse learning styles, from group projects and class presentations, to hands-on activities and pneumonic devices.

Comprehension of the written material was necessary, and focusing on reading comprehension before answering questions was found to be a successful technique for many students. According to Explorer Eddy, "Sometimes it'll say, 'All the following apply except.' Well, the first one applies so boom that was the answer. It's like, yeah, but it says, 'except.' Did you see that?" An initial step to reading comprehension was the understanding of scientific jargon. Increasing this understanding not only enabled students to better comprehend the questions, text, chapters, and other subject-related

material available online, but also enhanced their class discussions. Explorer Eddy stressed the importance of scientific vocabulary:

> Vocab is important. Kids need to—especially in science. If I'm talking to you about a certain thing and I'm using a vocab and jargon that goes with the topic and you say, "Huh?" It's like, well, that means you don't know the vocab.

While the teachers expressed concerns about standardized testing, they agreed that teachers should be held accountable for making sure their students learn. Scientist Sheela said, "The teachers are responsible for teaching… It's a very good idea to hold the teachers accountable," but felt that "high-stake testing is not a viable answer." Moreover, the tests were also reported to be biased against those students who lacked test-taking skills. According to Chemist Camilla, "Yeah. You feel that the scores may not truly reflect what the students know, all the time, because they don't really put effort in that particular standardized test." The supporting themes that emerged from the participants' responses are discussed in the following sections.

Personal Characteristics

Each of the teachers had a genuine passion for and mastery of science, and had left previous professions to become educators. They all felt that this previous experience outside of education was extremely advantageous for them as teachers because their content knowledge of science was very high. This gave them the confidence to incorporate more hands-on activities and lab experiments into their classes that might otherwise intimidate teachers without a background in research science. Believer Ben

said, “Here’s the primary reason teachers don’t do labs, because they don’t want to look bad in front of their students, okay.” Moreover, according to Chemist Camilla:

> One of the things is my content knowledge, my PhD, which gives us a good exposure to hands on experiments where you learn from your mistakes, and you do the experiments. Same thing I used in classroom also as a science teacher where the students are learning by doing the experiments which motivates them a lot.

Their previous experience in scientific research and advanced degrees in their fields enabled all of these teachers to incorporate unique and challenging aspects into their classes.

The teachers reported that being passionate about what they teach and loving science was a must in order for a teacher to be an effective educator. Phrases such as, “passion for the job,” “love to share knowledge with kids,” and “if you don’t like teaching you shouldn’t be in it,” were used throughout the interviews to describe the kind of attitude, passion, and commitment needed to be a successful science teacher. One reason for this was the fact that science teachers need to constantly educate themselves to best serve their students. The very nature of science involves constant learning, active participation, and experimentation, both for the students and the teachers. According to Explorer Eddy:

> I think science is something that's constantly changing, you have constant learning of what’s new. I mean Pluto was a planet when I was taking science. It’s

> no longer considered a planet. Why? There's a whole bunch of things that change on a regular basis in science, so you have to [stay] above [it].

This love for learning and innate curiosity was a major motivation for these individuals to pursue science education as a profession.

Single-Gender Environment

The teachers all firmly believed that girls can learn and excel in STEM fields, and that their teaching did not really differ between single-gender and coed classroom environments. All teachers had previously taught in coed schools, so they had a good context for comparison. Believer Ben noted that he thought "girls are just as good as boys, I really do… in fact, in some cases smarter," and Chemist Camilla said, "I feel that students learn the same way whether it's mixed community or single gender like [the] girls' school." However, they also recognized that the single-gender learning environment appeared to facilitate their students' success, allowing girls to feel more comfortable speaking up and asking questions than they did in coed classrooms. Chemist Camilla said that her students "shared more" in a single-gender environment and Explorer Eddy noted that "Sometimes the girls get more curious… They are ready to explore more, devote more time." Ultimately, the girls in the single-sex school were reported to be more vocal and confident in class. An interesting finding related to the motivation of teachers to work in a single-gender school was their own educational experience in a single-gender school. As stated by Chemist Camilla, who attended a girls' elementary school:

> I felt that as a student, I used to feel more comfortable going to that school, but there were some things that I always used to think they should be more than that like in my time, so I thought in the girls' school, I will be able to do a few things like experimenting, using technology, and maybe motivate them.

While the teaching strategies may not have differed between coed and single-gender classrooms, according to the teachers, the girls' attitudes towards and comfort level with science changed significantly in a single-gender environment.

Parental Involvement

The teachers all identified parental involvement as a key factor to student success. While Believer Ben experienced less parental involvement with older students in the past, "The higher up you go the less parents you see," he was impressed with the parental involvement at YWCPA, stating that "the parent involvement has been great." He even commented on the quality of the school's PTO organization, whose members frequently stopped by to see if he needed any support or resources. Chemist Camilla noted that most of the parents "keep inquiring about their students. They come by school," acknowledging that this "does make a difference" to student success.

The most important initiative that teachers recognized as important for enhancing the student learning experience was to foster increased communication between the students and parents. Scientist Sheela acknowledged that prior issues she had experienced with parents and students were resolved when she established consistent lines of communication, "This has made my life easier, and I started communicating

more with the parents… I try to motivate the kids. I ask for their cooperation. That has helped me a lot."

Overall, the parents were a significant source of encouragement and support for both the students and teachers. The teachers indicated that not only did parents participate in parent-teacher conferences, but they also kept regular checks on their children. According to Chemist Camilla, "In this school, actually parents are very supportive. Most of the parents are cooperative. Most of them always keep inquiring about their students. They come by school. They attend those, what do we call it? Parent conference, parent meeting?" Furthermore, Believer Ben commented that he frequently interacted with parents informally in the hallways, updating them on their child's progress:

> I have the type of relationship with parents, if I see them in the hall, "hey, let's talk." [Laughter] If they see me in the hall, they do the same thing… I like to talk to them about their children whether they're doing bad or good. Mostly good.

Overall, teachers expressed that open communication with both parents and students was instrumental in facilitating student success.

Teacher Training and Professional Development

On the whole, the teachers at YWCPA were satisfied with the level of professional development that they received, although several teachers expressed frustration that administrators had ignored their feedback regarding teacher trainings. In regards to professional development opportunities, Believer Ben joked, "Better than any other school I've been at, okay. I can't complain. Sometimes they want me to go to

trainings even when I don't wanna go train." They were able to attend multiple training opportunities, including the American Science Teachers Conference and the yearly National Math and Science Initiative (NMSI). The teachers then incorporated the resources from these professional development opportunities into their classrooms. Some had even attended the AP training course at Rice University. However, some teachers did express some criticism regarding teacher trainings. Explorer Eddy criticized the training he had attended and said, "They're boring, wasteless and all you wanna do is get done with them." However, he also recognized that "there are good trainings and I know the NMSI one will be one of those, so I'm looking forward to that." It therefore seems likely that he had not experienced the same professional development opportunities as the other three teachers who were satisfied with their training.

Ultimately, the teachers deemed it essential that successful training and professional development programs incorporate feedback about such meetings from the teachers themselves, which was lacking in some cases. Scientist Sheela was very focused on learning the new technologies available for teaching and mentioned that she tried to attend as many technology-oriented training sessions so that she could be more "techno savvy" to keep up with her students' needs. Explorer Eddy stated:

> Sometimes I wish they would get input from the staff as to what we think would be–for example, if you could give me one way that I could give the students ways that they could study, because there's gotta be a bunch of different ways. What works for one child is not gonna work for another.

Teachers were also satisfied with their electronic resources, but noted that actual lab materials could sometimes be a limiting factor. Believer Ben stated, "Because I do a lot of labs, I go out and I buy a lot of consumables, personally. That's an obstacle." Chemist Camilla noted that "sometimes the lack of resources, lack of space" was a hurdle to educational activities. Chemist Camilla resolved this issue in her classroom by making use of the abundant internet-based educational resources, saying, "If we do not have enough equipment, we can do the experiments online and get the same concept."

Real-Life Learning Applications

Each of the teachers believed that relating science concepts to real-life experiences and applications was key to achieving student success. Being able to link classroom subjects to relevant life experiences brought science to life for their students and engaged them in their own learning. All four teachers strongly advocated student-centered, hands-on, project-based, and cooperative learning techniques to achieve this goal.

The one strategy of a successful science teacher that was reported by all the teachers interviewed was the importance of directly associating a science topic to the real-life experiences of the students. For instance, Scientist Sheela suggested teaching the concept of density by using New York state as an example to her students. She also taught her students to question seemingly mundane, everyday issues, such as "what kind of toothpaste is good?" or which shampoo is best? "When you go for buying some shampoo, if you have a little knowledge of the chemistry, which kind of pH you would need, you would look for that pH instead of hurting your hair," emphasizing the practical

uses of scientific knowledge that would benefit her students in the future. Believer Ben also used this approach in his classes, saying:

> The attribute that I think I bring to the teaching field best is translating to a practical application. What does this mean to me? Why am I learning this? Because so many times I know in high school, kids will say, "Why am I taking this course? "You don't want to say, "Well, you need to take it to graduate." You want to say, "Well somewhere down the line you're gonna do this."

Participation in the science fair was also found to be useful for demonstrating the relevance of science to the students' daily lives. Chemist Camilla emphasized the importance of student participation in the science fair, "We are also involved in science fair. We do the projects that involve students and where they can learn that how the science is used in real life." The teachers used various other strategies to drive home the relevance of science to their students. Several techniques were found to be particularly effective, including project-based learning (PBL) and cooperative learning. Chemist Camilla stated, "One of the approaches we use is cooperative learning…. Yeah, most of the students with like challenges or learning disabilities, cooperative learning is very helpful. Hands on activities." These group activities and projects often helped students learn from each other. Believer Ben said that he tried to "group them [students] according to their strengths" and rotated through the groups to make sure that everyone was participating and making progress. He noted that it was necessary to "make sure more than one person is talking in the group because kids who are struggling tend to hide."

Other requirements that appeared to be necessary components of an effective learning environment were hands-on activities and making an effort to encourage students' curiosity. Chemist Camilla used both "the interactive journal as well as the labs that are interactive, too" in her classroom, and Teachers 1–3 highlighted the use of multiple activities and labs in their science classes. Scientist Sheela was perhaps the strongest proponent of the need to ask questions in science:

> Basically in order to make the first step, you have to have a question. Question about anything. If you're eating anything. If you're watching anything. If you're looking at anything. Even the pen and the paper which you are using to study even the book you are studying, the first question. How did this book get into existence? Who invented this? Everything is what, who, how, when? All these exclamations start the basics of the science.

This analysis also found that teachers afforded students relative freedom to design their own learning process according to their own needs. The teachers felt that this was incredibly important to engage the students and ensure that they were constantly learning and grasping concepts. Often, the teachers described their role as one of a "facilitator" in a student's learning process. While still actively listening, guiding, and assessing their students as needed, the teachers gave them the freedom to question and investigate on their own. In regards to her role as an educational facilitator, Scientist Sheela said:

> I want to see how the kids want to move. I give them a chance to make their own steps. I just help them during that process. I provide them with all the means,

> technology, resource, everything. Even the experimentation, the experimental lab, everything.

The teachers even regarded failure as a worthwhile process; in fact, some deemed failure an integral part of powerful, long-lasting learning. Believer Ben specifically believed in the value of failure to motivate:

> Sometimes, in that learning cycle I stand back, and I believe failure is a powerful learning tool because if I give you a procedure and say, "read through this." I give you everything you need to do it, and I expect you to do it, sometimes I stand back and just watch, okay. Then, I'll do a debrief. "What do you think you could have done differently? What did they do differently from you?"

The teachers often deliberately delayed correcting their students so that the students would have the chance to fail. "Sometimes, you know you stand there as a teacher and you're biting a hole in your lip because you want to tell them what to do, but you say no they got to go through this failure here," said Believer Ben. By working on their own, thinking outside of the box, and then learning from their own mistakes, students gained the tools they needed to succeed in science long term.

Each of the teachers found that educating students on the relevance of a particular topic to their own lives was a very successful method that engaged students' willingness to learn what might otherwise be a very dry scientific concept. Once students were interested in a specific question or topic that they could directly relate to, the teachers had captured their attention and could go into more detail about the scientific reasons behind these practical questions. According to Scientist Sheela, "They [students]

understand and then they think oh, it's important for us to understand the importance. Then they understand. If they understand its importance and its application in their life, then they are not going to refuse to learn it."

Conclusion

While the four science teachers interviewed in this study had vastly different life stories and paths to their educational careers, they echoed common themes in response to the interview questions. The teachers valued education and recognized the ability of all students to learn, which was apparent in the multitude of approaches they used to engage their students and help them succeed. They all felt that there was no difference in the ability of girls and boys to excel in STEM fields, but also noted the learning advantages for girls in a single-gender classroom environment. They all operated from a culturally responsive pedagogical framework, as many of the participants had come from similar backgrounds as their students and the teachers thus used that knowledge to forge connections with them. The teachers valued parental involvement in their children's success and widely acknowledged the necessity for continuing professional development and training to enable them to adequately serve their students. Ultimately, the teachers all stressed the importance of engaging students by highlighting the real-life applications of science concepts and they were able to do so in unique ways because of their past experiences in research science and their passion for the subject. The importance of these common themes is discussed further in Chapter 5. Recommendations for practice and implications for future research are also presented.

CHAPTER V

DISCUSSION OF FINDINGS, CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS FOR FUTURE RESEARCH

Introduction

This research studied the voices of successful science teachers in an urban, single-gender girls' school. I utilized a qualitative approach involving semistructured interviews and coding to record the experiences, practices, and views of four science teachers. Each of these educators was responsible for teaching female students in Grades 6 through 12 at a second-generation, girls' academy located in a large, urban school district. I identified and contacted these instructors based on four key indicators of success and relevance: (a) field of instruction, (b) number of years of service, (c) student performance data for the past 3 years, and (d) principal nominations. I collected these data while keeping in mind the constructivist research philosophies, leading me to identify or construct meaning by recognizing the rich and varied experiences of people's lives.

I completed an extensive literature review of single-gender schools and pedagogical practices. These previous findings guided the current study by helping me to contextualize the particular school under investigation in relation to other single-gender classrooms, and to understand the teachers' pedagogies in relation to those used in other educational contexts serving students in Grades 6-12.

In particular, the current study focused on answering the following three research questions:

Q1. How do successful science teachers in an urban single gender girls school describe their personal characteristics that contribute to their students' success and achievement?

Q2. How do successful science teachers in an urban single gender girls school describe their effective acts of teaching in the classroom ?

Q3. How do successful science teachers in an urban single gender girls school describe factors that impact their students' achievement ?

I investigated these research questions by conducting thorough in-person interviews with four successful science teachers. I designed a semistructured interview guide to help me achieve a focused, timely, and reliable conversation with the interviewees. I decided to use the actual words of the teachers and their personal narrative in the analysis rather than paraphrasing these ideas.

Furthermore, I realized that my own unique positionality and experiences as a teacher and administrator could affect the study, design, and interpretation of the findings. Therefore, to avoid these potential biases, I utilized an interpretive method to construct a qualitative study design. Conversations conducted via telephone were transcribed and rigorously reviewed. I compared the interviews with one another and considered them in terms of the relevant literature in order to identify and classify them into prominent themes. These emergent concepts represented the overall nature of the discussions that I sustained with the sampled teachers.

Single-education schools have been a topic of debate since their inception, receiving mixed responses from various parts of society. Particularly significant within the American educational system, in which single-gender private and parochial schools have occupied a fundamental role for generations, these schools are often referred to as "second generation" single-sex schools (Mansfield, 2013). The use of the term "second generation" refers to the fact that current single-sex schools are designed to address the educational inequalities of students that have traditionally been underserved in the public education system.

Single-sex institutions have been largely associated with numerous challenges, ranging from the acquisition, distribution, and use of resources, to problems with technology, materials, and infrastructure. These resource-related issues can also extend to inadequate teacher training and professional development of the educators in single-sex institutions, increasing the educational inequalities that students face in these environments. The teachers interviewed in this study were largely happy with their level of professional development, but there were some complaints and targeted suggestions for improvements that, if addressed, would greatly enhance their ability to educate their students. Furthermore, the literature has suggested that these single-gender schools could potentially reinforce gender and racial stereotypes. Riordan (2002) and Salomone (2003) found that single-sex schools were sometimes ignored by the parents of female students due to the legacy of male privilege associated with all-male academies, and certain members of the African American community view these schools as a resurgence of racially segregated institutions. The present study's findings suggest that addressing

these complex issues requires adequate support for single-sex institutions and a commitment to hiring a diverse set of talented educators. Teachers with the same background or qualities as their student population can serve to directly challenge stereotypes instead of enforcing them. In fact, one of the teachers interviewed in this study found that the background he shared with his students helped them to trust him more, not only as an educator but also as an example of what they themselves were capable of accomplishing.

Summary of Findings

Personal Characteristics

The present research study indicates that the sampled teachers are excellent resources to their schools based on the widely held notion that passionate teachers can singlehandedly create a responsive, motivated, and successful class of students. This is supported by the results of focus group discussions led by of the teachers interviewed in this study displayed obvious passion for their scientific subjects, with all of them holding relevant graduate and professional degrees. In fact, every single teacher stated that they loved science or their specific scientific subject during the interview. Believer Ben asserted that only teachers who have a passion for teaching their particular subjects should remain in their positions because they are far more successful at engaging their students, “If you don’t like teaching, you shouldn’t be in it. I hear a lot of teachers talking about I hate this job, and I just don’t think they can be effective if you don’t like what you’re doing. I like science, I love science, I love sharing my knowledge with kids.”

The feeling that one's teachers care about their success has also been recognized as an important factor that strongly impacts students of color. In a study conducted by Tosolt (2010), it was reported that all of the teachers at the selected school were perceived to be caring by the students. This finding was consistent with that school's goal of creating strong bonds between the teachers and students. Moreover, research has shown that relationships are fundamental to care ethics (Noddings, 2012). Noddings claimed that the relationship between a teacher and a student was based on the actions of both partners to create and sustain a culture of care. Teachers must show interest in their students' success and well-being, while also earning the care of the students they serve. Key to this idea of care ethics is the quality of attentiveness, because a truly caring teacher must listen to the actual needs of the student as opposed to their presumed needs based on the institution or curriculum. This attentive and reactive behavior was apparent in the interviewed teachers. The teachers wanted their students to be inquisitive and guide their own learning. Scientist Sheela even described herself as a "facilitator" of the students' education. Furthermore, Explorer Eddy said, "Because it's not in the curriculum, oh sorry, can't talk about that? No," when he discussed his desire to teach topics that engaged the students, not just those that were required to excel on standardized tests. Such behavior communicated to the students that the teacher was listening to them and cared about their interests and knowledge.

Many of the teachers interviewed in this study repeated that they valued a caring, trusting relationship with their students to help them succeed. Chemist Camilla stated, "I feel that is also in my teaching, also in my behavior, also exhibited, that I'm firm. At the

same time, I'm very caring also. My students know that 'my teacher cares for me and she's responsible.'" This caring relationship encouraged her students to approach her for help in other subjects, like math, because they knew they could trust her guidance. Chemist Camilla's ability to establish a caring relationship, according to care ethics, actually helped her students excel not only in science, but in other subjects as well.

Research has demonstrated that the teacher–student relationship is pivotal to a student's ability to connect with a subject on a deeper level by both encouraging and supporting this endeavor. The teachers interviewed for the current study claimed to have had such experiences with their students, who predominantly expressed fondness for their teachers. This affinity was explained by the teachers' monumental efforts to help students understand the course materials and requirements, while catering to their individual learning styles. Given the students' various learning demands, including some learning disabilities, successful teachers invested vast amounts of time planning multiple hands-on activities and teaching strategies to ensure the success of each student. Chemist Camilla reported about the extra lengths she went to when working with an autistic student who required additional attention beyond that of her neuronormative peers, "She used to get excited really quickly and disruptive. To teach that student, I had to learn to have a very structured classroom and [be] very calm." Many of these successful teachers went above and beyond the normal lesson planning time to ensure that their students engaged with the subject, and Believer Ben described this investment of time and effort as "astronomical." Particular attention was given to students that were at risk of falling behind by offering after-school and weekend tutorials, extra study hours, and patience.

Chemist Camilla said specifically, “I’m always there to help them. They can stay after school. They can come on Saturdays.” This investment of extra time is another characteristic that also evidences the care ethics embodied by each of the teachers.

Teacher Training and Professional Development

Passion for one’s subject matter was also associated with the desire to stay up-to-date on new and emerging ideas in the teacher’s respective fields. Teachers realized that this type of cutting-edge content knowledge contributed directly to the development of their class lesson plans. For example, Scientist Sheela explained that, “every year I want to bring something new, like the way the kids learn.” Incorporating new ideas and discoveries allowed these successful science teachers to grab their students’ interest with new information and diversify their classroom activities from year to year.

The content knowledge possessed by these qualified teachers proved useful throughout their teaching careers. As explained by Scientist Sheela, “One of the things is my content knowledge, my PhD, which gives us a good exposure to hands on experiments where you learn from your mistakes, and you do the experiments.” Educators with a background in science are able to pull from their experiences to educate their students in ways that teachers without that experience cannot. Believer Ben reflected on the importance of content knowledge, and said that the lack of such knowledge was often the reason that some teachers conducted fewer lab experiments and hands-on activities in their classes, even though these teaching strategies are highly effective in science education. He suggested that teachers without the adequate knowledge and background in science were often fearful of experiment failures in front

of their students. Finally, Chemist Camilla said that content knowledge was sometimes the greatest factor influencing teaching success. Thus, the lack of content knowledge can clearly limit the ability of teachers to address the different learning styles of students in their classes, especially for students who are visual or kinetic learners.

Confirming previous research by Spielhagen (2011), teacher training and professional development were also found to contribute directly to an educator's success. The teachers spoke highly of these opportunities and how much they had gained from various programs that they then incorporated into their classes. However, while Believer Ben seemed satisfied with the amount of training he received, Explorer Eddy was adamant that the training and professional development needed to be improved and was often a "waste of time." This echoes the criticism in the literature review of previous studies that have suggested that single-sex schools do not have adequate resources to serve their students (Evans, 2014; Spielhagen, 2011). Clearly, the concern regarding resources for professional development in single-sex schools is valid in at least some educators' experiences.

Pedagogical Practices

Each of the four educators adopted a unique approach to teaching his or her students. Such differences in pedagogical practice are in line with Atwater's approach to science teaching, in which unique communities of students and individuals must be seen as complicated persons with diverse needs and cultural experiences. Furthermore, in a study conducted by Bonner (2014), each of the three exemplary female teachers sampled was found to have utilized unique teaching styles. The current study corroborates this

finding and contends that successful teachers each have their own customized teaching styles and strategies for ensuring diverse students' learning success. Exceptional teachers were reported to be highly sensitive to the different learning styles of their students, reactive to their students' needs as they arose, and particularly attentive to comprehension demands.

The successful teachers that I interviewed for the present study echoed these habits. Believer Ben strongly argued for setting a daily routine for the class to follow so that students immediately knew what was expected of them upon entering the class. The most noteworthy aspect of this teacher's attitude was the desire to treat each student equally and fairly, which is a very important aspect discussed in the literature about single-gender schools. In particular, Rychly and Graves (2012) have argued that teachers must be caring, empathetic, and reflective of their beliefs about people from other cultures in order to design and implement culturally responsive pedagogies (Rychly & Graves, 2012). While this routine-based approach may initially seem contrary to such a theory, Believer Ben rationalized that this level of consistency actually contributed to developing an unbiased classroom community. This action perpetuates a trusting relationship between the teacher and student (Pang, 2001). Believer Ben has had to deprogram some of his students' attitudes in regards to science learning for girls, because some of his students had been told that they would not be successful in the science classroom. He had to instill in them the belief that they could be successful, and show his belief in them as strong students in science.

According to Pang (2005), there are essential components of caring in education which include trusting relationships between students and teachers, as well as, between the teacher and the community. The teachers in this study believed in their students and spent time talking informally to parents, learning more about them and showing interest in their students' lives outside of the four walls of the science classroom. The teachers used this time to talk to parents in a non-threatening environment to gain their respect, trust and support in the academic partnership for success in science.

Alternatively, Chemist Camilla focused more on the individual abilities of her students to best identify each individual's strengths and weaknesses. Instead of setting a strict, daily classroom routine, Chemist Camilla focused more on the initial design of the lessons themselves to effectively teach to a wide variety of cultural backgrounds and learning styles. In contrast to both Teachers 1 and 2, Scientist Sheela adapted her pedagogical approach to be student centered, allowing students to choose their own individual activities from a set of appropriate assignments rather than planning single classroom lessons ahead of time. She allowed students to choose how they wanted to learn a concept, allowing them to take control of their own education. Scientist Sheela explained that this approach means that many students end up working autonomously: "If you walk into my class, you will see differentiation. Everyone is not doing the same thing…I am a very big fan of the learning choices…I have a set of activities, not just one activity to teach one topic….and I give them a chance to pick their way of learning. Some people like doing research. I give them six chances. I have a tic-tac-toe. They can look at their choices. I have some printed and laminated pieces mostly which go with the

topics. They look at the topics, which helps me to teach those. They pick their own activities, their own styles." Although the pedagogical approaches of Teachers 2 and 3 differed, they both strove to teach their diverse student population in a manner that enabled effective learning for each individual, which is often a significant challenge for teachers (Sampson & Garrison-Wade, 2011).

Explorer Eddy utilized yet another approach to addressing these varied learning styles in the classroom. The unique feature about this teacher's style was that he based each student's approach to learning upon the results of a one-on-one discussion during which he and the student addressed individual likes, dislikes, abilities, and approaches to learning. Thus, in this case, the first focus was placed on identifying students' learning styles and the second on teaching each student accordingly. This approach provided a more reliable match in terms of teaching and learning styles, as there was confirmation from the student about her individual needs. Such an emphasis on utilizing various instructional strategies in order to teach to students with different learning styles is a foundational characteristic of culturally responsive teaching (Gay, 2000).

The teachers also endeavored to understand their students' shortcomings and strengths in an effort to create a conducive learning environment for the entire class. Chemist Camilla described how she established a calm classroom atmosphere guided by routine in order to help an excitable autistic student she once taught. Scientist Sheela mentioned that she tried to simplify complex concepts in her daily lessons and assessments, particularly when working with challenged students and students with disabilities. Chemist Camilla preferred using the technique of cooperative learning, in

which students learn from each other, when working with disabled or otherwise challenged students. She was a strong proponent of group learning for such students as well as the utilization of a variety of hands-on activities and extra teaching time. Explorer Eddy was very dedicated to using technological resources to enhance the teaching–learning experience of challenged students. The unique teaching approaches of these teachers to address their students' various learning needs speaks to their dedication to do whatever is necessary to ensure the success of their students. Such attentiveness to individual students' specific needs exemplified by all four teachers is one of the key characteristics of care ethics (Noddings, 2012).

Real-Life Learning Applications

Each teacher commented on how his or her students were more engaged in learning when they understood the real-life applications of science. Thus, the teachers made every effort to connect their science lessons with the students' daily lives. Some teachers went so far as to link such simple questions as which toothpaste or shampoo is best with the relevant scientific concepts to answer these questions, such as pH.

This emphasis on real-life applications is in line with Atwater's (1993) approach to science teaching, whereby students are encouraged to ask questions regarding the relevance of concepts they are learning to their lives. It is also similar to the untraditional teaching methods used by other successful teachers, including the use of music, chants, dance, and recitation to help students connect with generally dry subjects like mathematics (Bonner, 2014). Moreover, the Lang Science Program at the American Museum of Natural History stands as an example of how effective it can be to use real-

world experiences to bring learning to life for students (Adams et al., 2014). The Young Women's Leadership School further exemplifies the ability of hands-on, inquiry-based activities to lead to the high academic performance of students from diverse backgrounds (Mansfield, 2014).

Each teacher approached the incorporation of real-life scientific applications in his or her own unique way. Believer Ben identified hands-on experiences with practical science as an important way for students to gain new knowledge. He believed in "learning by doing" and incorporated frequent labs into his lesson plans. Chemist Camilla further supported this real-world approach by linking it to the importance of the teachers' content knowledge, arguing that this was the most important and essential component of effective teaching. She noted that teachers with a research background were more comfortable facilitating hands-on experiments in the classroom. Chemist Camilla felt that such experiments and activities should go hand-in-hand with book and lecture-based learning. Overall, it appeared that teachers with high levels of content knowledge were better able to make connections between complex science concepts and the daily lives of their students.

Scientist Sheela strongly expressed her opinion that teachers are responsible for improvements in student performance and claimed that the secret to pedagogical success is utilizing whatever method that enables the student to understand a concept. In fact, this educator asserted that strategies applied by teachers for effective teaching and learning were the basic ingredients required to be successful as a science teacher. This idea was also reflected in the teacher's claim that making each science concept relevant

to the students was just as important as learning the concept itself. The teacher was of an inquisitive nature herself, which is why she urged her students to ask more questions. Throughout the conversation, the teacher expressed this belief multiple times. Explorer Eddy, on the other hand, was a strong proponent of outdoor field trips. He felt it was necessary for his students to experience the topics they were learning in their earth and environmental science classes in person. Practical knowledge, according to Explorer Eddy, was a must for enabling an effective teaching–learning scenario. Both of Teachers 3 and 4 felt that real-life applications and practical knowledge of science concepts were the most effective strategies to ensure student success and engagement, a claim that supports previous research (Bonner, 2014; Mansfield, 2014).

Factors Impacting Student Success

The Single-Gender Environment

The existing literature demonstrates the tendency of teachers to claim that their teaching abilities were not based on the types of schools at which they taught. Furthermore, as indicated by Hoffman et al.'s findings (2008), teacher efficacy existed independently of classroom arrangements. Such a claim is effectively summarized by a comment made by one of the teachers interviewed, "Good teaching is good teaching" (Hoffman et al., 2008, p. 24). The only difference noted in regards to teaching environment was that the teachers' confidence increased among those who were enthusiastic about teaching in single-gender schools (Hoffman et al., 2008).

The present research makes a similar claim regarding the nature of teaching: the nature of the setting in which an educator instructs is not the key indicator of his or her

teaching ability. For example, Chemist Camilla held a particularly strong viewpoint that all students, whether girls or boys, in a single-gender school or co-ed school, learned in a similar manner. Thus, the pedagogical environment established by a teacher is only a minor factor in terms of his or her teaching success.

As noted in the literature review, single-gender education has been critiqued for reinforcing rigid, limiting, and detrimental racial and gender stereotypes (Eliot, 2013; Goodkind, 2012; Patterson, 2012). In particular, Pahlke et al. (2014) have asserted that gender-segregated environments perpetuate gender-stereotyped social relationships and neurological gender differences. However, the actual experiences of the students in these schools offer a different perspective which highlights the educational achievement possible in such an environment. The teachers in this study readily identified the advantages of a single-gender classroom. Such benefits were especially noticeable for female students who, as stated by Chemist Camilla, were found to be "More comfortable sharing…when they are just the girls." Similar claims have been made by several researchers, including Farinde and Lewis (2012), NWLC and LDF (2014), Perry et al. (2012), Pinder and Blackwell (2014), and West-Olatunji et al. (2010). Pedagogical scholarship has widely recognized the fact that many girls, particularly those of color, benefit from a single-gender classroom because they feel more comfortable expressing their ideas in such a setting. Herr and Arms (2002) even claimed that the initiative to provide single-gender classes within coeducational schools was "working for the girls," suggesting that single-gender classrooms within coeducational environments may also facilitate higher academic achievement among female students.

The support for female educational achievement is particularly important in light of research that has noted the severe underrepresentation of women of color in STEM fields. Single-gender schools may offer the greatest possibility for ending this disparity, as girls in such supportive environments may be more inclined to study mathematics and science (Farinde & Lewis, 2012; NWLC & LDF, 2014). The current findings also suggest that these schools are endowed with a higher percentage of girls interested in STEM fields than their coeducational counterparts.

The present study suggests an interesting finding in regards to gender preferences in these schools: male teachers were found to be somewhat skeptical about teaching at an all-girls school. Believer Ben, who was male, clearly stated this: "I didn't think about the girls' school. I thought about the boys' school, because, you can call it what you want, but it must have been a male thing. I thought they only hired women at the girls' school." It took multiple attempts to convince Believer Ben to teach at an all-girls school. In contrast, the female teachers were emotionally influenced to teach in an all-girls environment. Chemist Camilla revealed that she had studied in an all-girls school herself and that single-gender schools made her feel more connected to the teaching and learning environment. She shared that her own educational experiences in single-gender schools inspired her to teach in one herself and to encourage more experimentation and use of new technologies to motivate her female STEM students.

Unfortunately, research has found that single-gender schools are disproportionately affected by a shortage of resources and other educational challenges, in addition to those already inherent in institutions that primarily work with underserved

communities from diverse ethnicities and cultural backgrounds (Evans, 2014). Evans (2014) claimed that most of the themes identified as prevalent in single-gender schools were unrelated to students' ethnicities, instead reflecting on the obstacles that instructors face when teaching students with special needs and behavioral problems in schools with inadequate resources.

Technological resources and materials are also considered important factors contributing to the teaching–learning experience. As Bonner explained (2014), making technology available to students supports discussion inside and outside of the classroom, further contributing to student empowerment and increased confidence. In particular, Bonner noted that "females of color provided a sense of empowerment and strength that many of the girls had not experienced in a mathematics classroom" (p. 385). However, single-gender schools were found to be severely lacking in technological resources due to a lack of funding (NWLC & LDF, 2014). This shortage was reported to have limited the success of education in single-gender schools. Believer Ben, in particular, claimed that such resources were essential to teaching subjects such as science, whose comprehension is nearly impossible without access to resources such as laboratories and scientific equipment.

This limited access to resources may be considered even more important in the single-gender educational environment of this study, given the innovative teaching styles adopted by these teachers to cater to students' individual learning abilities, speeds, and methods. As explained by one teacher:

> The other obstacle to good science, the way I teach it, are resources. You gotta have some degree of good equipment, when I say good equipment I'm talking about hardware, the laboratory apparatus that they'll be using, say in college and in industry. The microscopes, we've got those, you need the PH meters, the centrifuges, the incubators, things like that, the hardware. HSD is lacking in those areas.

The absence of such resources was reported to have severely deleterious effects on the futures of persons of color learning in such schools (NWLC & LDF, 2014). Chemist Camilla further pointed out that, for science, hands-on labs and other resources constitute a learning style that is required by certain students. The connection between such lab materials and the ability to learn science necessitates the need for these resources in schools. However, according to the educators' claims there is currently a severe lack of resources, physical space, and materials in single-gender schools.

Explorer Eddy, in particular, noted that the greatest obstacle to teaching at his school was the large number of students in a single classroom. This difficulty was associated with the old building in which he taught. This building, which went against OSHA regulations in many ways, contained small, overcrowded classrooms that hampered a conducive learning environment. Again, additional funding for single-gender schools to build appropriate lab space that can safely accommodate larger classes would resolve this issue.

Parental Involvement

The current study identified another important concept in regards to parental involvement at single-gender schools. As Explorer Eddy revealed, the parents of female students preferred sending their children to single-gender schools because they perceived these schools to be safer and less distracting than a coeducational environment. This claim is supported by the academic literature as well. For instance, Pahlke et al. (2014) found that many parents, teachers, and students were supportive of single-sex education.

Parental involvement in single-gender schools, however, remains a highly debatable topic. Despite claims in favor of parental involvement for students from marginalized groups, specifically in regards to the development of internal resources that enable students to overcome challenges and obstacles to achievement, the present study found several instances where parental involvement was detrimental to learning. Believer Ben revealed that some African American students came from a culture that did not see the "value of education" because of what he referred to as the failure chain:

> A lot of these kids, they're in an environment where there's a failure chain. Their parents didn't go to college, a lot of 'em may not have finished high school, or didn't do well in high school. They're looking at their children to get educated because they believe education will get them out of poverty. Or get them out of the failure chain.

Scientist Sheela also held negative views towards parental involvement because it had at times interfered with her pedagogical practices. This teacher specifically mentioned that

parents sometimes had inordinately high expectations of the teachers while occasionally being uncooperative.

Despite some of these negative opinions, overall the teachers encouraged better communication with parents and some level of parental involvement in their children's education. Chemist Camilla revealed that parents were often extremely supportive of the teaching–learning process, actively taking an interest in their children's education through parent–teacher conferences and tutoring. This teacher, in fact, praised parental involvement, regarding parents as an essential "check and balance system" for the student's growth. Believer Ben also praised the involvement of parents at the single-gender school where he taught because he thought it was necessary that parents stay involved even when their children reached middle and high school age.

Standardized Testing

According to Wilkins (2014), when teachers are passionate about their jobs, they feel that it is "their responsibility to create a comfortable, motivational learning environment, and they expected their students' to show effort in return." Believer Ben, although sensitive to the fact that students need to be taught content in an effective manner, was completely against the notion that teachers should be held accountable for student underperformance. He shared past experiences in which he was specifically urged to help his students perform at higher levels on standardized tests, despite the fact that his students were performing above the district average:

> As far as holding a teacher accountable, because I've been on both sides of the coin, sometimes there are student apathy. You know, I don't care about this test

> and I'm just taking it, it doesn't matter. I don't think a teacher should be held accountable for that. I guess if I had to answer that questions, I think teachers should be responsible for delivering the content, evaluating their students along the way, and helping them prepare.

Explorer Eddy echoed this opinion, expressing his concern about "teaching to the test" because educators did not want to be punished for their students' poor performance on standardized tests.

One solution to this problem, as Believer Ben suggested, was "end of course testing." Unfortunately, this suggestion is not practical. Although teachers should not be held completely responsible for student performance and terminal educational testing schemes could help to eliminate the gap between student performance and teacher accountability, this solution lacks feasibility.

Chemist Camilla, on the other hand, felt personally accountable for her students' performance and asserted that it was the duty of each teacher to ensure that students succeeded in a way that was reflected in standardized test scores. Moreover, she personalized student performance by regarding the successes of her students as her own successes. This further motivated her to teach effectively and ensure her students' success.

Despite the varied opinions of these teachers on the effectiveness of standardized testing to assess a teacher's abilities or student learning, they all agreed that there should be some type of assessment method. A combination of formal testing and informal

testing was suggested as a valid way to provide feedback on an educator's teaching ability and assess the success of the students in a subject.

Conclusions

Having arrived at the abovementioned findings in the present study and completed a rigorous review of the literature, here I will offer a more comprehensive overview of single-gender schools through the perspective of successful science teachers.

These teachers were predominantly characterized by a passion for science and their students, an interest in ongoing scientific developments, and the use of real-life examples and applications in their teaching. Having taught students from a wide array of backgrounds within both single-sex and coeducational settings, the instructors were advocates of equality and fairness in educational opportunities for both genders. Furthermore, these educators adopted a caring, concerned, and student-centered approach to learning.

Additionally, the teachers held that the students, regardless of it being a single-sex or coeducational environment, learned in similar ways. While they recognized that each individual student had his or her own learning style, the teachers found no real differences between the overall ability of students to learn in coeducational versus single-sex schools. However, these educators acknowledged certain benefits to a single-sex education that made it particularly attractive to female students and their parents. These included fewer distractions due to the presence of a single gender, increased confidence and leadership opportunities, and a perceived increase in safety.

However, the glaring reality about these schools is that they suffer from a severe lack of resources, teacher training, materials, and technology—a scarcity that has been shown to impede the development of a conducive teaching–learning environment (NWLC & LDF, 2014). Specifically, there is a need for culturally responsive professional development for teachers and trainings for parents on strategies that would encourage and increase parental involvement and engagement. The present study also highlighted the difficulties associated with standardized testing as it is currently being practiced in schools. The teachers readily agreed that the students in such schools have varied learning abilities and styles that must be addressed through both formal and informal assessments, as well as customized teaching strategies.

Recommendations

In line with this study's findings and conclusions, I recommend an increased focus on single-gender schools given the rising preference for these institutions among students from disadvantaged backgrounds. To accomplish this, I suggest that:

- superintendents lay an increased focus on all girls schools or classrooms given the rising preference for such in urban environments
- principals recruit science teachers who have strong credentials in science and a passion for teaching science that involves hands on activities, labs and real world application
- school district leaders and principals lobby for more funds for all girls schools for scientific equipment, lab materials, physical lab space, and teacher professional development

- strategic and culturally responsive training is provided to parents to invite, encourage involve and engagement them in their children's learning, working with both the teachers
- principals provide teachers with resources necessary to continue their own scientific education and professional development so that they can offer their students ample opportunities to experience hands-on activities and experiments.

Implications for Future Research

The present study only involved interviews with four science teachers in one single-gender school. Additional research involving a larger number of science teachers from multiple single-sex schools would further substantiate the findings of the present study. Moreover, expanding this type of study to include other subjects, not just science, would broaden the applicability of the findings. In addition, a comparison study involving both single-sex and coeducational environments would highlight the unique advantages and challenges inherent to these educational spaces.

Due to the academic nature of this research, certain restrictions were put in place in terms of the time and financial resources available. If such obstacles could be overcome, a much more comprehensive study on this topic could be undertaken. Such a study could utilize several other aspects of the teaching–learning relationship and potentially include a quantitative assessment of teaching effectiveness, which would dramatically contribute to the current knowledge about single-gender schools.

Despite the challenges facing single-sex schools in terms of resources and space, the quality of teachers in the school under investigation was impressive. These teachers not only held advanced degrees in science, but they also had an obvious passion for their subject and for the success of their students. They strongly believed in the ability of all their students to succeed in science, regardless of gender or learning disability, and they felt that it was their responsibility as teachers to make that happen. This personal characteristic of passion for science and the emphasis these teachers placed on care ethics in their classrooms was exemplary. These teachers, although often limited in resources and lab materials, made the best of their situation by coming up with creative solutions and using technology to aid them, all in a culturally responsive manner. Such excellent teachers, combined with motivated and involved parents who believed in the importance of their children's education, can only become better educators when given the resources and training they need. Investing in the professional development and training of these passionate, motivated educators directly benefits students, and should be considered a major pathway to help increase the success of girls in STEM fields, particularly those from underserved communities.

REFERENCES

Adams, J. D., Gupta, P., & Cotumaccio, A. (2014). Long-term participants: A museum program enhances girls' STEM interests, motivation, and persistence. *Afterschool Matters, 20*, 13–20.

Aiken, W. (1957). *Education of women in Texas*. San Antonio, TX: Naylor.

Allen, W., Epps, E., Guillory, E., Suh, S., & Bonous-Hammarth, M. (2000). The Black academic: Faculty status among African Americans in U.S. higher education. *The Journal of Negro Education, 69*(1/2), 112–127.

Allensworth, E. (2012). Want to improve teaching? Create collaborative, supportive schools. *American Educator, 36*(3), 30–31.

American Association for the Advancement of Science [AAAS]. (1989). *Science for all Americans*. Retrieved from http://www.project2061.org/publications/bsl/

American Association for the Advancement of Science [AAAS]. (1993). *Benchmarks for science literacy*. Retrieved from http://www.project2061.org/publications/bsl/

Atwater, M. M. (1993). Multicultural education: Assumptions and alternative views. *The Science Teacher, 60*(3), 32–37.

Atwater, M. M. (1996). Social constructivism: Infusion into multicultural science education research. *Journal of Research in Science Teaching, 33*, 821–838.

Atwater, M. M. (2010). Multicultural science education and curriculum materials. *Science Activities, 47*, 103–108. doi:10.1080/00368121003631652

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York, NY: Freeman.

Banks, J. A. (2004). Multicultural education: Historical development, dimensions, and practice. In J. A. Banks (Ed.), *Handbook of research on multicultural education* (pp. 3–29). San Francisco, CA: Jossey-Bass.

Baptiste, H. P. (1994). A comprehensive multicultural teacher education program: An idea whose time has come. In M. M. Atwater, K. Radzik-Marsh, & M. Strutchens (Eds.), *Multicultural education: Inclusion of all* (pp. 65–92). Athens, GA: University of Georgia.

Blount, J. (2005). *Fit to teach: Same-sex desire, gender, and school work in the twentieth century*. Albany, NY: SUNY Press.

Bogdan, R. C., & Biklen, S. K. (1998). *Foundations of qualitative research in education: An introduction to theory and methods* (3rd ed.). Boston, MA: Allyn and Bacon.

Bogdan, R. C., & Biklen, S. K. (2007). *Research for education: An introduction to theories and methods*. New York, NY: Pearson.

Bonner, E. P. (2014). Investigating practices of highly successful mathematics teachers of traditionally underserved students. *Educational Studies in Mathematics, 86*, 377–399.

Brittian, A. S., & Gray, D. L. (2014). African American students' perceptions of differential treatment in learning environments: Examining the moderating role of peer support, connection to heritage, and discrimination efficacy. *Journal of Education, 194*, 1–9.

Brown, N., & Benken, B. M. (2009). So when do we teach mathematics? Vital elements of professional development for high school mathematics teachers in an urban context. *Teacher Education Quarterly*, *36*(3), 55–73.

Bruner, J. (1990). *Acts of meaning*. Cambridge, MA: Harvard University Press.

Byrd, C. M., & Chavous, T. (2011). Racial identity, school racial climate, and school intrinsic motivation among African American youth: The importance of person-context congruence. *Journal of Research on Adolescence, 21*, 849–860.

Campbell, S. L. (2012). For colored girls: Factors that influence teacher recommendations into advanced courses for Black girls. *Review of Black Political Economy, 39*, 389–402.

Chavous, T. M., Smalls, C., Rivas-Drake, D., Griffin, T., & Cogburn, C. (2008). Gender matters, too: The influences of racial discrimination and racial identity on academic engagement outcomes among African American adolescents. *Developmental Psychology, 44*, 637–654.

Cochran-Smith, M., Barnatt, J., Lahann, R., Shakman, K., & Terrell, D. (2009). Teacher education for social justice: Critiquing the critiques. In W. Ayers, T. Quinn, & D. Stovall (Eds.), *The handbook of social justice in education* (pp. 625–639). London, United Kingdom: Taylor & Francis.

Collins, P. H. (2000). *Black feminist thought: Knowledge, consciousness, and the politics of empowerment* (2nd ed.). New York, NY: Routledge.

Cottrell, D. M. (2010a, June 15). National Women's Conference, 1977. *Texas State Historical Association.* Retrieved from http://www.tshaonline.org/handbook/online/articles/pwngq

Cottrell, D. M. (2010b, June 15). Women and education. *Texas State Historical Association.* Retrieved from https://tshaonline.org/handbook/online/articles/khwku

Crenshaw, K. (1989). Demarginalizing the intersection of race and sex: A black feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics. *University of Chicago Legal Forum, 140*, 139–167. Retrieved from http://philpapers.org/rec/CREDTI

Creswell, J. W. (2005). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Upper Saddle River, NJ: Pearson Education Inc.

Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Darling-Hammond, L. (2002). Research and rhetoric on teacher certification: A response to "Teacher Certification Reconsidered." *Education Policy Analysis Archives, 10*(36).

Denzin, N. K., & Lincoln, Y. S. (1994). *Handbook of qualitative research*. Thousand Oaks, CA: Sage.

Dillard, C. (1995). Leading with her life: An African American feminist (re)interpretation of leadership of an urban high school principal. *Educational Administration Quarterly, 31*(4), 539–564.

Dorman, E. H. (2012). "Everything that's challenging in my school makes me a better teacher": Negotiating tensions in learning to teach for equity. *Journal of Urban Learning, Teaching, and Research, 8*, 83–92.

Dotterer, A. M., McHale, S. M., & Crouter, A. C. (2009). Sociocultural factors and school engagement among African American youth: The roles of racial discrimination, racial socialization, and ethnic identity. *Applied Developmental Science, 13*(2), 61–73.

Douglas, B., Lewis, C. W., Douglas, A., Scott, M. E., & Garrison-Wade, D. (2008). The impact of White teachers on the academic achievement of Black students: An exploratory qualitative analysis. *Educational Foundations*, *22*(1–2), 47–62.

Eliot, L. (2013). Single-sex education and the brain. *Sex Roles, 69*, 363–381.

Evans, B. R. (2013a). Supporting students from underrepresented groups in mathematics for alternative certification teachers. *Journal of the National Association for Alternative Certification, 8*(1), 16–26.

Evans, B. R. (2013b). Supporting female students in mathematics for alternative certification teachers. *Journal of the National Association for Alternative Certification, 8*(2), 43–50.

Evans, B. R. (2014). Perspectives on teaching from alternative certification teachers from diverse backgrounds. *Journal of the National Association for Alternative Certification, 9*(1), 32–40.

Evans-Winters, V. E., & Esposito, J. (2010). Other people's daughters: Critical race feminism and Black girls' education. *Educational Foundations*, *24*(1–2), 11–24.

Farinde, A. A., & Lewis, C. W. (2012). The underrepresentation of African American female students in STEM fields: Implications for classroom teachers. *US-China Education Review, B4*, 421–430.

Ford, D. Y. (2015, January). Culturally responsive gifted classrooms for culturally different students: A focus on invitational learning. *Gifted Child Today, 38*(1), 67–69.

Friend, C. A., Hunter, A. G., & Fletcher, A. C. (2011). Parental racial socialization and the academic achievement of African American children: A cultural-ecological approach. *Journal of African American Studies, 15*, 40–57.

Friend, J. (2006). Research on same-gender grouping in eighth grade science classrooms. *Research in Middle Level Education Online, 30*(4), 1–15.

Gall, J. D., Borg, W. R., & Gall, J. P. (1996). *Educational research: An introduction* (6th ed.). White Plains, NY: Longman Publishers.

Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational research: an introduction* (7th ed.). Boston, MA: A & B Publications.

Gay, G. (2000). *Culturally responsive teaching : Theory, research, and practice* (Multicultural Education Series, No. 8). New York, NY: Teachers College Press.

Gollnick, D. (1995). National and state initiatives for multicultural education. In J. Banks, & C. Banks (Eds.), *Handbook of research on multicultural education* (pp.44–64). Old Tappan, NJ: Macmillan.

Goodkind, S. (2012). Single-sex public education for low-income youth of color: A critical theoretical review. *Sex Roles, 69*(7), 393–402. doi:10.1007/s11199-012-0219-2

Goodkind, S. (2013). Single-sex public education for low-income youth of color: A critical theoretical review. *Sex Roles, 69*, 393–402.

Hamre, B. K., & Pianta, R. C. (2007). Learning opportunities in preschool and early elementary classrooms. In R. C. Pianta, M. J. Cox, & K. L. Snow (Eds.), *School readiness and the transition to kindergarten in the era of accountability* (pp. 49–84). Baltimore, MD: Brookes.

Hayes, A. R., Pahlke, E. E., & Bigler, R. S. (2011). The efficacy of single-sex education: Testing for selection and peer quality effects. *Sex Roles, 65*, 693–703.

Herr, K. & Arms, E. (2002). The intersection of educational reforms: Single-gender academics in a public middle school. In A. Datnow & L. Hubbard (Eds.), *Gender in Policy and Practice: Perspectives on Single Sex and Coeducational Schooling* (pp. 74–89). New York, NY: RoutledgeFalmer.

Hoffman, B. H., Badgett, B. A., & Parker, R. P. (2008). The effect of single-sex instruction in a large, urban, at-risk high school. *Journal of Educational Research, 102*, 15–36.

Hughes, J. N., Wu, J.-Y., Kwok, O., Villarreal, V., & Johnson, A. Y. (2012). Indirect effects of child reports of teacher-student relationship on achievement. *Journal of Educational Psychology, 104*, 350–365.

Johnson, J. F. (1998). *The promise of school reform in Texas*. Austin, TX: The Charles A. Dana Center.

Jost, K. (2002). Single-sex education: Do all-boy and all-girl schools enhance learning? *CQ Researcher, 12*(25), 569–592.

Koonce, J. B. (2012). "Oh, those loud Black girls!": A phenomenological study of Black girls talking with an attitude. *Journal of Language and Literacy Education, 8*(2), 26–46. Retrieved from http://jolle.coe.uga.edu/wp-content/uploads/2012/06/Loud-Black-Girls.pdf

Ladson-Billings, G. (1995). But that's just good teaching! The case for culturally relevant pedagogy. *Theory Into Practice, 34*(3), 159–165.

Ladson-Billings, G. (2009). *The dreamkeepers: Successful teachers of African American children* (2nd ed.). San Francisco, CA: Jossey-Bass.

Larke, P. J. (1990). Cultural diversity awareness inventory: Assessing the sensitivity of pre-service teachers. *Action in Teacher Education, 12*(3), 23–30.

Lee, O., Luykx, A., Buxton, C., & Shaver, A. (2007). The challenge of altering elementary school teachers' beliefs and practices regarding linguistic and cultural diversity in science instruction. *Journal Of Research In Science Teaching, 44*(9), 1269–1291.

Lee, V. (2002). Single-sex vs. coeducational schools. In *The Jossey-Bass reader on gender in education* (pp. 677–699). San Francisco, CA: John Wiley & Sons.

Leininger, M. M. (1985). Ethnography and ethnonursing: Models and modes of qualitative dataanalysis. In M. M. Leininger (Ed.), *Qualitative research methods in nursing* (pp. 33–72). Orlando, FL: Grune & Stratton.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry* (Vol. 75). Los Angeles, CA: Sage Publications.

Lindlof, T. R., & Taylor, B. C. (2010). *Qualitative communication research methods*. Los Angeles, CA: Sage Publications.

Lucas, X., & Greenberg, J. (2008). Responding to the linguistic reality of mainstream classrooms: Preparing all teachers to teach English language learners. In M. Cochran Smith, S. Feiman-Nemser, & J. Mclntyre (Eds.), *Handbook of research on teacher education: Enduring issues in changing contexts* (3rd ed., pp. 606–636). Mahwah, NJ: Lawrence Erlbaum Associates.

Madigan, J. C. (2009). The education of girls and women in the United States: A historical perspective. *Advances in Gender and Education, 1*, 11–13.

Mansfield, K. C. (2013). The growth of single-sex schools: Federal policy meets local needs and interests. *Education Policy Analysis Archives, 21*(78). Retrieved from http://epaa.asu.edu/ojs/article/view/1181

Mansfield, K. C. (2014). How listening to student voices informs and strengthens social justice research and practice. *Educational Administration Quarterly, 50*, 392–430.

Mariano, J. M., Going, J., Schrock, K., & Sweeting, K. (2011). Youth purpose and the perception of social supports among African-American girls. *Journal of Youth Studies, 14*, 921–937.

Marshall, C., & Rossman, G. B. (1989). *Designing qualitative research*. Los Angeles, CA: Sage Publications.

McDonald, M., & Zeichner, K. M. (2009). Social justice teacher education. In W. Ayers, T. Quinn, & D. Stovall (Eds.), *Handbook of social justice in education* (pp. 595–610). New York, NY: Routledge.

McGee Banks, C. A., & Banks, J. A. (1995). Equity pedagogy: An essential component of multicultural education. *Theory Into Practice, 34*, 152–158.

McLaren, P. (2015). *Life in schools: An introduction to critical pedagogy in the foundations of education* (6th ed.). Boulder, CO: Paradigm Publishers.

McMahon, S. D., Felix, E. D., & Nagarajan, T. (2011). Social support and neighborhood stressors among African American youth: Networks and relations to self-worth. *Journal of Child and Family Studies, 20*, 255–262.

Merriam, S. B. (1988). *Case study research in education: A qualitative approach*. San Francisco, CA: Jossey-Bass.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco, CA: Jossey-Bass Publishers.

Meyer, P. (2008). Learning separately: The case for single-sex schools. *Education Next, 8*(1). Retrieved from http://educationnext.org/learning-separately/

Morales, E. K. (2010). Linking strengths: Identifying and exploring protective factor clusters in academically resilient low-socioeconomic urban students of color. *Roeper Review, 32*, 164–175.

Murray, C., Waas, G. A., & Murray, K. M. (2008). Child race and gender as moderators of the association between teacher-child relationships and school adjustment. *Psychology in the Schools, 45*, 562–578. doi:10.1002/pits.20324

National Women's Law Center & NAACP Legal Defense and Educational Fund. (2014). *Unlocking opportunity for African American girls: A call to action for educational equity*. Retrieved from http://www.nwlc.org/sites/default/files/pdfs/unlocking_opportunity_for_african_american_girls_report.pdf

Neal, L. I., McCray, A. D., Webb-Johnson, G., & Bridgest, S. T. (2003). The effects of African American movement styles on teachers' perceptions and reactions. *The Journal of Special Education, 37*, 49–57.

Nieto, S. (1993). Creating possibilities: EducatingLatino students Massachusetts. In R. Rivera & S. Nieto (Eds.), *The education of Latino students in Massachusetts: Issues, research, and policy implications* (pp. 243–261). Boston, MA: Gastón Institute for Latino Public Policy & Development.

Nieto, S., & McDonough, K. (2011). "Placing equity front and center" revisited. In A. F. Ball & C. A. Tyson (Eds.), *Studying diversity in teacher education* (pp. 363–384). New York, NY: Rowman & Littlefield Publishers.

Noddings, N. (1992). *The challenge to care in schools*. New York, NY: Teachers College Press.

Noddings, N. (1995). *Philosophy of education*. Boulder, CO: Westview Press.

Noddings, N. (2012). The caring revolution in teaching. *Oxford Review of Education, 38*, 771–781.

Orlikowski, W., & Baroudi, J. (1991). Studying information technology in organizations: Research approaches and assumptions. *Information Systems Research 2*(1), 1–28.

Pahlke, E., Bigler, R. S., & Patterson, M. M. (2014). Reasoning about single-sex schooling for girls among students, parents, and teachers. *Sex Roles, 71*, 261–271.

Pang, V. O. (2001). *Multicultural education: A caring-centered, reflective approach*. Columbus, OH: McGraw-Hill.

Pang, V. O. (2005). *Multicultural education: a caring-centered, reflective approach*. Boston, MA: McGraw Hill.

Park, J. Y. (2012). Re-imaging reader-response in middle and secondary schools: Early adolescent girls' critical and communal reader responses to the young adult novel "Speak". *Children's Literature in Education, 43*, 191–212.

Parsons, E. C. (2008). Positionality of African Americans and a theoretical accommodation of it: Rethinking science education research. *Science Education, 92*(6), 1127–1144.

Patitu, C. L., & Hinton, K. G. (2003). The experiences of African American women faculty and administrators in higher education: Has anything changed? *New Directions for Student Services, 2003*(104), 79–93.

Patterson, M. M., & Pahlke, E. (2011). Student characteristics associated with girls' success in a single-sex school. *Sex Roles, 65*, 737–750.

Patterson, G. A. (2012). Separating the boys from the girls. *Phi Delta Kappan, 93*(5), 37–41.

Patton, M. Q. (1990). *Qualitative evaluation and research methods*. Los Angeles, CA: Sage Publications.

Patton, M. Q. (2002). *Qualitative research and evaluation methods*. San Francisco, CA: Sage Publications.

Perry, B. L., Link, T., Boelter, C., & Leukefeld, C. (2012). Blinded to science: Gender differences in the effects of race, ethnicity, and socioeconomic status on academic and science attitudes among sixth graders. *Gender and Education, 24*, 725–743.

Pinder, P. J., & Blackwell, E. L. (2014). The "Black Girl Turn" in research on gender, race, and science education: Toward exploring and understanding the early experiences of Black females in science, a literature review. *Journal of African American Studies, 18*, 63–71.

Polleck, J. N. (2010). Creating transformational spaces: High school book clubs with inner-city adolescent females. *High School Journal, 93*(2), 50–68. doi:10.1353/hsj.0.0042

Ponelis, S. R. (2015). Using interpretive qualitative case studies for exploratory research in doctoral studies: A case of Information Systems research in small and medium enterprises. *International Journal of Doctoral Studies*, *10*, 535–550.

Riordan, C. (1990). *Girls and boys in school: Together or separate?* New York, NY: Teachers College Press.

Riordan, C. (2002). What do we know about the effects of single-sex schools in the private sector? In A. Datnow & L. Hubbard (Eds.), *Gender in policy and practice: Perspectives on single-sex and coeducational schooling* (pp. 10–30). New York, NY: Routledge.

Roberts, M. A. (2010). Toward a theory of culturally relevant critical teacher care: African American teachers' definitions and perceptions of care for African American students. *Journal of Moral Education, 39*, 449–467.

Rollock, N. (2007). Why Black girls don't matter: Exploring how race and gender shape academic success in an inner city school. *Support for Learning, 22*, 197–202.

Roofe, C. (2015). The urban teacher: Towards a context-responsive teacher preparation curriculum. *International Studies in Educational Administration, 43*(1), 5–18.

Rychly, L., & Graves, E. (2012). Teacher characteristics for culturally responsive pedagogy. *Multicultural Perspectives, 14*(1), 44–49.

Salomone, R. C. (2003). *Same, different, equal: Rethinking single-sex schooling*. New Haven, CT: Yale University Press.

Sampson, D., & Garrison-Wade, D. F. (2011). Cultural vibrancy: Exploring the preferences of African American children toward culturally relevant and non-culturally relevant lessons. *Urban Review, 43*, 279–309.

Sarbin, T. R. (1986). *Narrative psychology: The storied nature of human conduct*. Santa Barbara, CA: Praeger Publishers/Greenwood Publishing Group.

Schmeichel, M. (2012). Good teaching? An examination of culturally relevant pedagogy as an equity practice. *Journal of Curriculum Studies, 44*, 211–231. doi:10.1080/00220272.2011.591434

Schram, T. (1994). Players along the margin: Diversity and adaptation in a lower track classroom. In G. Spindler & L. Spindler (Eds.), *Pathways to cultural awareness: Cultural therapy with teachers and students* (pp. 61–89). Thousand Oaks, CA: Corwin Press.

Scott, M. T. (2012). Socio-emotional and psychological issues and needs of gifted African-American children: Culture matters. *Interdisciplinary Journal of Teaching and Learning, 2*(1), 23–33.

Seaton, E. K., Caldwell, C. H., Sellers, R. M., & Jackson, J. S. (2010). An intersectional approach for understanding perceived discrimination and psychological well-being among African American and Caribbean Black youth. *Developmental Psychology, 46*, 1372–1379.

Shaunessy, E., & McHatton, P. A. (2009). Urban students' perceptions of teachers: Views of students in general, special, and honors education. *Urban Review, 41*, 486–503.

Spielhagen, F. R. (2011). “It all depends…”: Middle school teachers evaluate single-sex classes. *RMLE Online, 34*(7). Retrieved from http://files.eric.ed.gov/fulltext/EJ925247.pdf

Spielhagen, F. R. (2013). *Debating single-sex education: Separate and equal?* (2nd ed.). Lanham, MD: Rowman & Littlefield Education.

Spilt, J. L., Hughes, J. N., Wu, J.-Y., & Kwok, O. (2012). Dynamics of teacher-student relationships: Stability and change across elementary school and the influence on children’s academic success. *Child Development, 83*, 1180–1195.

Stairs, A. J. (2010). The learning and practice of preservice teachers in an urban school-university partnership: The struggle to enact culturally responsive pedagogy. *2010 Yearbook of Urban Learning*, *Teaching, and Research*, 26–36. Retrieved from http://files.eric.ed.gov/fulltext/EJ912044.pdf

Tan, L. (2009). The 5 E’s of emancipator pedagogy: The rehumanizing approach to teaching and learning with inner city youth. In W. Ayers, T. Quinn, & D. Stovall (Eds.), *Handbook of social justice in education* (pp. 484–496). New York, NY: Routledge.

Taylor, E. (2009). The foundations of critical race theory in education: An introduction. In E. Taylor, D. Gillborn, & G. J. Ladson-Billings (Eds.), *Foundations of critical race theory in education* (pp. 1–13). New York, NY: Routledge.

The National Academies Press [NAP]. (1996). *National science education standards*. Retrieved from https://www.nap.edu/read/4962/chapter/1

Thomas, O. N., Caldwell, C. H., Faison, N., & Jackson, J. S. (2009). Promoting academic achievement: The role of racial identity in buffering perceptions of teacher discrimination on academic achievement among African American and Caribbean Black adolescents. *Journal of Educational Psychology, 101*, 420–431.

Tosolt, B. (2010). Gender and race differences in middle school students' perceptions of caring teacher behaviors. *Multicultural Perspectives, 12*(3), 145–151.

Tyack, D., & Hansot, E. (1992). *Learning together: A history of coeducation in American public schools*. New York, NY: Russell Sage Foundation.

Vygotsky, L. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.

Wallace, M. (2013). High school teachers and African American parents: A (not so) collaborative effort to increase student success. *High School Journal, 96*(3), 195–208.

Wang, M.-T., & Eccles, J. S. (2012). Social support matters: Longitudinal effects of social support on three dimensions of school engagement from middle to high school. *Child Development, 83*, 877–895.

Warren, S. R., Noftle, J. T., Ganley, D. D., & Quintanar, A. P. (2011). Preparing urban teachers to partner with families and communities. *School Community Journal, 21*(1), 95–112.

West-Olatunji, C., Shure, L., Pringle, R., Adams, T., Lewis, D., & Cholewa, C. (2010). Exploring how school counselors position low-income African American girls as mathematics and science learners. *Professional School Counseling, 13*(3), 184–195.

Wilkins, J. (2014). Good teacher-student relationships: Perspectives of teachers in urban high schools. *American Secondary Education, 43*(1), 52–68.

Williams, K. V. (2010). *Middle school teachers' reflective responses to the cultural awareness and beliefs inventory about African American learners in an urban school district: A qualitative study* (Order No. 3446579). Retrieved from ProQuest Dissertations & Theses Global. (856359333).

APPENDIX A

TEXAS A&M UNIVERSITY TELEPHONE SCRIPT FOR RECRUITMENT OF RESEARCH PARTICIPANT

Title: VOICES OF SUCCESSFUL SCIENCE TEACHERS IN AN URBAN SINGLE GENDER GIRLS' SCHOOL

Hello, this is Jyoti Malhan from Texas A & M University. I would like to speak with (*Name of participant)* about a study you are eligible for at our institution.

I would like to provide you with some basic information about the study. At any time, you may stop our conversation all together. Would you like to hear more about the study?

If no, I will thank them for their time and hang up. If yes, I will briefly describe the research as follows.

This study involves an interview that will last 60 -90 minutes spread over 2 to 3 days. The first interview should last 45 minutes approximately. There will be a follow up of 20-30 minutes spread over day 2 or 3 as needed. If you decide to take part in the study, you will be asked to sign a consent form. If you decide you do not want to participate, there will be no penalty to you, and you will not lose any benefits you normally would have.

You are being asked to be in this study because you are secondary science teacher in an urban girls' school. You have served in this role for at least three or more years, you are presently serving in the capacity of science teacher, you have met Average Yearly Progress in 3 consecutive years (2013-2015) and you have impacted your campus performance as a result of your teaching. 4 teachers (participants) will be invited to participate in this study. Do you have any questions about what I have shared with you so far?

I also want to share that the things that you will be involved in have no more risks associated with them than you would come across in everyday life. There is no direct benefit to you by being in this study. What the researchers find out from this study may help to inform educators about the circumstances involved in being a science teacher in a secondary school. New and aspiring science educators who aspire to become science teachers can apply this research to gain insight from existing teachers and can also learn from this study by reflecting upon their own experiences.

Your participation is completely voluntary. A decision whether or not to participate in this conversation will not affect your job in any way. Your answers will be confidential. No one will know the answers except for the research team. Do you have any questions about this study?

If you have questions after we hang up please feel free to call me at 713-885-3683. Also if you have any questions or concerns about the "rights of research subjects", you may contact Texas A & M University Human Research Protection Program office by phone at 1-979-458-4067, toll free at 1-855-795-8636, or by email at irb@tamu.edu.

I also want to share that aside from your time, there are no costs for taking part in the study. You will not be paid for being in this study.

This study has been approved by the school administration at your school. The records of this study will be kept private. No identifiers linking you to this study will be included in any sort of report that might be published. Research records will be stored securely information about you will be stored in locked file cabinet. The consent form you will sign will be filed securely in an official area. If you would like more information, you may contact me at 713-885-3683 or jyotimalhan@yahoo.com.

Please let me know via phone or email by next week if you are willing to participate in this study. I will then schedule a time for conducting the interview at your convenience. I want to thank you for listening to me and for your time.

APPENDIX B

TEXAS A&M UNIVERSITY HUMAN SUBJECTS PROTECTION PROGRAM

CONSENT FORM

Project Title: **VOICES OF SUCCESSFUL SCIENCE TEACHERS IN AN URBAN SINGLE GENDER GIRLS' SCHOOL**

You are invited to take part in a research study being conducted by Jyoti Malhan, a researcher from Texas A&M University. The information in this form is provided to help you decide whether or not to take part. If you decide to take part in the study, you will be asked to sign this consent form. If you decide you do not want to participate, there will be no penalty to you, and you will not lose any benefits you normally would have.

Why Is This Study Being Done?

The purpose of this study is to examine and give voice to the life experiences and teaching practices of science teachers in an urban single gender girls' secondary school. Furthermore, this study aims to add to the limited research base regarding the lived experiences of science teachers from the participants' point of view, as they will be able to apprise other teachers in similar settings on the issues of teaching Science.

Why Am I Being Asked To Be In This Study?

You are being asked to be in this study because you are secondary science teacher an urban girls school. You have served in this role for at least three or more years, you are presently serving in the capacity of science teacher, you have met Average Yearly Progress in 3 consecutive years (2013-2015) and you have impacted your campus performance as a result of your teaching.

How Many People Will Be Asked To Be In This Study?

4 people (participants) will be invited to participate in this study locally.

What Are the Alternatives to being in this study?

The alternative to being in the study is not to participate.

What Will I Be Asked To Do In This Study?

Your participation in this study will last up to 90 minutes total and may include two to three visits. The procedures you will be asked to perform are described below. The first visit will last about 45 to 60 minutes. During this visit I will ask questions from an interview protocol/questionnaire. In order to get exact information from you, and increase the reliability of the study, you will be audio taped in the interview session.

Your name will be pre-coded to the recording tape that will be used to record the interview session. The transcriptions (writing down from the tape what you said) will also be coded in order to further protect your confidentiality. Written reports may entail the use of quoted material. At the conclusion of this study, the information gathered and audiotapes, identifiable only by subject number will be stored in locked file cabinet that only I will be able to access.

Will Photos, Video or Audio Recordings Be Made Of Me during the Study?

I will make an audio recording during the study so that I am able to get exact information from you and to increase the strength of the study. If you do not give permission for the audio recording to be obtained, you cannot participate in this study.

_____ I give my permission for audio recordings to be made of me during my participation in this research study.

Are There Any Risks To Me?

The things that you will have no more risks than you would come across in everyday life.

Are There Any Benefits To Me?

There is no direct benefit to you by being in this study. What the researchers find out from this study may help to inform educators about the circumstances involved in being a science teacher in a secondary school. New and aspiring science educators who aspire to become science teachers can apply this research to gain insight from existing teachers and can also learn from this study by reflecting upon their own experiences.

Will There Be Any Costs To Me?

Aside from your time, there are no costs for taking part in the study.

Will I Be Paid To Be In This Study?

You will not be paid for being in this study.

Will Information From This Study Be Kept Private?

The records of this study will be kept private. No identifiers linking you to this study will be included in any sort of report that might be published. Research records will be stored securely information about you will be stored in locked file cabinet. This consent form will be filed securely in an official area.

Information about you will be kept confidential to the extent permitted or required by law. People who have access to your information include the Principal Investigator and research study personnel. Representatives of regulatory agencies such as the Office of Human Research Protections (OHRP) and entities such as the Texas A & M University Human Subjects Protection Program may access your records to make sure the study is being run correctly and that information is collected properly.

For questions about your IRB rights as a research participant, to provide input regarding research, or if you have questions, complaints or concerns about the research, you may call the Texas A & M University Human Research Protection Program office by phone at 1-979-458-4067, toll free at 1-855-795-8636, or by email at irb@tamu.edu

_____ _____

Participant's Signature Date

_____

Printed Name

APPENDIX C

INTERVIEW PROTOCOL

VOICES OF SUCCESSFUL SCIENCE TEACHERS IN SINGLE GENDER ALL GIRLS SCHOOLS

Personal Information

1. Tell me something about yourself.

2. How many years of elementary/secondary teaching experience did you have prior to becoming a science teacher at the girls school?

3. How many years have you been employed as a teacher in this school (or in other girls' schools)?

Qualities/Effectiveness

1. What do you feel are some of the important personal qualities, values, and behaviors necessary for teaching and instructional effectiveness?
2. What do you think are some of your strong qualities as a teacher that has helped you in your position as science teacher?
3. Please share some of the important life experiences that you have had which facilitated your decision to become a science educator?
4. How do you feel about teaching science? What are the shared beliefs among the science department?
5. What interpersonal dynamics do you feel impacted your effectiveness as a science teacher? (How were you motivated toward becoming a science teacher in a single gender girls' school?)

6. What role, if any, did your upbringing play in the way you teach?
7. What values, interests, goals, and beliefs influence the way you conduct yourself, personally and professionally?
8. Please describe some of the obstacles or constraints that cause you the most concern as you try to carry out your duties as a science teacher.

Teaching Practices

1. Has there been a change in the demographics, since you started teaching here? Paint a picture of what the demographics were when you first came here.
2. What types of challenges have you faced since the change, if any?
3. How do your students feel about you?
4. How do you address the learning styles of your students?
5. For those who have problems, what are the special challenges you face in helping them learn?
6. What are some of your strategies in working with these students?
7. Tell me about the support that you get from the administrative staff.
8. Describe the resources you have for your teaching.
9. What kind of support and assistance do you receive from other teachers?
10. Tell me about the parental involvement and support that you get at your school.
11. Tell me about the staff development at this school and in the district.

Impact of Effective Teaching on Student Performance

1. As a teacher, how did you go about establishing a successful learning environment for your students?

2. Please describe some of the approaches/techniques you used in gaining success for your students.
3. From your experiences as a science teacher, name 2-3 key dimensions of teaching for sustained reform – the habits of mind and heart – that enable teachers to guide their students to be successful over the long term. Describe these in the context of your concrete experiences as a science teacher.
4. Generally speaking, do you think it is a good idea or a bad idea to hold teachers accountable for student standardized test scores at the building level? Why or why not?
5. How should teachers measure the success of their students? Is high-stakes testing a viable answer?
6. If teachers are responsible for school improvement and student achievement, what are the secrets to their success and what are the limits to their powers?