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Awareness, Advocacy, and Activism: A Self-Study of Social Justice Supervision of

Secondary Science Teacher Candidates

by

Stephanie A. Arthur

A dissertation submitted in partial fulfillment
of the requirement for the degree of
Doctor of Philosophy in Curriculum and Instruction
with a concentration in Teacher Education
Department of Teaching and Learning
College of Education
University of South Florida

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Dedication

This dissertation is dedicated to new STEM teachers entering this crucially needed and highly rewarding field of education. Teaching secondary science provided me with incredible experiences in which I witnessed the development of students' sense of curiosity, wonder, and inquiry about the nature of science and how the world around them works. Supervising new science teacher candidates in teacher preparation programs has been my greatest honor. The opportunities to continue learning alongside them and to develop my skills of pedagogical and content support has been a life-fulfilling accomplishment. To all of the STEM teacher candidates I have supervised, I admire your dedication and commitment to teaching so that students of all racial/ethnic/economic backgrounds can learn and be empowered by science. To future STEM field teacher candidates, I look forward to continuing my supervision by implementing all of the research-based skills that I have gained and refined over the past years. As a result of incoming STEM teachers' devotion and perseverance to equitable science teaching, more students will be empowered to apply the content from their classrooms to enact change in their communities.

We look at science as something very elite, which only a few people can learn. That's just not true. You just have to start early and give kids a foundation. Kids live up, or down, to expectations (Mae Jemison, American physician and first Black woman in space).

Acknowledgements

I am simultaneously humbled and excited to share this study that came about as a result of the many individuals who played significant roles in supporting and encouraging me throughout the dissertation process. I have so many amazing people in my life to acknowledge and for that, I recognize my blessings.

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with focusing on the 'I' and yet you facilitated the process so that I learned how powerful the process was for increasing my own understanding and skillset in ways that benefited my teacher candidates. As if that were not enough to support my learning, you created and invited me into the professional learning group for teacher education and equity. Through the many collaborations and group presentation at N.A.M.E. in Tucson, I realized that my research interests fully aligned within the field of supervision of teacher candidates that centers within a culturally responsive framework to ensure equity in the secondary science classroom.

To Dr. Darlene DeMarie, thank you on so many levels. The warm and engaging camaraderie that you cultivated with our group of mixed psychology and education students many semesters ago resulted in a small family of amazing ladies with incredibly diverse backgrounds. Your international experience and unique perspective always brings everyone together and promotes dialogue that is enlightening and empowering for all. Your friendship outside of academia has been instrumental in affirming my motivations and goals when I often felt like I was not qualified to be here in this rigorous realm of academia. I am honored that you invited me in each subsequent semester to join the sessions with Dr. Art Bochner. You knew early on that I struggled with qualitative research and through autoethnography, you illuminated a pathway to inspire my shift in paradigm. I am truly thankful for your persistent, warm, and positive encouragement which has been instrumental throughout this process.

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Even though I dedicated this study to my past, present, and future secondary STEM teacher candidates, I feel compelled to acknowledge their receptivity and successful implementation of culturally responsive science planning and teaching. To all of the National Science Foundation Noyce Scholars that have gone through the program here, your devotion to the field of teaching in high-needs schools is a testament to your allegiance to the promotion of students from all cultural and economic backgrounds to pursue STEM careers.

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To my dearest life friends. So many words I have for each of you, but I may need way too many pages to express them here. Each and every one of you persisted in your encouragement, patience, and love for me throughout the past four years, I am profoundly thankful for you: Gina A, Michael B., Paige K., Lori L., Julia M., Marie M., Beth M., MC P., and Gina S. A special acknowledgement to Dennis F. I will always credit you with the reason I moved here over two decades ago to teach middle school science. Your leadership as well as friendship has been a significant source of motivation to remain active in the field of STEM education.

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Abstract

As the demographics of public K-12 schools continue to shift towards a wider representation including students of color and students from low-income households, it is critical for new secondary science teachers entering the field to be prepared to teach science that is culturally responsive to their students' needs and communities. As teacher candidates continue their pedagogical growth while in their final clinical internships in high-needs schools, there is great potential for the university supervisor to support their development within a social justice framework. By encouraging and supporting teacher candidates to include culturally responsive approaches in the biology, chemistry, physics, and earth science classrooms, students gain multiple perspectives for learning and integrating science content into their everyday lives. The purpose of this self-study was to investigate how my work as a university supervisor promoted an agenda for social justice awareness, advocacy, and activism with secondary science teacher candidates. Through the analysis of the data collected in this self-study, I sought to answer three key questions: 1) What practices can I, as a university supervisor, implement to promote awareness, advocacy, and activism (AAA) for social justice with secondary science teacher candidates? 2) In what ways do these practices promote awareness, advocacy, and activism (AAA)? 3) What have I learned about my supervision for AAA for social justice based on my experiences with secondary science teacher candidates?

Key findings from this self-study indicate supervision practices that can contribute to the development of science teacher candidates who become committed to establishing an equitable

classroom that seeks to empower all students including students of color and from low-income households. I found that by implementing the following supervision practices, I was able to cultivate the science teacher candidates' awareness and agency for developing the skills, knowledge, dispositions, assumptions, and high expectations for students of all racial, ethnic and economic backgrounds: 1) establish and maintain an open and trusting relationship with the teacher candidates, 2) incorporate targeted focus on social justice within the science teaching, 3) utilize problem-solving in challenge situations as entry points for investigation of inequities, 4) network with others in the field and community to expand the resource pool of ideas and strategies, and 5) reflect on the work of supervision with intention to shift approaches to best support the teacher candidates.

Through the process of self-study, I discovered the power of data analysis and synthesis of my reflections to enhance my own deeper understanding of supervision of science teaching within a social justice framework. Self-study encouraged me to review and reframe all aspects of the relationship with the teacher candidates, thus revealing areas of new learning as well as missed opportunities that heightened my own awareness of and confidence for future supervision for social justice in science teaching. As a result of this process, I present implications for the field of social justice and science supervision as well as recommendations for continued research in supervision of science teacher candidates.

Chapter 1: Introduction

In the United States today, public schools represent a wide spectrum of racially, ethnically, and economically diverse students. Projected demographics reveal continuing decrease in the percentage of White students and an increase for students of color (de Brey, et al., 2019). While the representation of diversity in schools is evidence of a culturally rich nation, there are inequities in the education system that impact students based on race, ethnicity, culture, and wealth (Milner, 2013). Achievement statistics are generally lower for students of diverse racial, cultural, and economic backgrounds (Hanushek, et al., 2019; Miller, et al., 2019; Morsy & Rothstein, 2019), and specifically in science education (Brand, 2014; Lee & Buxton, 2010; NCES, 2015). Specifically, students of color and students from low-income households have and continue to endure inequitable access to quality science education, thus facing "the most prevalent and persistent problem in science education" (Morales-Doyle, 2017, p. 1035).

Reaching back to the seminal 1966 study, *Equality of Educational Opportunity*, findings revealed that parental education, income, and race have a strong correlation with student achievement (Coleman, et al., 1966). Numerous research studies following this study, point to similar indicators. Poverty increases the likelihood that children from lower socioeconomic classes will experience reduced achievement in school (Miller, et al., 2019; Morsy & Rothstein, 2019). According to the 2019 report by Hanushek, et al., in terms of learning, for socioeconomic status, students at the 10th percentile remain approximately three to four years behind those in the 90th percentile.

A range of enduring stressful and toxic factors accompany the lives of children from low-income households, including neighborhoods that are unsafe due to high levels of crime, economic strains on the family where there may or may not be more than one parent in the home, families that are divided, or overcrowding of homes (Bowman, et al., 2018; Morsy & Rothstein, 2019; Shanks & Robinson, 2013). Students from lower economic backgrounds are at heightened risk for traumatic stress that can affect cognitive development (Miller, et al., 2019; Morsy & Rothstein, 2019; Owens, 2018).

Black and other minority children disproportionately come from low-income communities (Children's Defense Fund, 2020; Milner, 2013; Votruba-Drzal & Coley, 2019; Wight, et al., 2011; Rothstein, 2017). In 2018, nearly 73 percent of all children from low-income households were children of color (30.1% Black, 23.7% Latinx) compared to only 8.9% of White children (Children's Defense Fund, 2020). The United States Federal Government defines 'poor' as a family of four with an annual income that fell below $26,172 in the year 2018 (Semega, et al., 2020).

According to the Institute of Education Sciences National Center for Education Statistics (NCES) 2018 report *Status and Trends in the Education of Racial and Ethnic Groups*, the racial and ethnic diversity of the population of the United States has increased over the past two decades. As of 2017, 51% of school-age students are White, 14% are Black, and 35% are from other minority ethnic groups including Latinx, Asian, and those of two or more backgrounds. This same report reveals that 45% of Latinx students attend high-poverty schools, followed by 44% of Black students, 38% of American Indian/Alaska Native students, 24% of Pacific Islander students, 17% of students of two or more races, 14% of Asian students, and only 8% of White students. The updated reporting by NCES (February 2019) states that the rate of children under

the age of 18 living in poverty is 31% of Black children and 26% of Latinx children; this is significantly higher than White and Asian children (10% each).

There is a negative (or inverse) correlation between poverty, which disproportionately affects Black and Latinx students, and access to quality education, teachers, and schools (Hanselman & Fiel, 2017; Owens, 2018). In many public school districts, Black and White students remain segregated between schools and school districts (Fiel, 2013; Owens, 2020; Rothstein, 2017; Stroub and Richards, 2013) and within schools (Ansalone, 2010; Kogachi & Graham, 2020). Students of color and from low-income households are more likely to attend schools that lack sufficient funding and resources; these schools also have a high teacher attrition rate (Carver-Thomas & Darling-Hammond, 2019; Gagnon & Mattingly, 2012). Furthermore, there is a substantial cultural mismatch between teachers and students in schools with higher populations of Black, Latinx, and low-income students (Landsman & Lewis, 2006).

The disparity of equitable access to quality secondary science education is a critical concern for students of color, especially those from schools in lower economic communities (Bowman, et al., 2018). There is a lack of high quality science teachers who are strong in content and pedagogical knowledge to teach in hard-to-staff schools. Numerous structural barriers exist such as over-crowded and under-funded schools (based on lower community socioeconomic status), dearth of resources, lack of teachers with science content and pedagogical knowledge, and low interest or low commitment by teachers. These are all contributing factors for perpetuating the achievement gap that exists between students of color and students from low-income households as compared to their White counterparts.

The need for teachers to change how they teach science is reflected in the achievement gap between students of color and lower socioeconomic status and more privileged White

students (Brand, 2014; Lee & Buxton, 2010; National Assessment of Educational Progress, 2015). This achievement gap in science is based on numerous factors that play a role in the motivation and participation for students of color (Russell, 2014). Factors including access to school resources, socioeconomic and sociocultural barriers, family and home backgrounds, self-perception and interest, encouragement, can impact science learning (Oakes, 1990; Singh, et al., 2002). In addition, Brand (2014) argues that the influence of social inequities that marginalized students face need to be deconstructed in order to identify the structures in place that are oppressive and that create this achievement gap.

The STEM pipeline represents the narrowing of the pathway from secondary schools into college and STEM-based degree programs. This includes the high level rigorous science and math courses taken in high school that lead to entering into STEM majors in college (Burkam & Lee, 2003). There is an opportunity gap that is reflected by the low number of students of color taking rigorous high school science courses and entering the STEM-related fields (Tyson, et al., 2007). High school students of color, often from lower socioeconomic communities, frequently take fewer math and science courses than White students and many of these courses are less rigorous (Butler, et al., 2014; Tyson, et al., 2007). Therefore, fewer Black, Latinx, and students from low-income households end up going into STEM-related fields in high school and are filtered out of the pipeline for post-secondary STEM education (Butler, et al., 2014; Cannady, et al., 2014; Hinojosa, et al., 2016; Mendick, et al., 2017; New York Hall of Science, 2012).

A significant factor that leads to this situation is the difference in the culture between White teachers and their students of color and of lower-income households. Students are often taught mostly by teachers who are from cultural backgrounds that are different from their

students (Douglas, et al., 2008). According to the National Center for Education Statistics (NCES, 2017), approximately 79% of all public school teachers are White, non-Hispanic.

Students of color, often from lower-income communities, bear additional disadvantage due to the cultural mismatch between their White educators (Landsman & Lewis, 2006). Some teacher candidates may not be comfortable around their students of different cultural backgrounds and often maintain beliefs and judgements that are based on the students' race, socioeconomic class, and language (Brown & Crippen, 2016). Consequently, these teachers may not understand how to connect with their students, let alone to recognize their ability to achieve (Landsman & Lewis, 2006; Sleeter, 2008). White middle-class teachers may attribute a negative perspective to students of color, which then may affect their expectations and evaluation of those students' academic performance (Milner, 2006). This is tied to teachers' perceptions that have inappropriately blamed the culture and attitudes within Black students' communities (Atwater, et al., 2013). A deficit-based mindset about students of color will negatively impact teachers' ability to meet their students' needs and to address educational outcomes (Douglas, et al., 2008). When considering teacher turnover rates, much of the research points to the greatest occurrences in high-poverty schools that have large populations of students of color (Carver-Thomas & Darling-Hammond, 2017; Darling-Hammond, 2003; Kersaint, et al., 2007; Papay, et al., 2017).

As the cultural diversity in the public K-12 schools is increasing, students of color and/or students from lower socioeconomic communities should be given critical attention during teacher preparation, and specifically during the final clinical internship. High-needs schools have long been besieged by achievement challenges often due to high turnover rates for faculty and a continuous cycle of inexperienced teachers (Johnson, et al., 2014). Schools that represent students of color and students from low-income households receive a larger number of new

teachers than higher achieving, wealthier schools (Gagnon & Mattingly, 2012). Gagnon and Mattingly (2012) state that research indicates a correlation between schools with large minority and low-income populations and the disproportionate rate of teacher attrition. Considering that many teacher candidates will possibly begin their first years of teaching in high-needs schools, there is need for preparation and support to prepare them to work with students of color and students from low-income households.

Novice teachers will need preparation and experience working in culturally diverse schools. As previously mentioned, access to resources, opportunities and quality education is lower for students from low-income households and students of color (Gay, 1993; Hanselman & Fiel, 2017; Miller, et al.; 2019). Partee (2014) argues that students from families with lower socioeconomic status and/or of color are more likely to have new teachers who are not as effective as compared to teachers of wealthier White students. White teachers are not as likely to be able to link the curriculum with the backgrounds of their students of color and are more likely to hold deficit-based assumptions about students' abilities for learning due to minimal knowledge about their students' communities (Ladson-Billings, 2011; Milner, 2010; Sleeter, 2008).

Since it is commonly recognized that there are ethnic, racial, and economic differences between students and their teachers, it is increasingly critical that White teachers take on more of a transformational approach to understanding racial identities to become active proponents for change (Howard, 2016). However, teacher candidates often have limited experience with students of racial, ethnic, and/or economic backgrounds different from their own (George, 2013). During the final clinical internship, teacher candidates may resort to traditional pedagogical practices that are insufficient for addressing the needs of their students of color and/or students

from low-income households. The role and function of a university supervisor is to coach the teacher candidate during the final clinical internship. Coaching entails the core practices implemented by the university supervisor which facilitates collaboration with teacher candidates by connecting standards and learning targets with student data in order to inform instructional practices (Sweeney, 2013). University supervisors can coach teacher candidates to examine identities, assumptions, and implicit biases in order to construct their lessons to teach science that best meets the needs of students of color and students from low-income households. Howard (2016) emphasizes the practice of examining one's own set of beliefs and assumptions, while considering past individual experiences with regard to culturally and ethnically different communities. University supervisors can implement strategies to help teacher candidates shift their mindsets to recognize how identity, privilege, and bias can play a role in assumptions and philosophies for how students learn.

Specifically, new science teachers struggle with connecting the instruction of science to students' lives and teaching for equity (George, 2013). Furthermore, secondary level science teachers tend to view their discipline and instruction as being bias- and culture-free (Lee & Buxton, 2010). Mensah (2011) emphasizes the importance for teacher candidates to have, "collaborative support with diverse others [e.g., peers in teacher development and the supervisor] in making connections and developing practices to teach science, such that they . . . have success in planning and teaching science in culturally relevant ways (p. 301) . . . [and] opportunities to adopt a language that elicits their roles as science teachers who are empowered to teach in culturally relevant ways" (p. 306).

Connecting to Coburn's (1996) assertion that students learn science through a social context and with a cross-discipline approach, Hammond and Brandt (2004) emphasize a shift

away from science education that is traditionally based on a Western perspective that is culturally neutral and objective, and instead adopt an understanding that science is a ". . . cultural activity, . . . and is socio-historically situated . . . a human endeavor, . . . communicated through cultural transmission, through a complex process that cannot be reduced solely to cognitive strategies" (p. 41). The university supervisor can work to encourage teachers to embrace the inherent social nature of science and how that is connected to the cultural contexts of the classroom students. Supervisors can facilitate development of awareness of how social justice factors into teaching science and can support an agenda that implements culturally responsive pedagogical approaches that will ensure a science curriculum for students that connects to their lives in responsive ways.

Purpose of the Study

This was a self-study to investigate how my work as a university supervisor promoted an agenda for social justice awareness, advocacy, and activism with secondary science teacher candidates. As the demographics of public K-12 schools have shifted, awareness and understanding for how to teach to meet the needs of students of color and students from low-income households is critical. I was interested in finding out how my supervision practices supported the preparation of teacher candidates to work with students of color and students from low-income households. The guiding purpose of this self-study was to gain a better understanding of how my work as a university supervisor supports the preparation of science teacher candidates to integrate a culturally responsive approach to teaching science content. Three research questions guided my self-study:

1) What practices can I, as a university supervisor, implement to promote awareness, advocacy, and activism (AAA) for social justice with secondary science teacher candidates?

2) In what ways do these practices promote awareness, advocacy, and activism (AAA)?

3) What have I learned about my supervision for awareness, advocacy, and activism (AAA) for social justice based on my experiences with secondary science teacher candidates?

This particular investigation was based on a select group of Master of Arts in Teaching (MAT) students in the field of secondary science education who are all current participants in a university-based Robert Noyce Scholarship Program. Funded by the National Science Foundation (NSF), scholarships were awarded to university STEM majors with an interest in teaching secondary science in high-needs public schools. The university-based Noyce program then trained, prepared, and supported the scholars' entry into high-needs middle and high school science classrooms. This is a two-year program that prepares the teacher candidates to teach secondary (6-12) science in high needs schools and to become "teacher decision-makers who effectively, efficaciously and judiciously implement research-based practices in secondary science classrooms to improve the education of all students, especially culturally and linguistically diverse learners" (Robert Noyce Teacher Scholarship Program Proposal, 2014, p. 1). The science MAT teacher candidates learn about the nature of science and how to teach by implementing reform- and evidence-based practices within a constructivist framework. This framework is designed to assess and challenge perspectives about teaching and to promote the academic and cultural values and goals of the public school district. The MAT teacher candidates practice using research-based science teaching that is student-centered based on factors such as

prior knowledge, background experiences, thinking, culture, and classroom performance (NSF 14-508, 2014).

By conducting a self-study, I examined my practices as a university supervisor with four science teacher candidates. Each candidate taught in their final clinical field placements in order to fulfill and complete the requirements for their Master of Arts in Teaching (MAT) degree. Additionally, they were full time teachers of record, employed by the district. This is to say that they planned, taught, and assessed a full course load, as any full-time teacher, during the entire internship period. Specifically, I wanted to learn more about how my specific practices, that I implemented into my supervision, would promote awareness of identity and equity for the teacher candidates and how that would transform into agency for teaching science that is culturally responsive and centered within a social justice perspective. By exploring identity and intersectionality and how those constructs impact the perception of a socially just science classroom, I sought to gain deeper insight into the impact of my role and practices as a university supervisor. I established this self-study in order to better understand how I could supervise to raise awareness for equity and encourage advocacy and activism for social justice with teacher candidates in their field placements.

As a university supervisor, I functioned as a mentor, coach, and evaluator all while working to develop and maintain a relationship with the teacher candidates. My role served many purposes including the support of the teacher candidates' growth in pedagogical skills as well as facilitating the increased understanding and awareness of the ways of teaching and understanding students in order to meet their needs most effectively (Glickman, et al., 2014; Nolan & Hoover, 2005; Sweeney, 2013). Pedagogical skills include lesson planning, classroom organization and management, student assessments, and other non-instructional duties.

Through my supervision, I intentionally implemented a schema of culturally responsive (Gay, 2000; Ladson-Billings, 1995) and sustaining (Paris, 2012) science teaching with the teacher candidates so they would conceptualize their classroom students' backgrounds in such a way that valued and embedded their needs (Atwater, 2010; Lee & Buxton, 2011). I supported the teacher candidates' use of culturally responsive teaching practices which I hoped would help them to uncover and disrupt their beliefs and assumptions about their students of color and students from low-income backgrounds. This practice included an investigation of the social and economic barriers that the teacher candidates' students faced.

Scientific literacy does not just include the curriculum and the concepts. It is important that all students learn how knowledge, decisions, and actions based on science can be applied to their personal lives. Science can be a catalyst for students to work to make changes in their own communities. Helping students to critically reflect on the tools of science can help them to make decisions based on science that have the potential to improve their personal lives. It guides students to view science not only as a way out of their problems, but also as a knowledge-based pathway that they can use to promote justice within their schools and communities thus, realizing the importance of science in their lives (Morales-Doyle, 2017). Science teaching that is centered on social justice disrupts the inequities that are in place as a result of oppressive systems.

As I established the purpose and research questions of my self-study, I established three critical constructs to guide my process and practices for supervision to promote an agenda of socially just science teaching with the teacher candidates. Within my supervision practices with the teacher candidates, I endeavored to 1) enhance their *awareness* for identity, intersectionality, and inequity, 2) promote their *advocacy* for equity through culturally responsive approaches in the science classroom, and 3) support their *activism* for social justice change in the candidates'

classrooms and beyond. Rigorous discussion through conferencing was a key component to enact the goals of my purpose. I facilitated dialogue that encouraged reflection about intersectionality, which promoted a better understanding for how power and language influence science teaching (Moore, 2008).

My work centered on supporting teacher candidates to increase their recognition of how to integrate the diversity of their students in order to bring effective change into their science classrooms. Through critical thinking and problem-solving, the teacher candidates developed their skillset and their confidence for creating and teaching culturally responsive science lessons that embedded the lived experiences of their students of color and from low-income households. Through ongoing reflection cycles within a safe, trusting, open atmosphere, I implemented supervisory practices to support their genuine shift in to and transformation for social justice in their classrooms. My guiding objective throughout the internship period was to promote agency in teacher candidates to become advocates and activists to maintain socially just science classrooms and communities.

I was mindful that social justice should not be a separate, culturally responsive add-on, or side agenda (Connell & Connell, 1993); rather it should be an underlying component for all of my objectives in working with teacher candidates. A persistent underlying goal was to nudge the teacher candidates to recognize power and privilege within the education system. The concept of awareness pervaded every aspect of my practice as a supervisor. I maintained consistent attention to opportunities for the science teacher candidates to deepen their understanding and extend their knowledge for intentional work as educators who would become devoted to social justice, all while they continued to grow professionally through inquiry for new ideas and interventions (Bright, 2015).

During the final clinical internship period, my supervisory practices included supporting the teacher candidates' development of equity-based culturally responsive science pedagogical approaches within a social justice lens. I had recognized this as a potentially powerful opportunity to facilitate the teacher candidate's understanding and awareness of inequities which would eventually lead to enactment of their own agency for promoting a more socially just approach to teaching the science content.

The purpose of this self-study was to discover the efficacy of my practices as a university supervisor to promote awareness for identity and inequity and encourage agency for teaching science content with a social justice lens with teacher candidates. From the data that I collected, I identified the supervision practices that were effective for promoting awareness, advocacy, and activism for social justice science teaching. Through the self-study process, I was able to refine my supervision practices in order to recognize and utilize those practices that resulted in greater impact with the teacher candidates. The introspective nature of my personal reflections revealed how I have transformed my own assumptions and objectives within my supervision for social justice practices. While this was not a study to overhaul the existing supervision frameworks, it was an intentional personal effort in which I sought the most impactful practice for infusing a social justice framework within and throughout the supervision process.

Overview of the Research Design

The research design for this investigation was self-study. I aligned with LaBoskey's (2004) four requirements for practicing self-study. The first requirement was my goal to improve my practice through self-initiated and self-focused study that would reframe my perspective and transform my practice. Second, I incorporated collaboration with teacher candidates and teachers as well as critical friends in education research, thus providing me with insight into alternative

perspectives (Loughran & Northfield, 1998). Third, I used a variety of qualitative methods for my data collection and analysis (LaBoskey, 2004) of which framed and reframed my practice throughout based on the supporting evidence as I discovered it. The fourth requirement supports my intention to publish my self-study so that others in the field might find similarities and differences which they can use to improve their own practices.

Self-study allowed me to understand and improve my practices as they related to my supervision for social justice with science teacher candidates. My focus was on my transformations as the researcher and supervisor, both on a personal and on a professional level. Additionally, the findings based on my work with the science teacher candidates assisted in my continuing development of a rigorous framework for supervision for social justice. By writing about and sharing my self-study, I hope to promote continued discussion and exploration. It is possible that other practitioners and researchers in the field of supervision may possibly gain insight that can inform their practice.

I used a variety of strategies and resources to assist my objective to unearth a deeper understanding for how my supervision practices support the development of awareness for identity and inequity and transition into advocates and activists for science teaching that is socially just with teacher candidates. Specifically, I was interested in finding out which supervision practices encouraged awareness of identity and inequities in the science classroom while promoting advocacy and activism for social justice. Ultimately, through self-study, I was able to synthesize the results from my data based on my reflections and interpretations. Thus, I was able to recognize my own transformations as a university supervisor based on the evidence that provided deeper insight and learning. My research questions guided my self-study to explore the outcomes with consideration of my objectives. The overarching goal of this self-study was to

investigate the effects of my work as a university supervisor promoting awareness, advocacy, and activism for social justice within the secondary science classroom. In chapter 3, I discuss the specific methods I used to collect and analyze data in relation to the research questions in greater detail.

Significance of the Study

Considering the cultural and economic diversity of students represented in today's schools juxtaposed with the readily acknowledged deficit of high quality teachers who are able and willing to teach within a culturally responsive science curriculum, it is critical for new teachers to enter into the field of science education prepared to recognize and address the academic and instructional needs of students. The 2020 combined National Science Teaching Association NSTA and Association for Science Teacher Education ASTE Standards for Science Teacher Preparation address equity in science teaching within their stated standards two, three, and six. These standards discuss how effective science teachers:

> plan learning units of study and equitable, culturally-responsive opportunities for all students based upon their understandings of how students learn and develop science knowledge, skills, and habits of mind . . ." (Standard 2) and "are able to plan for engaging all students in science learning by identifying appropriate learning goals that are consistent with knowledge of how students learn science and are aligned with standards . . . create an anti-bias, multicultural, and social justice learning environment to achieve these goals." (Standard 3), and "strive to continuously improve their knowledge of both science content and pedagogy, including approaches for addressing inequities and inclusion for all students in science. . . . (Standard 6), (Morrell, et al., 2020).

The fact remains that the high percentage of White middle-class teachers continues to remain stubbornly elevated, 79% as of the 2017-18 school year according to NCES (updated 2020). White students represent 48% of the population, Black students 15%, and Latinx students 27% for the same time period (NCES, 2020). On a side note, the percentage of Black teachers in 2017-18 was 7%, down from 8% during the 1999-2000 school year. It is commonly recognized that increasing the number of teachers of color is beneficial to all students. While there are many efforts in place to recruit and train future teachers of color (Achinstein, et al. 2010; Sleeter & Milner, 2011; White, et al., 2019), there must be increased efforts to help transform the mindsets of new White, middle-class teachers entering the field. Considering these facts, as a university supervisor working in the field of teacher preparation, I felt compelled to investigate my practices for promoting social justice with the science teacher candidates. My objective was to encourage the teacher candidates to cultivate culturally responsive science teaching for students of color and students from low-income households who have traditionally been marginalized from accessing and learning science in equitable and socially just ways (Mensah, 2013).

Key Terms and Description of Roles

Throughout this investigation, I have incorporated information from the research literature into all components of the self-study including the data collection, data analysis, and writing of the final report. Based on a review of the literature (Chapter 2), I found that the wide spectrum of terms and definitions can be confusing at times. Therefore, this section will provide a list of common terms and clarification for how I will adapt them for use within my study. This set of definitions of key terms is intended to maintain consistency for how I have used the terms as well as coherency my own understanding and interpretation throughout the dissertation write-up.

- *Activism* – work that attempts to bring awareness and concern for an issue to the forefront by taking actions to raise awareness of and to draw attention in a way that promotes concern and action for change (Parsons, 2016). An activist is one who, either alone or collaboratively, through sociotransformative approaches, focuses on social justice within their field, to enact social change (Rodriguez & Morrison, 2019). This concept is further described in Chapter 2.

- *Advocacy* – defined by Merriam-Webster (2020) as "the act or process of supporting a cause or proposal". Advocacy is a targeted mindset that ensures there is a sociocultural consciousness for understanding how marginalized students (of color and/or from low-income households) suffer disadvantages and how teachers can seek strategies to reverse the harm of exclusion from science by believing in their students' success and helping them to build confidence and transcend feelings of inadequacy (Brand, 2014). Cohen, et al. (2001) define advocacy as "the pursuit of influencing outcomes – including . . . resource-allocation decisions . . . that directly affect people's lives" (p. 8). This concept is further described in Chapter 2.

- *Awareness* - an ongoing state of recognition and consciousness, a constantly evolving and deepening mindfulness. According to the Cambridge Dictionary, awareness is the "knowledge that something exists, or understanding of a situation or subject at the present time based on information or experience" (2020). Zeichner (1993) indicates the importance of time taken to explore personal ethnic and cultural experiences and how this is all related to one's own individual identities. The awareness of identity and how the intersection develops based on encounters with other groups increases cultural competence (Williams-Gualandi, 2015). This concept is further described in Chapter 2.

- *Black students* – this term is used for students who identify racially and/or ethnically as Black or African American. While a range of terms are used in research including students of color, African American, and more recently, BIPOC (Black Indigenous People of Color), when referring to research (whether my own or from other sources) that explicitly focuses on Black students, the term Black students or students of color will be used interchangeably. BIPOC is an acronym that is emerging more frequently in the literature. However as of this writing, there are still as yet conflicting perspectives and therefore I will not use this. When describing students, the contextual situation is a consideration and therefore it may not be most appropriate to conflate different racial and ethnic groups under one umbrella term.

- *Coaching* – includes core practices that provide opportunities for the university supervisor and teacher candidate to collaborate by focusing on classroom student learning through conversations framed by standards and learning targets and employs the use of data such as student work that informs decisions about instructional practices (Sweeney, 2013).

- *Cultural relevance* - integration of cultural knowledge, prior experiences, and the ways that diverse learners perform in order to create a wider variety of strengths-based instructional strategies and approaches for effective instruction (Council of Chief State School Officers, 2011).

- *English Language Learner (ELL)* – or sometimes referred to as English Learners (EL), identifies "a complex, heterogeneous range of students who are in the process of learning English" (Da Silva, et al., 2020) as defined in the *NCTE Position Paper on the Role of English Teachers in Educating English Language Learners (ELLs)* (2020). For purposes

of this study, I have aligned with this terminology. Of note, the 2015 Every Student Succeeds Act (ESSA) declares, "Each State plan shall demonstrate that the State has adopted English language proficiency standards that . . . are aligned with the challenging State academic standards" (U.S. Department of Education, 2015, p. 24).

- *Equity* – a concept of social justice that implies fairness and impartiality; distinct from the term equality in that equity provides an exception in ways that ensure basic needs and rewards to all members of society (Atkins & Duckworth, 2019).

- *Final clinical internship* – period of one full semester in which a teacher candidate spends every day in their assigned classroom and school. They are paired with a site based teacher educator (SBTE).

    o *Traditional clinical internship* – a Teacher Candidate (TC) is placed into a public-school classroom. This pairing is established by the University Director of Field and Clinical Education in conjunction with the county district recruitment director. The teacher candidate works directly with the field classroom teacher, called a site based teacher educator (SBTE). There is a timeline of observations of the TC as they are scaffolded into teaching the classroom; the TC ultimately takes on the role of full-time teacher for the classroom students for a limited portion of the final clinical internship period. For this study, I did not work with any traditional teacher candidates. Description has been provided only to provide a frame of reference to compare the difference between the traditional and full time internships.

    o *Full time teacher of record paid clinical internship* – a Master of Arts (MAT) teacher candidate applies for a teaching job within the local region (note, this

option is not available to undergraduate level teacher candidates). In this scenario, the MAT teacher candidate takes on full responsibility as the employed teacher of record within their schools. They are paired with another full-time teacher within the same department in their school. This teacher serves in the role as site based teacher educator (SBTE). However, there is limited interaction and there is not a shared classroom situation as both teachers have a full course load to teach respective of the other. For this self-study, I worked only with full time, paid teacher candidates.

- Latinx - a gender-neutral, pan-ethnic label used to describe students of Hispanic descent from Latin American or Spanish origins; historically referred to as Hispanic, new trends are shifting towards the use of Latinx (Noe-Bustamante, et al., 2020). For this study I use the term Latinx.

- *Students from low-income households* – This is the term used in this report that is based on the term, "low-income students" as used by the U.S. Department of Education National Center for Education Statistics (NCES). According to the U.S. Department of Education (2021), a "low-income individual" is defined by a measure of family-based income indexed based on an established range such as eligibility for specially funding programs such as school lunches. The U.S. Department of Education states "an individual whose family's taxable income for the preceding year did not exceed 150 percent of the poverty level amount is considered low-income." Jensen (2013) also uses the term low-income students in his research that describes how this group of students are more likely to struggle in school and with engagement. In order to describe students from low-income

backgrounds, I have elected to slightly alter the term in order to place the student first. Therefore, the term used in this report is *students from low-income households*.

- *Master of Arts in Teaching (MAT) Science Education* – program to prepare students to teach science at the middle or high school levels through a variety of courses including methods, discipline, measurement, and content. Four concentrations are available: Biology, Chemistry, and Physics, and Earth Science. The MAT is a state approved program for certification all areas except Earth Science.

- *Power* – based on the historical, structural, organizational, and institutional construction established by historically privileged classes; creating a sense of which assumptions and practices are considered normal (Foucault, 1979; Philip & Gupta, 2020).

- *Site based teacher educator (SBTE)* – full time teachers in the classroom within the district whom the teacher candidate is paired for the duration of one semester. In a traditional internship, the SBTE mentors the teacher candidate, gradually scaffolding them to take over full responsibility for planning, managing, teaching, grading, and otherwise running the classes within that classroom. However, the teacher candidates in this study were all full-time paid interns so there was much less mentoring and interaction with the SBTEs. The SBTEs were not included in this study.

- *Social justice* – a framework based on equity that should be enacted within the educational system. According to the work of Atkins and Duckworth (2019), social justice is both explicit and implicit and is based on morality, fairness, tolerance, understanding, and equity. Dover (2013) establishes teaching for social justice that is based on political movements (democratic education, social justice education, critical

pedagogy, culturally responsive education) as well as focused on recognizing areas of inequality and issues of oppression.

- *Socioeconomic status* – economic condition regarding access to financial resources including basic necessities, home, and healthcare relative to other families where there is an understanding that increased wealth correlates to increased opportunity and access (Gorski, 2017).

- *Students of color* – based on the term persons of color, this first appeared in the 1796 The Oxford English Dictionary (Garcia, 2020). It became more readily used in the 1990s to replace the term nonwhite, which carries an implication of a deficit, whereas *of color* represents the positive perspective of the racial or ethnic background of an individual and today is used to refer to any non-European non-White person and considered a term of pride and respect (Houghton Mifflin Company, 2005). For this study, I use the term students of color to represent those non-White students who are of Black or Latinx backgrounds. See Black students above.

- *Teacher agency* - teacher candidates can develop agency by engaging in opportunities to relate assessment to development of knowledge, plan lessons, critically reflect, communicate with other stakeholders and community, and continue to construct their philosophies of learning (Turnbull, 2005). Agency is comprised of the cognitive processes, intrinsic motivation, and attitudes for appropriating resources in connection with the tools and skills they bring to the classroom and to other educators in the community (Toom, et al., 2017). Furthermore, agency is essential for the participation in the professional community as teacher candidates accept responsibility for collaborative learning amongst their peers, contribute to a professional community, and consider their

belief structures for their capabilities as teachers learning alongside other teachers (Toom, et al., 2017).

- *Teacher candidate (TC)* –university students within a teacher preparation program who are in their final clinical internship. TCs operate in the classroom simultaneously as a student themselves and as the developing educator. They bring with them and apply the knowledge that they attained in their university coursework in practical experiences with classrooms in the real world. The transition of focus on self as student, into the classroom teacher who is concerned for their classroom students' learning and well-being is scaffolded using a variety of inquiry-based strategies over the course of the internship period (Nolan & Hoover, 2005). Teacher candidates may be referred to as preservice teachers in other contexts, but for this study I use the term, teacher candidate.

- *Teacher evaluation* – the process where assessments are made about various aspects of the teacher candidate's performance which can be used to provide a comprehensive judgement of the quality of their performance. This is a state-mandated component of the teacher preparation program (Nolan & Hoover, 2005).

- *Teacher supervision* – an organizational function that aims to promote teacher growth, and gradual improvement in teaching performance with a goal of achieving greater student learning (Nolan & Hoover, 2005). The nature of the interaction between the supervisor and the teacher candidate is collaborative. The supervision, alongside the evaluation feedback, help to guide the teacher candidate's commitment to reflection and development through the internship process (Nolan & Hoover, 2005).

- *Trust* and *trusting* – a critical factor that bolsters the supervision practices for social justice in science teaching, therefore a brief description is warranted. According to

Merriam-Webster (2020), the definition of trust is "assured reliance on the character, ability, strength, or truth of someone or something; one in which confidence is placed". In a cross-discipline investigation, Rousseau, et al. (1998) define trust as "a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another" (p. 395). Tschannen-Moran (2014) defines trust as "willingness to be vulnerable based on the confidence that someone else is benevolent, honest, open, reliable, and competent" (p. 215), further asserting that trust is a central component for any mutually constructive interpersonal relationship. McBride and Skau (1995) call for a supervisory platform that consists of beliefs and educational philosophy that is based on building trust, which empowers teacher candidates, and fosters reflection. They note, "The process of [supervisory] reflection, undertaken in an environment based on trust and seeking the empowerment of participants, constitutes a powerful potential for improved practice" (p. 277).

- *University Supervisor* – the university supervisor functions to include the boundary-spanning role between the university and the teacher candidate's field school classroom. This includes coaching as a process that attends to the development and preparation of teacher candidates working with classroom children which can in turn, further inform the college of education (Burns, et al., 2016). The supervisor provides feedback that ensures that the teacher candidate integrates the university coursework and practical classroom experiences. This occurs while the university supervisor mediates challenges and works to enrich opportunities for skill development and growth in learning (Steadman & Brown, 2011).

COVID-19 Pandemic

During the Fall 2020 semester, the COVID-19 Pandemic instigated a school climate that was unprecedented across the world, nation, and here in the district of which this self-study was conducted. There was confusion and frustration amongst the district leaders, faculty, and the local parents as the frameworks for in-person (brick and mortar), e-learning, or hybrid learning were deliberated in the weeks leading up to the beginning of the semester.

The first week of the school calendar took place entirely online. Students and teachers logged in remotely and utilized the newly implemented program, Canvas, as a meeting and learning platform. During this first week, the Canvas system crashed multiple times district-wide, which impacted the teacher candidates that I supervised. During this same time period, teachers quickly realized that many students did not have appropriate access to devices and wireless bandwidth. In fact, a number of students used their phones in public places in order to join class. Awareness emerged early on that socioeconomic status would be a significant factor in the gap between those students who could access online learning and those who could not.

In addition to lack of devices and high speed wireless bandwidths, a range of additional challenges emerged that were correlated to the COVID-19 pandemic, including the shifts between e-learning and in-person learning, the frequent district-wide network crashes, the continuous alterations of class rosters as students transferred between the two types of learning, the energy and effort required to simultaneously teach two groups of students, the large number of students out for infection and/or quarantine, the high frequency of students skipping class when online, and navigating the daily tasks of teaching with the additional aspects of mask enforcement, social distancing, and sanitization.

Dealing with the challenges of teaching during the COVID-19 Pandemic dominated a large amount of the bandwidth for the teacher candidates and permeated a significant portion of our meetings. The teacher candidates discovered the high percentage of students in this district who come from low-income households. In fact, the teacher candidates developed an early awareness of how their students' financial issues negatively impacted their participation in class. Due to COVID-19, a large number of students were more forthcoming for revealing their responsibilities at home (i.e., caring for siblings and working jobs to assist their family budget). Additionally, many more students revealed that they were not equipped with the resources at home to keep up with classwork (i.e., slow Wi-Fi and or lack of computers for schoolwork).

The science of the virus emerged as a controversial topic in and of itself. Teachers and teacher candidates reported receiving pushback from their students about wearing face coverings and social distancing. Furthermore, some students shared skeptical beliefs about COVID-19 that they learned from their parents. This added to the stressful atmosphere of teaching in-person while mitigating a rapidly spreading virus and the considerations for public health.

Summary of Chapter

Teacher candidates must account for their personal backgrounds and how that affects their ideological beliefs, biases, and assumptions as science teachers working to meet the needs of students from all racial/ethnic backgrounds (Mensah, 2009). University supervisors have the potential to play a crucial transformative role in helping teacher candidates to confront their deep-seeded belief structures and alter any deficit-based assumptions and philosophies for teaching students of color and students from low-income households. Douglas, et al. (2008) recommends more effort be placed on improving teacher preparation programs to better prepare

teachers to gain the knowledge and skills to effectively understand, respect, interact, and teach students of color.

The goal for my self-study centered on an agenda of supervising science teacher candidates within a framework of social justice. I supervised teacher candidates to recognize the ways that structural barriers (both tangible and intangible) within the confines of classrooms and schools can hinder the learning for students of color and students from low-income households. I explored and cultivated supervision practices to encourage teacher candidates to take the steps to redefine what it means to teach science for all students. I implemented my supervision practices in order to transition the teacher candidates to become advocates for their students within the science classroom, with the hope that they would eventually become activists for larger social justice change within their schools and wider communities. I implemented meaningful, research-based resources and facilitated reflection and inquiry as core strategies of my practices. Through this self-study, the practitioner-based inquiry and reflection provided me with insightful discoveries about the impactful practices that transformed my own development as a supervisor.

This self-study presents the findings from my work to promote enhanced awareness for identity and inequity, as well as advocacy and activism for social justice teaching in the science classroom with science teacher candidates. The investigation spanned the duration of the final clinical internship. It encompassed all of the findings that evolved from dialogue within the period of supervision. This self-study helped me to better understand how my practices as a university supervisor impacted the assumptions, philosophies, and classroom practices of my science teacher candidates.

This self-study has helped me to dig deeper into the practices of supervision that enhance awareness, advocacy, and activism for social justice science teaching with science teacher

candidates. The findings from this self-study helped me to organize, analyze, and subsequently transform my practice going forward. Though not generalizable, the insights I share may provide useful considerations for others in the field.

Thomas Bailey, President of Columbia University Teachers College, charged the graduating class of new teachers at the recent 2020 convocation speech with the task to take this as an,

> . . . opportunity to fix what's broken, to right what's wrong, and put society on track to create a healthier, more equitable, and more just world. . . . [as] so many bear the brunt of disparities, health, education, and income that have long afflicted our society. . . . We need you now more than ever, we need your creativity, expertise, and commitment to social justice.

Through my supervision for socially just science teaching, my objective was and continues to play a supportive role in the preparation of science teacher candidates to meet the charge of Dr. Bailey. Through the supervision process of my work with science Master of Arts in science teacher candidates, I have gained rich insight and understanding for the practices that are effective for promoting awareness, advocacy, and activism. I have shifted my practices of supervision to impact the teacher candidates' deeper awareness of the critical needs of all students, to enrich and solidify their advocacy for a more socially just science curriculum, and to encourage their transformation into activists for social justice in their schools and communities.

Outline of Dissertation

This dissertation includes a total of five chapters as well as a number of appendices. The present chapter, chapter one, contains an introduction and general overview. Chapter two contains a literature review. Chapter three presents the theoretical perspective, the research

design, the preliminary findings from a prior pilot study of which guided my decision to conduct this broader self-study, a detailed explanation of data collection methods, my positionality, the considerations for validity and ethics, the data analysis, and finally the limitations. Chapter four contains the findings of the self-study discussed within three sections as they relate to the research questions. Each section devotes extensive coverage of the findings as they relate to each research question, including extensive description with insightful quotes as needed. Themes that came to light are also listed here. Chapter five contains the discussion based on the findings as they relate to each of the research questions. Implications for current and continued work, limitations that surfaced, suggestions for continued research, and a conclusion round out this final chapter. The appendix section includes copies of the Internal Review Board (IRB) approval, the informed consent form, data collection instruments, and the pilot study.

Chapter 2: Literature Review

Introduction

Researchers in the field of teacher preparation generally concur that an increased focus on clinical preparation has been a net benefit for the field (Darling-Hammond, 2017). Teacher candidate education and preparation is essential and along with active mentoring, this can determine the quality of learning for new teachers in training (Zeichner, 2002). Through the field placement experience, the teacher candidates have time to practice and develop, thus transferring to increased confidence and success in the classroom (Darling-Hammond, 2000). The field experience provides teacher candidates with an opportunity to practice for pedagogical growth as well as reflection and development that is important to successfully transition into full time teaching.

Supervision entails the continuous development of teacher candidate learning through consistent and frequent formative feedback (Glickman et al., 2014). The university supervisor acknowledges the teacher candidate's strengths and skills, supporting their development while also honoring their individual style and context (Nolan & Hoover, 2004). It is commonly established that the primary objective of the university supervisor is to foster the professional growth and development of the teacher candidate (Burns, et al., 2016; Nolan & Hoover, 2005). As Jacobs, et al. (2017) found in the literature, the complexity of what supervision entails has expanded beyond just observation and evaluation feedback. It extends to the building of relationships, consideration for innovative approaches, and commitment to research.

The university supervisor can serve as a major support structure for the teacher candidate as well as the liaison between the collaborating teacher and the university through mentoring and coaching (Nolan & Hoover, 2005). The university supervisor can learn along with the teacher candidates in a co-reflective approach for constructing understanding and objectives. This includes the intentional supervision practices to encourage teacher candidates to seek evidence for science classroom student learning and achievement that ensures understanding and growth for students of all racial, ethnic, and socioeconomic (SES) backgrounds.

Supervision

According to the National Council for Accreditation of Teacher Education (NCATE) *Blue Ribbon Panel Report* (2010), teacher candidates require mentors and supervisors who have specifically been trained to support and to be accountable for their candidates' learning and performance. According to the 2018 American Association of Colleges for Teacher Education (AACTE) Clinical Practice Commission Report, the university supervisor is considered a

> specific type of boundary-spanning teacher educator who assumes mentoring and partnership responsibilities in addition to their school responsibilities . . . working in a hybrid role across school and university contexts. These individuals serve teacher candidates at any point along a professional continuum and are active participants in teacher preparation.

Supervisors must conduct efforts during the early period of the internship towards building mutual trust, establishing respect in both directions, as well as making it safe for the teacher candidate to have freedom of expression while ensuring that the mentoring and supervision serves the primary goal of increasing the classroom students' achievement (Sweeney, 2013). Mentoring includes the practice of facilitating critical conversations in which

the teacher candidate can experiment and take risks with their own developing pedagogy and then reflect and build on those experiences in a way that teaching becomes more of a community effort (Loughran, 2014). This includes three vital skills that contribute to their function a) technical skills (observing and planning as well as evaluation), b) pedagogical knowledge (teaching, learning, and the development of teaching skills), and c) interpersonal skills (ability to communicate and collaborate in relationships) (Burns and Badiali, 2016). The university supervisor and teacher candidate should review evidence of student learning to serve as a guide for classroom planning and incorporation of the curriculum (Sweeney, 2013).

Frameworks for Supervision

The university supervisor mentors, co-examines instructional methods, supports the partnership with the school and classroom teacher, and is responsible for evaluation (NCATE, 2010). Various frameworks for supervision provide research-based guidelines and models. Each provide research-driven strategies that are recommended and can be incorporated for supervision. The following sections provide a brief overview of the distinguishing characteristics from each framework that informed my supervision practices (organized in alphabetical order researcher last name).

Supervision as Self-Study (Burns, 2012; Burns, Jacobs, & Yendol-Hoppey, 2016). Supervisors who engage in inquiry or self-study can be a key strategy to increase the efficacy for supporting the development of their teacher candidates. This involves a self-examination of the supervisor's own practice through questioning, analyzing data, and making claims in a way that can help them to work with their preservice teachers.

Clinical Pedagogical Skills and Seven Pathways (Burns and Badiali, 2018). According to Burns and Badiali there are six clinical pedagogical skills and seven pathways for

implementation and practice of supervision: 1) noticing, 2) ignoring, 3) intervening, 4) pointing, 5) unpacking, and 6) processing (p. 431). These skills are best understood in the context of the supervision through seven pathways that interweave these skills based on the specific scenario and needs of the teacher candidate. The various pathways to implement the skills are often nuanced and embedded within the supervision with each teacher candidate based on the scenario.

Clinical Supervision (Cogan, 1973; Goldhammer, 1969). This model entails a cycle that includes five components. There is a pre-observation conference in which the teacher candidate discusses the intended lesson plan that they will teach This is followed by an observation in the classroom where the university supervisor takes meticulous notes of the various aspects of the lesson. After the observation, the supervisor and teacher candidate analyze the notes as well as any evaluating tool used. During the post-observation conference, the supervisor and teacher candidate review the lesson, notes, and analysis. Finally, a plan of action for upcoming cycles of observation is created.

Cognitive Coaching (Costa & Garmston, 2012). This model is based on a relationship between the university supervisor and teacher candidate that is authentic, honest, respectful, confidential, and non-judgmental. The emphasis is on the teacher candidate directing their own learning through the guidance of the supervisor to encourage processes of thinking and reflection that lead to self-empowerment. Emphasis is placed on the metacognitive process.

Arts-Based Supervision (Eisner, 1998). This model asserts that supervision and specifically, evaluation, should be more of an inquiry-based, arts-inspired phenomenon of which Eisner termed 'connoisseurship'. Teaching can be described as an artform and therefore the instructional facilitation of the development of pedagogy can be considered an art. Evaluation should move away from the objective, scientific perspective to one that acknowledges the range

of innovative ways in which teacher candidates can develop their skills. Eisner's connoisseurship includes the technical skills (content, organization and planning, classroom management, and teaching methods) as they intertwine with the interactions between students and teacher, reflections on practice, and considerations for how students respond to the content.

Developmental Supervision (Glickman, Gordon, & Ross-Gordon, 2018). This is a developmental approach to supervision that emphasizes the collaborative aspect. The supervisor and teacher candidate work together in positive professional relationship towards a common goal of instructional improvement based on shared responsibilities, decisions made together, and a mutual atmosphere of respect and common interests. A key feature of this model is that the supervisor understands the achievement patterns, the cultural characteristics, and any instances of inequity for students of diverse backgrounds.

Salient Skills of Classroom Supervision (Nolan & Hoover, 2004). This model suggests that the university supervisor establish trust and incorporate active listening and a positive attitude. Time is dedicated to clarifying the teacher candidate's espoused platforms (including their values, views, and expectations for teaching and student learning). Inquiry and reflection while analyzing classroom data is used to encourage teacher candidates to make sense of the data in a way that provides meaning, identifies patterns, seeks problematic areas for further investigation, and acknowledges positive teaching. Through pre-observation and post-observation conferences, the university supervisor helps to promote coherency by including rehearsal, active listening, probing, and summarizing to assist in the preparation and review of the lesson. The supervisor uses scaffolding to support the teacher candidates with risk-taking and problem-solving approaches with an attitude of growth and collaboration. (p. 50).

Supervision as a Moral Activity (Sergiovanni & Starratt, 2007). Supervision can be considered a moral activity and serves a role in supporting the capacity for schools to better serve the academic success of students. Through the connections with their school and students, teachers feel a sense of duty to contribute to the community based on common values, shared research, and principles. Part of this includes promoting social justice on a regular basis for the professional development and growth of the teacher candidate's instructional practices. There are four commitments for the morality and professionalism in supervision which include 1) practice in an exemplary way, 2) practice toward valued social ends, 3) one's own practice as well as the practice itself, and 4) the ethic of caring.

The supervision frameworks mentioned above can be utilized by the university supervisor to help the teacher candidate with organization, planning, and boosting efforts for classroom management and achievement at the instructional level. The implementation of these supportive supervision systems can be used to inform the practices that the university supervisor employs to help construct pedagogical mastery with the teacher candidates. The diligence that a university supervisor commits to extensive participation, collaboration, reflection, data collection, and analysis can promote agency towards more meaningful engagement for all. The development of the teacher candidate is supported alongside the consistent focus on the classroom students' learning and achievement.

My conceptualization of supervision draws from the frameworks presented above. The pre- and post-conferences around the observation cycles as described by Cogan (1973) and Goldhammer (1969) serve as the overarching framework for meetings and observations. I extended the cognitive coaching model of Costa & Garmston (2012) in which there is emphasis on developing a relationship between the supervisor and teacher candidates that is based on

authenticity, honesty, respect, and non-judgment. The six clinical pedagogical skills and seven pathways as discussed by Burns and Badiali (2018), include the often nuanced but frequently embedded approaches to implement the skills with the teacher candidates based on each individual scenario. Furthermore, the salient skills of classroom supervision as described by Nolan & Hoover (2004) places significant emphasis on the trust, active listening, and positive attitude. They specifically encourage the dedication of time through inquiry and reflection for clarification of the teacher candidate's espoused values, views, and expectations for teaching and student learning). I cultivated the assertion by Sergiovanni & Starratt (2007) that supervision is a moral activity and thus should promote social justice on a regular basis within the professional development and growth of the teacher candidate's instructional practices. The work of Glickman, et al. (2018) through developmental supervision guided the collaborative process of comingling my understanding of students from diverse cultural and economic backgrounds based on achievement patterns, cultural characteristics, and areas of inequity. By pairing the arts-based supervision (Eisner, 1998) through inquiry and arts-inspired experiences, I was able to encourage the teacher candidates to develop their pedagogical skills by including innovative methods. Finally, by focusing on self-study of my supervision (Burns, 2012; Burns, et al., 2016), I included the self-examination component of my own practice by continuously questioning, reflecting, and analyzing data that guided my work with the teacher candidates.

Evaluation

University supervision for teacher preparation is based on both supervision and evaluation. While both are critically important, there is a distinct nature and set of tasks for evaluation. Supervision includes an evaluation function which provides a documented source of accountability for teacher candidate progression and growth. Nolan and Hoover (2004) describe

the purpose of evaluation to allow for judgement calls about the teacher candidate's overall quality in their performance and competence and typically includes some sort of quantitative and qualitative summative rating based on a set of standards.

Evaluation should be conducted in a way that it is a result of sincere mentoring with effort to maintain a trusting relationship with the teacher candidate (Nolan & Hoover, 2005). Evaluation is utilized within a growth-minded approach to provide both formative and summative feedback to the teacher candidate with a focus on strengths (Glickman, et al., 2014; Tschannen-Moran & Tschannen-Moran, 2010). The evaluation tool is included in the set of artifacts that the university supervisor and the teacher candidate review together to address areas of strength and areas of improvement. The task of evaluation is juxtaposed to supervising the teacher candidate.

The evaluation component of the relationship can present tension based on the power differential. However, when used constructively, evaluation can help the teacher candidate to become more aware of areas to focus their practice for improved pedagogical development. If the evaluation tool is presented and utilized in a way that is constructive to the teacher candidate's reflection, and growth-based, then perception of power disparity can be alleviated. Supervision along with the evaluation component can help to shape and transform the pedagogical development of the teacher candidates.

Inquiry

Inquiry through a process of investigating one's own position in the classroom in the context of background experiences and prior knowledge and how that affects meaning (Dewey, 1933, 1938) can be insightful for teacher candidates' development. "Inquiry into what we typically do is central to reflective teaching because it forces us to question our teaching beliefs

and behaviors in light of student learning" (Nolan & Hoover, 2005, p. 55). Consistent cycles of professional conversations between the teacher candidate and supervisor, comprised of reflection which includes self-assessment with regard to the standards of practice and how that connects with evidence of development, should permeate the duration of the internship (Danielson, 2010).

Teacher preparation programs have commonly implemented a goal to promote and foster an inquiry stance in teacher candidates that they will carry on throughout their professional careers (Cochran-Smith, & Lytle, 2009). According to Cochran-Smith & Lytle (2009), inquiry as stance is

> a worldview and a habit of mind—a way of knowing and being in the world of educational practice that carries across educational contexts and various points in one's professional career and that links individuals to larger groups, and social movements intended to challenge the inequities perpetuated by the educational status quo (p. viii).

As DiCiccio, et al. (2014) point out in their phenomenological case study, most teacher candidates enter their preparation programs mindful of their own exposure to K-12 schools and learning. This phenomenon is unique to the field of education and is known as the "apprenticeship of observation" (Lortie, 1975). DiCiccio, et al., (2014) discuss how cultural backgrounds, beliefs (about self and others), religion, gender, significant life events along with the formal knowledge from school and college inform teacher candidates' beliefs and expectations for teaching. Five categories of expectations that teacher candidates hold emerged from their study. These include 1) personal expectations for success, 2) expectations for the role and responsibilities as a teacher, 3) instructional (planning and instruction) expectations, 4) classroom management expectations, and 5) expectation for applying the content from the education program to the classroom students. By studying and understanding these expectations,

teacher candidates come to realize the discrepancy between their actual selves and their ideal selves in relation to their ought selves and any tension that results. Supervisors can help teacher candidates to consider their expectations and beliefs of students and compare those with the outcomes of their teaching.

Cochran-Smith and Lytle (2009) point to three areas of inquiry based on pedagogy, content, and outcome. This includes three primary strategies for inquiry: a) questioning and probing to investigate situations, b) co-constructing knowledge to generate meaningful interpretations, and c) problematizing challenges in the classroom in order to promote a broad perspective of inquiry (Cochran-Smith, 2009). The university supervisor should encourage teacher candidates to view the classroom as a place for inquiring about their own as well as others' practices and assumptions (Cochran-Smith &Lytle, 2009). A challenge persists for supervisors to seek ways to promote an attitude in teacher candidates for innovative uses of strategies in novel situations by espousing an inquiry approach in order to explore alternative ways to resolve issues (Hammerness, et al., 2005, p. 360).

The necessary inquiry stance that teachers take can be connected to the outcomes that emerge from their own reflection on teaching (Loughran, 2006). Through careful review of the teacher candidates' experiences and the actions taken, reflection helps build understanding. Then steps can be taken to resolve areas of concern through cognitive inquiry (Weiss & Weiss, 2001). This connects to Dewey's (1933, 1938) approach to inquiry which requires an investigation of the existing experiences in the context of prior knowledge to generate meaning and connections. When insights occur, a learner is better able to create new knowledge from these experiences and to develop alternative ways of behaving. Teachers who reflect effectively gain new perspectives on the dilemmas and contradictions inherent in classroom practices, improve judgement, and

increase their capacity to take purposeful action based on the knowledge they discover (Zepeda, 2013).

Loughran (2006) points to a three-pronged set of principles of practice as a way to inquire into one's own thinking within the pedagogy. For the supervisor and teacher candidate, these include a) relationship centered on mutual and genuine awareness of needs and concerns based on trust and honesty, b) purposeful teaching that includes well-planned procedures that incorporate experience and engagement all while consistently being metacognitive, and c) modeling both the intentional and unintentional behaviors for responsive and reflexive teaching while encouraging framing and reframing as a strategy for problem-solving. The university supervisor should review their own consistency of personal beliefs and philosophies with regard to their practices and confirm that this is an intentional expectation for the teacher candidate to explore and develop within their own practice. Loughran (2006) encourages the articulation of each individual's personal principles of practice in order to promote the alignment of beliefs within the act of teaching. When a supervisor accesses and understands a teacher candidate's espoused platform (beliefs, morals, and convictions related to why and how teachers teach), the supervisor is able to view what occurs in the classroom from the teacher's perspective, which can aid in collaboration with the teacher candidate (Nolan & Hoover, 2004).

Working in Culturally Diverse Schools

Many teacher candidates will work with students who represent a range of racial, ethnic, and economic backgrounds different from their own. In addition to the pedagogical and content skills that teacher candidates implement, the university supervisor has the potential to play a critical role in facilitating the teacher candidate's growing awareness, advocacy, and activism for equity and social justice in the science classroom.

In conducting a review of 125 studies from a range of universities, Cochran-Smith and Villegas (2016) investigated the 2009 National Center for Education Statistics. This report revealed that 44% of the student population are of color and only 17% of teachers are of color within United States public school enrollment. They found that teacher education programs predominantly consisted of white, middle-class teacher candidates and pointed to the mounting cultural gap between teachers and their students and how that gap can be reduced through quality teacher preparation programs (Cochran-Smith & Villegas, 2016).

Field placement within a culturally and economically diverse school is a crucial component of the process for education training. This immersion experience provides teacher candidates with the meaningful connections of theory to their developing practice working with students from all backgrounds (Fitchett, et al., 2012). Not only is it critical that teacher candidates are aware of and commit to understanding the various cultures that exist in their classrooms and school communities, but they must find ways to embed those cultures so that they become the basis for learning (Ladson-Billings, 2001). This can promote teacher candidates' confidence to become active participants and advocates within the schools which may result in positive outcomes for their students as well as their lives as teachers (Colón-Muñiz, 2010). Teacher candidates must be supported to conduct their own self-reflection and to consider what is meant by helping all students to learn, to hold high expectations for all, and to hold the ideas and prior knowledge that all students bring to the classroom with high regard (Maulucci & Fann, 2016). Teacher candidates will require support for their efforts to include socially just practices in their lessons and teaching. University supervisors should work to support teacher candidates to adequately assess the range of diverse cultures in their classrooms in a way that avoids the formation of negative attitudes about those students (Jacobs, 2017).

The university supervisor and teacher candidate can collaborate based on the collection of and reflection on data. Both members analyze the data to discover new understandings, construct interpretations, and co-generate knowledge based on the teacher candidate and their classroom students (Atkins & Duckworth, 2019). It is critical that all teachers have the time and support to effectively learn how to use a variety of assessments and reflection practices that will guide how they recognize their students' ways of understanding, participating, and communicating to ensure that privilege is accounted for in ways that can be addressed (Neri, et al., 2019).

Bridging Theory (Coursework) to the Field (Classroom)

Teacher candidates may encounter a different reality in their clinical field experience compared to what they learned and interpreted from their coursework, which may shift their expectations for teaching. Allsopp, et al. (2006) point out that teacher candidates may be grappling with professional expectations prior to realizing their own professional and personal growth; the transfer from their identity as college students to that of classroom teacher that can cause tension. Allsopp, et al. (2006) found that by providing opportunities for teacher candidates to actively implement their course content, they transition into a more active role in taking ownership of their field experience by making objective connections, recognizing and implementing their experiences as a positive structure, and creating constructive future plans. At some point, the teacher candidates may become more knowledgeable about what works best for the students in their classroom based on their daily involvement with all of the contextual factors within their classroom and school community (Loughran, 2006).

Loughran (2006) called for a shift from the theory-based approach to teacher learning to an "expert-practitioner-based approach" (p. 137). This aligns with Schön (1983) who argued that while actually immersed within the real-world classroom context, teachers can practice and

enhance effective decisions. They self-examine their own pedagogy to frame and re-frame challenging problematic situations. The university supervisor should work to empower teacher candidates in their ability to function responsibly as the primary source for decision making and problem solving about and within their own practice without needing explicit supervisory intervention (Nolan & Hoover, 2008).

There is an issue of distance and disconnect between the university coursework and the field experience that can create a challenge for teacher candidates trying to enact the theories with their classroom students (Bullough et al., 1997; Zeichner, 2007, 2010). Another significant challenge is the 'Whiteness' of the university space where the structure is based on a system dominated by White perspective and influence, thus undetected by those whose membership belongs to White privilege (Louis, et al., 2018). The work of the university supervisor is a key component for the process of helping the teacher candidate to transfer the theory they learned in their coursework into determined, goal-oriented teaching practices with their own students. Athanases and Martin (2006) note the strengths of university supervisors who model teaching that embraces and embeds culture within a caring context as a method for teacher candidates to learn to advocate for equity.

Third Space

There is a critical opportunity within the collaboration space that comprises the relationship between the university supervisor and the teacher candidate. According to Zeichner (2010), there is a less structured hybrid space between the university-based academic training program and the experiences in the field placement that provides a democratic-minded approach to working in schools. This can be described as a third space between the university side where the coursework and the school field assignment interact. This third space can serve as a bridge

between the academic knowledge and practical application; thus inquiry promotes a receptive space to support the teacher candidate's development (Cochran-Smith & Lytle, 1999).

Third space, as originally presented by Bhabha (1990) and the later work of Soja (1996), is where an examination of the actual lived experience of an individual occurs as it connects to the intersection of knowledge as it constructed based on identity, culture, and social factors. Soja (1996) describes this space as an area where new understanding can be a catalyst for the generation of social change. He explains that the third space represents a hybrid area in between a first space that consists of experiences of the community and the beliefs that emerge based on the mix of different factors from that community and a second space where the formalized training contributes to the construction of perception of norms. In this third space, work can be done to examine personal biases and belief structures to find out how they inform the way people interact.

The conceptual framework of third space as defined by Bhabba (1990) and Soja (1996) can be aligned with the relationship between a university supervisor and teacher candidates. The relationship that emerges within the third space ranges in style, depth, and efficacy. Third space consists of the components based on the university experience, which includes coursework in secondary science education and practicum and the transition into the real-world classroom with full teaching responsibilities. Burns and Baker (2016) established a set of assertions based on their findings from their study of formalized boundary-spanning roles of university supervisors. The fourth assertion explicitly points out the complex work of supervisors as "boundary-spanners in their efforts to enact their many tasks [that includes] teaching, collaboration and community, individual support, equity, curriculum development and support, and research for innovation" (p. 33). According to Moje, et al. (2004), the third space can also be used to focus

specifically on the students who have been traditionally marginalized and undervalued in schools by looking at ways to incorporate the characteristics of their homes and communities into the classroom thus giving them a greater voice in their education. The relationship between the university supervisor and teacher candidate can serve as a third space, where there is significant capacity for frequent and continuous growth based on the interaction, collaboration, problematizing, and synthetization of the data.

Equity in Schools

There has been an increase in enrollment of students of color (Black, Hispanic, Asian/Pacific Islander, and two or more racial backgrounds) and it was projected that these groups of students will exceed White students by the year 2022 (Hussar & Bailey, 2014). According to the Pew Research Center, as of Fall 2019, this has already happened; they report that 52.9% of children come from racial and ethnic minority groups (2019). Considering the shift in national demographics in public schools, it is critical to consider the educational needs of students from a range of racial/ethnic/economic backgrounds and how to best prepare incoming teachers to respond to and sustain their cultures within the science curriculum. Furthermore, it is important to learn how to most effectively prepare teachers to educate students of color, many from low-income communities, and this undergirds the agenda to effectively prepare novice teachers (Douglas, et al., 2008).

The diverse school landscape in the United States should serve as a backdrop when considering teacher preparation. As of 2013, the majority of United States K-12 students come from lower socioeconomic communities, and the highest concentration of these students reside in the southeastern region of the country (Suitts, 2016). According to the 2016 statistics as reported by NCES, the rate of children living in poverty was 31% for Black children, 26% for Latinx

children, and 10% for White children. Furthermore, according to the same report, 45% of Latinx students attended high-poverty schools, followed by 44% of Black students, 38% of American Indian/Alaska Native students, 24% of Pacific Islander students, 17% of students of two or more races, 14% of Asian students, and only 8% of White students.

Teachers, researchers in education, school administrators, and policymakers appear to recognize the importance of equity in science education, but they possibly understand the meaning of equity in different ways (Fortney, et al., 2019). According to Rodriguez and Morrison (2019) equity means instilling targeted policies and practices to work towards a higher level of access and increased opportunities that can provide success for all students. They also note the critical importance of distinguishing between equity and equality in that treating everyone the exact same way may provide equality, but it does not recognize the differentiation in level the needs for each individual. Only by providing multiple opportunities that are equitable for success can equity be achieved (Rodriguez & Morrison, 2019).

Quality: Schools and Teachers

It is readily known, often studied, and a widespread opinion that highly-qualified teachers and better-quality teaching can ameliorate the achievement gap between low-income and affluent students (National Research Council, 2001). As teacher turnover rates continue to remain high, much of the research points to the greatest occurrences of teacher attrition and lower quality teachers in underachieving and underperforming schools where most students are from diverse racial/ethnic/economic backgrounds (Carver-Thomas & Darling-Hammond, 2017; Darling-Hammond, 2003; Kersaint, et al., 2007; Papay, et al., 2017). Underachieving schools have endured a long history of failure, marked by frequent administrative turnover and a continuous cycle of inexperienced teachers (Johnson, et al., 2014). Novice teachers require additional

teacher support during their beginning years, this leads to an increased turnover rate within the schools in these districts.

Gagnon and Mattingly (2012) conducted an analysis of data that represents 6,569 districts based on the 2009-2010 Civil Rights Data Collection (CRDC), the 2009 Small Area Income and Poverty Estimates (SAIPE), and the 2010 U.S. Census. The researchers found that there is a higher percentage of beginning teachers working in the districts with the higher concentration of students of color and a moderately higher percentage of beginning teachers working in schools with higher poverty rates. Furthermore, they found that the districts located in large cities with higher percentages of low-income and racially/ethnically diverse students are most likely to have a higher concentration of beginning teachers. Considering that expert teachers are essential to improving student learning (Darling-Hammond & Ducommum, 2007), students in schools representing higher populations of students of color and from low-income households are at a critical deficit. Gagnon and Mattingly (2012) further point out that their data indicate a correlation between highly culturally diverse schools with a high percentage of and disproportionate rate of teacher attrition.

The effectiveness of teachers is a leading factor that affects the quality of a school and subsequently, there is not enough effort to focus on improving teacher quality to work with disadvantaged students (Hanushek, et al., 2019). The challenge to retain effective teachers persists and results in lower hiring standards (Darling-Hammond, 2013; Ingersoll & May, 2012). The outcome has produced unskilled and underqualified science and math teachers, and this predominantly affects students from low-income households throughout the country, thus one of the most critical problems in modern education (Ingersoll, 2004). Schools with a high percentage of students of color and students from low-income households represent the most frequent

teacher turnover rates and there is a greater number of employed teachers shifting away from these schools (Ingersoll, 2011; Ingersoll & May, 2012).

It has been commonly recognized that the shortfalls for quality science teachers lies disproportionately within schools that represent predominantly racial/ethnic/economically diverse communities (Darling-Hammond, 1984; Ingersoll & May, 2012; Quartz et al., 2008). Darling-Hammond (2013) assert that schools with high percentages of students of color and from low-income suffer more from the lower quality teaching that they receive by inexperienced teachers. High-poverty schools face a disproportionately large challenge in hiring qualified experienced teachers for their vacancies and thus an inability to provide equitable education to all children (García & Weiss, 2019). In particular, teachers who are more prepared to teach science and mathematics are more likely to shift from underachieving and under performing schools to those located in wealthier districts that have less minority students (Ingersoll, & May, 2012).

There is a significant achievement gap between White, middle/high income students and students of color students (Athanases & Martin, 2006). This achievement gap is due to a disparity in opportunity. Gorski (2017) argues that the achievement gap is, in fact, an opportunity gap. He argues that this can be mitigated through teachers prepared to work with students of diverse racial/ethnic/economic backgrounds and who recognize the disparity in resources these students lack. Students from low-income households face compounded challenges for academic achievement because they come from under-funded and oftentimes disruptive communities as compared to their White counterparts (Miller, et al., 2019). The low quality of teaching in their schools described above accounts in part for this gap.

When it comes to science assessments, the traditionally underserved students of color and students from low-income households are more likely to underperform as compared to wealthier, White students (Lee & Buxton, 2010). According to the 2015 National Assessment of Educational Progress NAEP Science Assessment, there is a disparity between the science scores between Black students and their White, wealthier counterparts. The NAEP science scores are based on a scale of 0-300. The grade 8 science scores based on race reveals a score of 165 for White students and 131 for Black students (the average score at the 10th percentile for White students is 128 and for Black students is 88; the average score at the 90th percentile for White students is 200 and for Black students is 172). For grade 12, the gap in average science scores based on race reports 160 for White students and 124 for Black students (the average score at the 10th percentile for White students is 117 and for Black students is 82; the average score at the 90th percentile for White students is 201 and for Black students is 167).

The National School Lunch Program Eligibility (U.S. Department of Agriculture Food and Nutrition Service) for 2015 establishes that students receive free lunch if their family income is below 130 percent of the established poverty level and receive reduced-price lunch if their family income is between 130 and 185 percent of the established poverty level. The science scores for 8th grade students who are ineligible for free lunch is 167 and the scores for those who are eligible for free lunch is 140 (where the average score at the 10th percentile for ineligible students is 167 and for eligible students is 140; the average score at the 90th percentile for ineligible students is 202 and for eligible students is 180). For grade 12, the average science scores for students who are ineligible for free lunch is 160 and the scores for those who are eligible for free lunch is135 (where the average score at the 10th percentile for ineligible students

is 116 and for eligible students is 91; the average score at the 90th percentile for ineligible

students is 202 and for eligible students is 178).

Cultural Mismatch

The majority of students of color are taught in classrooms by teachers who do not share

their cultural backgrounds (Douglas, et al., 2008). According to the National Center for

Education Statistics NCES report, *Status and Trends in the Education of Racial and Ethnic*

Groups 2018, 79% of teachers are White, non-Hispanic (non-Latinx). This report emphasizes

how the diversity of the population of the United States has increased over the past two decades.

Through an understanding of the shifting demographics, efforts need to be made that will support

the preparation of teachers to work with students of color and students from low-income

households. The National Center for Education Statistics NCES reported that as of 2017, 51% of

school-age students were White, 14% were Black, and 35% were from other minority ethnic

groups including Hispanic (Latinx), Asian, and those of two or more backgrounds. Students

arrive each day representing a vast range of ethnic, racial, cultural, socioeconomic communities;

oftentimes in stark contrast from that of their teachers.

Differences in the culture between White teachers and their students of color is a critical

concern when considering the outcomes. Irvine (1990) identifies an "absence of

synchronization" between the culture of schools and the culture that many students bring to

schools. When White teachers expect students to imitate their White behaviors, patterns of

dialogue, or attitudes that do not match their background, the White teacher's expectations for

conformity are not met. The lack of a match between a teacher's culture, language, and attitudes

with their students from a culture different from their own can create an incongruous disconnect

regarding the behaviors, speech patterns, and attitudes of the students who do not conform to the

teacher's expectations; this leads to the lower expectations for these students (Boser, et al., 2014; Bryan & Atwater, 2002; Gershenson, et al., 2016; Milner, 2015, Segal, 2014; Sleeter, 2008). A 2016 study by Gershenson, et al. reports that White teachers are 40 percent less likely to expect their Black students to graduate from high school and Black students who had a non-Black 10th grade teacher were less likely to pursue that particular subject any further as a result of teacher bias and lower expectations.

Research has shown that teachers often have a deficit in the knowledge and skills needed to teach students of color (Landsman & Lewis, 2006). Partee (2014) argues that students from low-income households and/or students of color are more likely to have novice and less effective teachers than their White counterparts, despite the acknowledged national efforts to ensure equity in assigning high quality educators to schools with predominantly minority student populations. In addition, White teachers lack the ability to link the curriculum with the backgrounds of their students of color (Sleeter, 2008). Milner (2015) identifies five common problematic mindsets in his work with teaching teachers: 1) color blindness; the hesitation to acknowledge students' racial background, 2) treating all students the same regardless of their cultural backgrounds, 3) meritocracy and the harmful myth it perpetuates 4) lower expectations for students of color, and 5) blindness to community context. Milner further points out that by adopting a colorblind stance, teachers can fail to identify and recognize talented and exceptional students. Moreover, he argues that these problematic mindsets prevent teachers from recognizing structural classroom practices that can lead to a disproportionate number of referrals for special education and classifications of misbehavior for students of color.

White, middle-class teacher candidates may lack meaningful experiences with culturally and linguistically diverse populations, which can lead to misconceptions about cultural diversity

and to the formation of counterproductive beliefs about their students (Siwatu, 2007). If the standardized coursework for teacher preparation is based on what is considered to be the best practices, this may perpetuate the dominant culture, and in fact prevent teachers who desire to teach all diverse learners, from actually realizing the unique needs and strengths of children from different cultural backgrounds (Bailey & Pransky, 2005). While coursework can be based on what is considered to be the most current information and research, each classroom will require flexibility and ability to understand the unique lives of each student and that may not always match the coursework from the university.

There is a positive correlation between the socioeconomic status of families and access to opportunities and educational achievement (Gay, 1993). Students of color and those who come from low-income households have fewer opportunities. For the most part, university-based teacher preparation programs provide teacher candidates with some training in culturally responsive pedagogical practices for multicultural classrooms (Sleeter, 2017). However, many science teacher candidates leave their programs not prepared to teach the racially/ethnically/economically diverse students in their classrooms, therefore it is critical that they are given opportunities to teach in culturally diverse classrooms to build their skillset for understanding and recognizing their students' potential (Russell, et al., 2014). Gorski (2013) urges teachers to identify bias in their assumptions and beliefs as it pertains to students affected by low-income backgrounds. Specifically, Gorski charges those in the field to attain a "deeper, more empathetic, and more holistic understanding of the effects of poverty and class bias on the school experiences of poor and working class students…to nudge us past the simplifications and stereotypes…by dropping the deficit views…" (p. 5).

STEM Pipeline

Students of color frequently take fewer science courses than White students (U.S. Department of Education Civil Rights Data Collection [CRDC], (2018). According to the CRDC, during the 2015-16 school year, the percentage for White high school students enrolled in biology (50%), chemistry (52%), and physics (51%) was significantly higher than Black students enrolled in biology (15%), chemistry (14%), and physics (12%). Additionally, Black students are less likely to take the more rigorous and advanced science courses and those who do, are less likely to pass advance placement (AP) tests and students from low-income households are less likely to take advanced science courses as compared to their higher socioeconomic peers (The Education Trust, 2014). Clearly the stratification by racial class and socioeconomic status for enrolling in high school science courses is pervasive.

There is a commonly used metaphor to describe the pathway of students through science courses into a STEM-based degree, the pipeline model. This pipeline model speaks to the narrowing of the flow from middle and high school to college in which children of color and from low-income households tend to leak out of the pipe and do not gain equitable access to STEM courses and ultimately degree programs (Cannady, et al., 2014, Mendick, et al., 2017, New York Hall of Science, 2012). According to the pipeline model, this results in the lower representation of students of color enrolled in postsecondary STEM courses (Hinojosa et al., 2016), and lower numbers of Black and Latinx students entering into the STEM fields (National Action Council for Minorities in Engineering, 2014). According to the pipeline model, the low representation of students of color in the STEM disciplines leads to their low representation in the science teaching field.

Teacher Preparation Standards: Equity

There needs to be ongoing and consistent efforts to prepare teacher candidates to engage

in equitable, socially just teaching practices. Training and supporting teacher candidates to be

able to create a classroom atmosphere where their students feel like they are understood and their

lived experiences are embraced, is a significant challenge for teachers working within

underachieving and underperforming schools. It is essential to support incoming teachers to be

prepared to work with students who are not White and not middle-class. Teachers will need to

have a solid foundation for pedagogical methods that view and incorporate the various assets that

their non-dominant cultural, linguistic, and ethnic students bring to the classroom (Neri, et al.,

2019).

Table 1. includes a list of frameworks of standards that have been established by teacher

preparation and teaching organizations.

Table 1. Teacher Preparation Standards: Equity for Diverse Students

Organization	Standards Dedicated to Equity / Social Justice
Association of Teacher Educators (ATE) Standards for Teacher Educators	Teachers must have cultural competence and social justice consciousness, through self-awareness of both the preservice teacher's and university supervisor's own historical cultures and belief systems (2008).
Interstate Teacher Assessment and Support Consortium (InTASC) Model Core Teaching Standards	2(k) The teacher knows how to access information about the values of diverse cultures and communities and how to incorporate learners' experiences, cultures, and community resources into instruction, 3(l) The teacher understands how learner diversity can affect communication and knows how to communicate effectively in differing environments, 5(g) The teacher facilitates learners' ability to develop diverse social and cultural perspectives that expand their understanding of local and global issues and create novel approaches to solving problems, and7(i) The teacher understands learning theory, human development, cultural diversity, and individual differences and how these impact ongoing planning.

Table 1. (Continued)

2013 Council for the Accreditation of Educator Preparation [CAEP]	(2.3) - The provider works with partners to design clinical experiences of sufficient depth, breadth, diversity, coherence, and duration to ensure that candidates demonstrate their developing effectiveness and positive impact on all students' learning and development." The 2016 National Board for Professional Teaching Standards assert Five Core Propositions for What Teachers Should Know and Do. They specifically state that, "Teachers are committed to students and their learning… Teachers Recognize Individual Differences in Their Students and Adjust Their Practice Accordingly…Teachers treat students equitably…Teachers work collaboratively with the community.
2020 National Science Teaching Association [NSTA] / Association for Science Teacher Education [ASTE] Standards for Science Teacher Preparation	Standard 2: Effective teachers of science plan learning units of study and equitable, culturally-responsive opportunities for all students based upon their understandings of how students learn and develop science knowledge, skills, and habits of mind... Standard 3 Effective teachers of science are able to plan for engaging all students in science learning by identifying appropriate learning goals that are consistent with knowledge of how students learn science and are aligned with standards…Effective teachers create an anti-bias, multicultural, and social justice learning environment to achieve these goals. Standard 6: Effective teachers of science strive to continuously improve their knowledge of both science content and pedagogy, including approaches for addressing inequities and inclusion for all students in science… (Morrell, Rogers, Roehrig, & Veal, 2020).

Social Justice in Teaching

Teachers who do not feel comfortable around their students of diverse cultural backgrounds may not recognize their students' ability to achieve and may struggle to understand how to connect with and to teach them (Sleeter, 2008). As Milner (2006) argues, the negative perspective that White middle-class teachers may attribute to students of color can affect expectations and assessments for student academic performance. If a teacher brings a deficit-based frame of reference about their students of color, this will negatively impact the ability to address their students' educational outcomes (Douglas, et al., 2008).

Taylor (2010) argues that efforts have been insufficient in promoting teacher candidates' determination to extend their knowledge of culturally responsive pedagogy beyond course work into their field placement classrooms thus missing the mark in meeting the needs of the increasing diversity of student populations. Preparing teacher candidates to develop culturally responsive skills and practices should be a significant component of any teacher preparation program (Villegas & Lucas, 2002). If new teachers are to teach at culturally diverse schools, then their training will need to explicitly address the knowledge and skills that they will need to work in those schools (Catapano, 2006). Many university-based teacher preparation programs include a focus on multicultural education and set up internships in high needs schools that serve populations impacted by poverty. Yet research has continued to reveal an overwhelming bias of White perspective that frames the discourse and practices in many of these programs (Sleeter, 2001).

Cochran-Smith and Villegas (2016) argue for continued research that is explicitly devoted to preparing new teachers to teach students from lower economic communities. Bryan and Atwater (2002) specifically contend that science education programs must scrutinize and challenge the beliefs and assumptions about the ways their students of diverse racial/ethnic/economic backgrounds learn science. The extensive case study of 21 teacher candidates by Lambeth and Smith (2016) reveal that more needs to be done with the preparation for working with students of differing racial, cultural, and economic backgrounds from their own. They further maintain the need for additional research that focuses on examining how teacher candidates reflect on their own culture and how aspects of power and privilege might impact their teaching practices.

Culturally Responsive Teaching

Douglas, et al. (2008) recommends more effort be placed on improving teacher preparation programs to better prepare teachers to gain the knowledge and skills to effectively understand, respect, interact, and teach students of color. An examination of the social and economic obstacles that students of color and from low-income households face can greatly inform their teachers. It is essential that teachers not only recognize, but respect and integrate the various attributes, experiences, and perspectives of students of culturally and ethnically diverse backgrounds (Gay, 2000, Ladson-Billings, 1995, Nieto, 2000).

One way for teachers to engage with students who do not share their ethnic, cultural, or economic backgrounds is through the enactment of culturally responsive teaching (Gay, 2000, Ladson-Billings, 1995). Villegas and Lucas (2002) discuss six salient characteristics of culturally responsive teaching.

1) Sociocultural consciousness is the interaction of factors such as ethnicity, social class, and language and how they can influence the way that people think and behave.

2) Teachers with an affirming, asset-based perspective of students from culturally diverse backgrounds validate that there is a dominant climate in schools based on a White, middle-class perspective. They acknowledge that there are a multitude of ways that students think, talk, behave, and learn. It is teachers' responsibility to ensure that students of color and from low-income households have a pathway to function within the school society.

3) All teachers have a responsibility for to commit to bringing about social transformation. They have a moral obligation to operate as agents of change as they facilitate the development of their students.

4) Students each bring a unique set of experiences based on their own cultures and communities. Therefore, teachers must embed constructivist approaches to teaching and learning that acknowledge and incorporate how students might think and learn based on their backgrounds.

5) Through the use of a range of strategies, teacher candidates can gain insight into the lives of their students. This can be accomplished through visits to homes and communities, consulting with the members of students' communities, creating opportunities in the classroom for students to connect their goals and plans for their future with how they perceive school can assist them.

6) Culturally responsive teaching methods must be at the core of the pedagogical practice for ensuing inclusivity in the design of lessons and assessments.

There is a period of uncertainty when teacher candidates realize that they need to span the gap between their prior assumptions about students and motivation for learning and achievement (sometimes a deficit mindset based on their perceptions of students from different groups than their own) and how they can become part of the solution to bringing greater equity for those students. Teacher candidates who engage in culturally responsive teaching practices can unearth and disrupt their perceptions and recognize areas for increasing diversity awareness in order to bring positive change into their classroom, thus presenting a space for genuine social transformation. They can develop the awareness of and confidence for a constructive learning environment that embeds critical thinking and problem-solving through the promotion of inclusive cross-cultural collaboration within meaningful and intentional lessons designed to embed the lived experiences of all students.

Paris (2012) takes the framework for culturally responsive teaching (Gay, 2000) a step further with a culturally sustaining pedagogy, which "seeks to perpetuate and foster—to sustain—linguistic, literate, and cultural pluralism as part of the democratic project of schooling…. [that includes] explicit resistances that embrace cultural pluralism and cultural equality" (p.93). This conceptual framework serves to provide teacher candidates with a schema to conceptualize their students' backgrounds in a way that they can promote a stance for valuing and embedding their students' cultural and linguistic backgrounds despite the practices that dominate the school environment (Paris, 2012). Culture is at the core of teaching and learning; therefore, instruction needs to be inclusive, socially relevant, and situated within authentic contexts (King, 2019).

Culturally Responsive Teaching in Science

Banks (2010) suggests an increased emphasis on preparing teachers to integrate multicultural content in the curriculum that focuses more on transformative approaches to social justice action within the science classroom. The final clinical internship is a time period when teacher candidates can develop their culturally responsive pedagogical approaches to teaching science. This is an opportunity where they can develop and enact agency for promoting equity and working for a more socially just approach to teaching the science content. Part of the preparation to equip and empower teacher candidates to teach using socially just pedagogical practices can be supported by the university supervisor.

In the secondary science classrooms, there is a necessity for the increased awareness and incorporation of attitudes and approaches that recognize the spectrum of ethnic, racial, cultural, and economic backgrounds of students. Hanson (2009) found that students of color (this study focused on female students in particular) have been deterred from entering the science fields due

to racism and this discourages their enrollment in high school science courses. There is an increased need for pedagogical methods that teach science that is more varied and inclusive of today's diverse student population. Students of color need their diverse cultural backgrounds to be recognized and incorporated into the classroom. Teachers need to do more than just recognize basic awareness of diversity, they need to adopt broader and more inclusive understanding of their students from diverse backgrounds in a way that promotes a positive outlook for working with those students (Moore, 2006).

> With a broader understanding of diversity that extends from the learner to communities to include diverse methods of teaching and ways of learning, . . . [teachers] focus their thinking on making science curriculum authentic, relevant, and meaningful by connecting science to the lives of their students. Curriculum development connects to their development of a science disposition - one that promotes positive, critical, and affirming attitudes not only for the diverse students they teach but also for themselves as science teachers and for the subject matter of science . . . [and] encourages critical awareness of curriculum as an approach to teach diverse learners and as a place to continue professional development as teachers in science (Moore, 2006, p. 123).

A current objective of science education reform is to enhance and increase access to rigorous science content and lessons and hold high standards for students from all backgrounds (Mensah, 2016; Milner, 2006). Science teachers must recognize that all children should have free access to science and understand that science is their right and that it can empower them in ways for advancement (Moore, 2006).

It is critical that teacher educators commit to preparing teacher candidates to become agents of change for including social justice in their teaching practices (Hoyle, 2018). Since

Western science has historically excluded people of color, science teachers need to be able to evaluate their classrooms in order to develop better initiatives that mitigate the existing barriers to achievement (Maulucci & Fann, 2016). In the science classroom, the unique characteristics of students can be incorporated into their study of concepts within all subject areas including biology, chemistry, physics, and earth science. By including culturally responsive approaches in the science classroom, students gain multiple perspectives for learning and integrating science content in their everyday lives.

Mensah (2019) details how race and racism are entrenched within science education and asks pertinent questions about the perception of who can do science, who can teach science, who is a scientist, who is a science teacher, and what is considered science knowledge to be taught. In order to make science learning accessible to all learners (which includes students from low-income households and students of color), it is essential that science teachers adopt the belief that every child has a right to learn science, should have free access to resources, is empowered through learning science, and will be able to advance through the opportunities that come from learning science (Moore, 2006). Teachers who understand their students' activities outside of school (listening to music, watching YouTube, dancing, playing sports and games, acting in plays in their church, creating art for example), realize that they need to welcome these outside interests and activities into their classroom (Milner, 2018). It is critical that teacher candidates inquire into and learn about the cultural practices that comprise their students' daily lives beyond the school walls. Emdin and Lee (2012) advocate for a hip hop themed pedagogical approach to connecting science and their students, which can "generate a genuine recognition of who they are, an appreciation of their motivation for academic success, and an understanding of how to capitalize on hip-hop culture for their identities as science learners. Such efforts can eventually

lead urban youth to become "the best and brightest" in the science classroom and pursue careers in science-related fields" (p. 2).

Culturally responsive teaching for science may be described use of multicultural education frameworks. Multicultural science education is described by Atwater (1995) as a way to integrate science content equitably in all classrooms and to construct science knowledge to enact a sense of empowerment for all students. It is an acknowledgment of how scientific knowledge is constructed by individual students from all backgrounds (Luft, 1998). Le and Matias (2019) argue for a multicultural science education that intentionally unveils and disrupts the 'Whiteness' of the current science curriculum that is based on a Eurocentric interpretation. They argue that there needs to be recognition for explicit prejudice and subconscious bias within science, realization about Whiteness and the privilege that comes along with that, rejection of deficit thinking and color-blindness, and creation of alternative science education spaces that validate and include the needs of students of color.

A critical analysis by Barton and Osborne (2001), discusses the unequal access to and the purposes served by science education in relation to the intersections of race and class. The researchers point out the need to contextualize and revise science education to match the needs of local groups of students; in other words, science education needs to be modified in order to meet the needs of a diverse range of ethnic, cultural, and economic student groups. Bang, et al. (2013) emphasize how scientific knowledge that is derived from a Western perspective and White dominance prevents students who have historically been marginalized based on race/ethnicity, to gain access to science. Many historians of science are conscious of how the term 'modern science' has been used to justify colonialism, rendering specific communities either winners or losers, and to mix European cultural past and present and call it "traditional

cultures" (Daston, 2017, p. 144). Bang, et al. (2013) claim that by "desettling science", teachers and students should ask questions and dismantle assumptions and ideas about science that they have been conditioned to adopt. Furthermore, if teachers do not allow students to question scientific assertions, then they promote and sustain the current power structures that have historically prevented access. Bang, et al. further prescribe extending the availability of science to all students by eradicating deficit-based assumptions about students of color and inviting students to connect scientific literacy to their individual lives (2013). Finley-Brook and Holloman (2016) contend that when students explicitly investigate inequities in STEM-related real-world scenarios such as poor air and water quality in lower-income communities, they can deepen their understanding and resolve to learn science.

For science education, there is a rich social component that includes how the values and characteristics of people can shape the way that science is learned and understood. Students should not have to shift and modify in order to fit within a strict narrow view of science, rather, science content and lessons must be diversified and taught in ways that meet the various needs of individual learners. For students from lower economic backgrounds and/or children of color, science can provide access to knowledge that they can connect to their immediate lives. By tailoring science lessons to ensure that all students from a range of diverse groups have equitable access, they can find a pathway to enact their own voice and be empowered to become agents of change within their communities which can improve the quality of life within the larger socio-political climate (Zahur, et al., 2002).

Social Justice: Awareness, Advocacy, and Activism (AAA)

Education that includes a focus on socially just practices provides for a classroom where all groups of students have equitable access and opportunities for participation in an environment

that meets the needs of all students (Adams, et al. (1997). There are targeted approaches that can be used to support the teacher candidate's agency for social justice awareness, advocacy, and activism. Teacher candidates bring with them the theories and methods for practice that they have read, researched, and discussed from their university coursework. It is a readily-established theory in the field that the knowledge and skills that teacher candidates need to learn should be in and from practice, and not just for practice (Ball & Cohen, 1999; Hammerness, et al., 2005; Lampert, 2010). Culturally responsive teaching is a key conceptual framework that can be incorporated into teaching science that is socially just. In order to effectively implement a culturally responsive approach to science teaching, there are mindsets and stances that support social justice in the classroom. The next sections present what has been discussed in the literature regarding the development of awareness, advocacy, and activism for teaching science that is based on a social justice perspective.

Relevant to this agenda is equity literacy for all (Gorski and Swalwell, 2015). This approach points to the factors that must be present for teacher candidates (and all teachers) to cultivate a teaching stance that is centered on equity. Equity literacy includes more than multiculturalism. It incorporates intercultural and cross-cultural teaching and learning, cultural competence and proficiency, and culturally responsive pedagogy that addresses and embraces race, ethnicity, and socioeconomic class (Gorski & Salwell, 2015). Gorski (2013) identifies the essential ideas for an equity literacy stance: a) ability to recognize bias and discrimination b) respond to inequities through mindful approaches, c) redress the inequities by seeking impactful ways to create social change, and d) develop and foster bias- and discrimination-free classrooms. The ability to recognize inequity requires awareness of the implicit biases that first need to be unearthed. The task to respond to inequities includes a stance for advocacy. This includes

identifying, investigating, and initiating dialogue that addresses the social and structural barriers that exist for students of color and students from low-income households. Teachers can adopt an activist stance for equity by rectifying the inequities in the larger system (i.e., school, community) and ensuring that science is taught within a culturally responsive framework.

Awareness. As teacher candidates enter their classrooms for the first time, they must promptly understand, adapt to, and incorporate a wide range of their students' cultural and socioeconomic status backgrounds that are different from their own. They may carry a predetermined system of assumptions, attitudes, and beliefs that inform their knowledge of content and practice. Beliefs and assumptions about students may be deficit-based and negative with regard to students of different cultural backgrounds than their own (Bryan & Atwater, 2002; Gershenson, et al., 2016; Milner, 2015, Segal, 2014; Sleeter, 2008; Smith, 1991). Making explicit the beliefs about teaching and learning and unearthing the attitudes about issues of culture, class, ethnicity, gender, and race is an essential component of the process for learning to teach (Bryan & Atwater, 2002). The identity of an educator needs to be clearly understood and challenged in order for there to be education reform that embraces anti-racist and multicultural schools (Carson, 2005).

A close examination of not just identity, but intersectionality is essential. Intersectionality consists of the interaction of various identities including social class, ethnic and racial background, gender, and a range of other overlapping aspects. According to the Center for Intersectionality and Social Policy Studies at Columbia Law School (2009), an individual person's identity markers intertwine with a range of historical, social, economic, and political norms of which may contribute to experiences of oppression or privilege, and even discrimination. Intersectionality is a complex concept that supervisors and teacher candidates can

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unpack as they work to understand identity as it relates to personal backgrounds, understanding of who our students are, and teacher stance. By studying intersectionality, this provides an instrument for analysis that helps to expose the interweaving social structural obstacles that create distinct power differentials as it relates to students' race, class, sex, and ability (Crenshaw, 1991). Considering intersectionality can bring to light how specific identity aspects assign power versus marginalization and subordination. Students bring with them the intersectionality of their individual cultural background from their families and communities.

The university supervisor and teacher candidate can focus on the classroom students and consider what cultural factors each individual brings into the science classroom. Students who live in poverty and students of color endure additional challenges that can be prohibitive, thus negatively impinging on access to learning (Howard & Rodriguez-Scheel, 2016). By working to recognize and identify where students may face deficits in the science classroom based on the intersectionality of race/ethnicity and economic backgrounds, the teacher candidate can work to ensure that their teaching addresses the needs of all students. Discussing the issues of intersectionality as it relates to critical education can promote different points of view that will enhance the ongoing analysis of social issues (Collins & Bilge, 2016).

Conducting an exploration of personal ethnic and cultural experiences and how that relates to their individual identities (Zeichner, 1993) takes time. The ability to understand one's own identity and intersection in relation to how it can develop and change based on encounters with other groups increases cultural competence (Williams-Gualandi, 2015). White teachers need to reexamine their assumptions and their practice to learn how this impacts students whose backgrounds differ from their own (Emdin, 2016). Rosalynne Duff (2020) discusses awareness of identity,

You also have to look into the structure of your identity because your identity is wrapped

up in . . . ideology. Because you get it when you're very young. Because when you think

of that internalization, there is the . . . self-awareness, . . . the deep inter-understanding of

how your mind impacts your emotions, in what you think impacts how you feel, . . . [and]

social awareness, that would be aware of how you're showing up, how you're talking to

people, being authentic . . . (ATN *Teaching to Thrive*, 2020).

Teacher candidates may struggle with finding ways to embed strategies for teaching

science that promote equity in their classroom as it relates to their students from different

backgrounds (Russell & Russell, 2014). Howard (2016) emphasizes the need to pay more

attention to self-examination of assumptions and past individual experiences with regard to

culturally and ethnically different communities. This intentional reflective inquiry has the

potential to rectify mindsets that are based upon privilege and steeped in unfamiliarity.

University supervisors collaborating with teacher candidates to unearth and examine their own

identities, assumptions, and philosophies can help to bridge a connection for working with

children from culturally diverse and economically underprivileged backgrounds. For there to be

a shift of perspective, there must be an in-depth conversation with oneself before encountering

the novel set of circumstances of which one does not relate (Carson, 2005). This self-awareness

of differences in cultural realities is the foundation for moving beyond an isolated zone that

affords a luxury of ignorance so that we can critically reflect how our own identity benefits in the

social hierarchy (Howard, 2006).

Reflection and inquiry are important approaches to ensure that there is a framework for

sociocultural awareness of personal identity and how teacher candidates can contextualize their

own experiences and background to advocate for culturally responsive teaching. Through

dialogue about classroom observations and collection of data, areas of economic and cultural disparities that create a pattern of achievement gaps can be exposed. Liu and Ball (2019) emphasize the need for teachers to be able to use problem-solving skills and creativity to help them actively engage and learn from their students by using metacognitive critical reflection. University supervisors need to be well-grounded in their own identity and stance as agents for change so that they can have critical discussions with the teacher candidates. The supervisor can encourage the teacher candidate to become more adept at identifying any patterns or themes of injustice that may emerge within their classroom.

There have been numerous studies that examine teachers' beliefs about teaching science content. Teaching science requires a unique frame of mind for science concepts as they connect to the world. A solid core for identity as a science teacher with a lens for social justice is also important. Findings from a 2017 study by Jordan, et al. indicate that novice teachers from STEM based backgrounds perceive their students and teaching through the lenses of each of their previous experiences in education. The researchers found that STEM teacher candidates hold expectations of student motivation, student academic achievement, and student behavior that are incongruent with the reality they faced in their classrooms. Furthermore, they found that this incongruence between experience and expectations created stress and frustration for their teacher candidates and point out that there will be a struggle to meet the academic, motivational, and behavioral needs of their students. Jordan, et al. assert the need for teacher candidates to be actively engaged in studying and challenging existing beliefs they already have about teaching. Furthermore, the teacher candidates need additional support for classroom management, planning, and other duties as well as specific training to prepare for the work required to work with adolescent development that is student-centered and based on motivational practices (2017).

Avraamidou (2014) conducted a review of 29 empirical studies that examined science teacher identity. The researcher found that there was a general consensus of three primary components to consider when defining and understanding what it means to talk about the nature of science and teacher identity: a) it is created based on social constructions, b) it is fluid and constantly changing, c) and is a multifaceted system of intricate and interrelated underlying factors. Furthermore, this researcher followed up with four primary assertions about science teacher identity development: 1) the study of identity provides a multidimensional lens for development of teaching, 2) science teacher identity plays a contextual role in the development of teachers, 3) the personal backgrounds of teachers in relation to science should be considered, and 4) social markers have an impact on the learning and development of teachers. By understanding this, we gain deeper insight into learning how to become a science teacher, how context factors in science teacher learning and the connections made within the community, and how socio-based characteristics that include culture, emotional experiences, and historical experiences of science teachers impact the science teacher development (Avraamidou, 2014).

Gilbert and Yerrick (2001) found that teachers tracked in schools of poor socioeconomic communities held low expectations for their science students. Thus, the quality of the science instruction was reduced based on a self-perpetuating system where even the students had low expectations for themselves (Gilbert & Yerrick, 2001). The limited exposure to students from culturally and/or economically different communities, can impact the beliefs of teachers about student potential for learning (Johnson & Atwater, 2014). Moore (2008) emphasizes that science teachers can be empowered to teach in ways that affect social improvement when they hold the belief that every student has a right to a high-quality science education.

There are a number of research studies that have spotlighted White teachers' lower levels of expectations for their students of color and students from low-income households based on their subjective perceptions of those students (Dee, 2005; Gershenson, et al., 2016; Gilbert & Yerrick, 2001, Akifyeva & Alieva, 2018). Dee (2005) conducted a study that investigated how racial, ethnic, and gender differences affected teachers and teaching. He found that the perceptions held by teachers, especially in the Southern region of the United States, are affected by the differing aspects between themselves and their students. Too many teachers assign an assumption of failure to children of color and from low-income households and this is connected to the gap in academic results (Howard, 2006). What has emerged from the research is that teachers who are not Black do not hold the same level of high expectations for Black children as compared to the White children in academic achievement (Gershenson, et al., 2016; Vinopal & Holt, 2019).

The university supervisor can work with teacher candidates to increase awareness by acknowledging and investigating how background experiences influence philosophies and beliefs for how all students construct knowledge and learn science. By facilitating a safe and receptive atmosphere, dialogue can go deeper to disrupt the teacher candidates' initial notions for how they view other cultures and embrace their students' backgrounds. It is important that teacher educators work with teacher candidates to illuminate and interrogate the destructive practices of deficit thinking by scaffolding and modeling positive perspectives of urban students to promote competence and confidence in their students' achievement (Bauml, et al., 2013).

Initially, teacher candidates my exhibit resistance to and denial of a need to recognize areas for privilege, power, oppression, and even racism. The privilege of not having to experience marginalization can make it more challenging to open up about underlying

assumptions about other cultures. Some teacher candidates might resist this uncomfortable discussion. There must be an opportunity to reframe self-identify as well as better understand the diverse identities of classroom students who possibly have experienced marginalization and/or oppression. Through the establishment of a safe space to unpack and support the cognitive/emotional growth of the teacher candidates' understanding of areas of identity and privilege, the university supervisor can help to cultivate increased awareness. This agenda is not just to learn new information, but to promote the transformation of teacher candidates who think differently about others (Carson, 2005).

The supervisor can implement collaborative inquiry with teacher candidates which may include sharing and reviewing research literature, lesson planning, cycles of reflection (Jacobs, 2006). Through ongoing reflection cycles within a safe, trusting, open atmosphere, the university supervisor can assist the unpacking of the teacher candidates' background experiences and philosophies while simultaneously scaffolding their growing awareness of the systemic social barriers in their school and classroom. A variety of targeted questions and prompts can be used as a strategy for collaborative investigation about beliefs, assumptions, and attitudes. The university supervisor might probe teacher candidates about their belief structures about teaching students from a range of cultures. Together, they can examine where those beliefs originated, how they have evolved, their connections to cultural differences, and how that cultivates advocacy for equity and inclusivity, and recognition and respect for all perspectives (Jacobs, 2014). Supervisors can guide teacher candidates' use of inquiry by asking critical questions and reflecting about the classroom setting and their developing practice. By making social justice a core objective throughout the internship, the collected data can be analyzed to identify themes and patterns and discuss a plan of action for enhanced approaches for equity.

Advocacy. As teacher candidates refine their understanding of identity (their own and their students), they may be more mindful of and receptive to the role and contribution of different cultural and economic backgrounds when planning and implementing inclusive teaching strategies. By paying closer attention to the voices of students of color and students from low-income households, teachers can examine the underlying framework of the classroom that may be contributing to inequity. The increased motivation and agency for equitable access to learning for all students can transform into advocacy for social justice. The definition of 'advocacy' according to Merriam-Webster (2020) is "the act or process of supporting a cause or proposal". Cohen, et al. (2001) define advocacy as "the pursuit of influencing outcomes – including public-policy and resource-allocation decisions within political, economic, and social systems and institutions – that directly affect people's lives" (p. 8).

Brand (2014) presents advocacy as a targeted approach that ensures there is a sociocultural consciousness to understanding how marginalized students suffer sociocultural disadvantages and how teachers can seek strategies to reverse the harm of exclusion from science by believing in their students' success and helping them to build confidence and transcend feelings of inadequacy. One of the critical jobs of science teachers is to challenge the status quo by questioning "Who does science?" when considering the traditional science curriculum and classroom and to make sure that the pipeline for a STEM track is accessible to all students regardless of their cultural and economic backgrounds (Butler, et al., 2014).

Teacher candidates may notice areas of inequity in their classroom and school and adjust their planning and teaching to better address the needs of their students. They can adjust their expectations by encouraging and supporting their students of color and students from low-income households to achieve at the same levels as White and/or more affluent students. A

deepened awareness can promote a stance for advocacy. Brand (2014) provides a useful and connected description for teacher advocacy,

> . . . a key strategy for teaching students who are socioculturally disadvantaged. . . . is informed by an awareness of how marginalized groups were sacrificed for the common good of the dominant class and consequently might require support to overcome the disparities. Teachers as advocates seek ways to reverse the impact of exclusion by first believing in their students' abilities to be successful and then inspiring confidence in them to overcome feelings of inadequacy. Advocacy is fueled by sociocultural consciousness (p. 68).

With a deeper awareness of the unique and important backgrounds that students of color and students from low-income households bring to the classroom, teacher candidates can advocate for improved teaching and learning opportunities for students of color and from low-income households. Chang, et al. (2011) investigated the capacity and commitment of teacher candidates to work with students of color and students from low-income households by instituting multicultural approaches. The researchers found that by working to create interpersonal relationships across race and social class, the teacher candidates increased their understanding of cultural diversity, recognized the structural inequities, and became advocates for addressing the challenges that the children faced. Catapano (2006) found that by learning more about the culturally diverse communities from which students come, teacher candidates gained confidence in working in areas that they may have held fear or preconceptions about before. The findings from this study reveal that by reaching out to the communities from which their students come from, exploring problem-solving strategies, considering multiple

perspectives, and reflecting about the difference they made in their classrooms, the teacher candidates became advocates for the students.

Advocates for culturally responsive science learning environments will challenge the worldviews that include the hegemony of traditional norms that are stubbornly embedded within the science curriculum, and they will propose new ideas and methods (Suriel, 2014). Once teacher candidates reach a cognitive place where they recognize and acknowledge the process of marginalization that affects students of color and students from low-income households, they can be encouraged and supported in becoming advocates for their students (Brand, 2014).

Supervisors with an objective for social justice provide support to teacher candidates promoting equity within their schools (Jacobs, 2006). The university supervisor can facilitate agency for seeking ways to transform the process of planning lessons that are culturally responsive and teaching in ways that engage students from all cultural and economic backgrounds. When teacher candidates identify patterns of inequity and how the perceived lack of value and worth may be internalized by their students, they can be supported in their advocacy for a more socially just science classroom by focusing their attention on remedying barriers to achievement through lessons that incorporate more of the students' unique cultural capital (Brand, 2014). The aim is to prepare future teachers to teach content through a culturally responsive approach that makes student achievement an attainable goal for all students while also impacting the overall sociopolitical consciousness (Barnes, 2006).

Activism. Attaining a stance as advocate for social justice plays a crucial role in encouraging commitments that transform into concrete future action and activism. Activism spans a broad spectrum of definitions and interpretations. Alsop and Bencze (2014) compiled and edited a book devoted to activism in science and technology education. In this work, they

recognize the varying descriptions of activism and provide this overall guiding explanation. Activism is

> . . . a broad contemporary and flexible concept. . . . [where a] large number of individuals and groups can self-identify within relatively open and empowering ways; . . . brings diverse groups together with sufficiently common but divergent educational and political commitments. . . [and may invite] controversy . . . and as a consequence invites reflection… [and is] action orientated (p. 8).

Howard (2006) recognizes the potential for White teachers to become activists by playing a "powerful reeducative influence in the lives" that they influence each day by focusing "attention, energy, and resources in the actual process of change . . . [by] speaking out against racism when we see it reflected in the words and behaviors of our students, colleagues, neighbors, and families" (p. 84). Teachers can take action that will result in change through their advocacy for those who have been marginalized or oppressed. Working with teachers of color to shift the power from the dominant groups, the traditional classroom power structures can be dismantled.

In the environmental science research by Parsons (2016), an activist is described as those who attempt to bring awareness and concern to the forefront of the unaware public sector. He argues that by taking actions to draw attention to an issue, more can be done to raise awareness and promote concern as compared to just speaking on behalf of the issue. An activist is one who, either alone or collaboratively, through sociotransformative approaches, focuses on social justice within their field, to enact social change (Rodriguez & Morrison, 2019). A sociotransformative method is when researchers seek to find deeper understanding by sharing relevant insights based on historical, sociocultural, and academic aspects alongside their participants (Tolbert, et al.,

2018). Ultimately, one who operates as an activist, puts effort into enacting change within a system.

Moore (2007) conducted a study of 23 elementary science teacher candidates. She found that the participants who were more aware of their self-identity and held agency as science teachers, developed as agents of change by establishing connections with students through science curriculum and pedagogy to connect to the interests and needs of their students. The teacher candidates reported enacting an activist impact only within the individual classrooms where they had direct control over how they taught, how they interacted with their students, their own level of expectations, and how they chose to implement the science content. Morales-Doyle (2017) describes action for social justice as a justice-centered science pedagogy that assumes there is inequity in the classroom that is not isolated. The researcher points out the deeply rooted historical and political problem of inequity and the only way to redress this is to align science teaching with social justice.

According to Cochran-Smith, et al. (2009), there are very few teachers who serve as activists in the field of social justice education. They argue that teachers advocating for social justice promote a wider societal change, which they refer to as "good and just teaching." (p. 349). The university supervisor can assist with intentional implementation of a perspective for social justice activism. Objectives can be established for heightened awareness, support for enactment of a stance as advocate for socially just pedagogical practices, and promotion of teacher candidate transformation to activists working for change in their classrooms and possibly, school communities. By promoting this authentic and intentional posture in the classroom, teacher candidates can observe how their efforts are engaging and empowering for all of their students. Ongoing and consistent interactions that embed a transformational agenda give

teacher candidates multiple opportunities to dig deep into the power structures that exist in their schools and pathways into learning (Howard, 2006).

Teacher candidates may come to view themselves as having the responsibility and capability to operate as agents of change. By actively pursuing and incorporating resources that serve the needs of all students, teacher candidates can become activists for a classroom that is founded on a social justice stance (Brand, 2014). University supervisors can respond to and enact Zeichner's (2017) call for teacher education programs to model the culturally responsive teaching for which they claim to advocate by enacting commitments to social justice by disrupting the power-knowledge hierarchy when working with the teacher candidates.

Through guided mentoring, teacher candidates can learn to define and articulate how equity issues and social justice affect their classrooms. What teachers understand about the diverse backgrounds their students bring to school with them and their ability to differentiate their approaches to work towards a classroom where all learners have equitable access to knowledge and resources in a way that connects their diverse backgrounds to the curriculum goals ensures that all students can learn (Darling-Hammond, 2002). Science teacher candidates who become critically aware of the inequities in science become empowered to initiate strategies and instruments that will motivate their students that can help to reverse the damage that has already occurred to their academic and emotional well-being and take responsibility for expanding this beyond the classroom to the larger society (Brand, 2014). The university supervisor can aid the teacher candidates in learning to identify the current structural systems that marginalize certain groups of students (Atkins & Duckworth, 2019).

Challenges

Teachers new to the field often have a lack of confidence in their capabilities and the associated fears of perceived unruly behavior with students of color and students from low-income households (Bauml, 2013). Teacher candidates may have studied the positive outcomes associated with culturally responsive teaching; however, they may be underconfident in their abilities to actually implement the practices necessary to support this approach due to lack of opportunities to observe and enact culturally responsive practices in a real classroom (Siwatu, 2007).

There is recognition that teacher candidates face a steep uphill climb as novice teachers engaging with an activist stance in their field placements; however, the teacher preparation programs can instill a consistent and strong message of social justice that encompasses the teacher candidates' expectations for equity in all areas of their own lives (Cochran-Smith, et al., 2009). An essential objective is to assist teacher candidates in viewing themselves as potential agents for change who operate within the school community by exploring how they can become effective leaders in organizations where they have a voice and potential impact (Darling-Hammond & Bransford, 2005).

Recall that teachers are predominantly White and middle-class. The objective is to prepare incoming teachers to bring a culturally responsive approach to enact a socially just science classroom environment for students of all racial, ethnic and economic backgrounds. University supervisors can support the preparation and of teaching science within a social justice framework. Tensions may come to light that can present a regression within the relationship between a university supervisor and teacher candidate. In addition, certain challenges may emerge including communication with the site based teacher educators, collaboration with school

communities, classroom and behavior management, confidence levels, effective connections with the families of students, feelings of isolation, and other issues that may arise.

Supervisors can facilitate the investigation by teacher candidates to unearth their own attitudes and philosophies about teaching students of diverse cultural backgrounds. Through honesty, vulnerability, and transparency, both participants can unpack their perceptions and explore any limitations regarding their assumption for the classroom students' potential and achievement. Preparing teacher candidates to engage in dialogue that is centered on social justice and culturally responsive teaching can increase their confidence in teaching students of color and those from lower SES backgrounds (Bauml, et al. 2013). Bauml, et al. (2013) suggest that facilitating cultural integration within teacher candidate training that incorporates university coursework and field placements can promote positive outcomes in their work with students of color and lower SES backgrounds. According to Neri, et al. (2019), the chances that teachers maintain sociopolitical awareness for equity and cultural aptitude increases if they are supported by the access to applicable and relevant culturally responsive pedagogical practices and resources. The supervisor can enact consistent support to promote the development of agency for socially just science teaching.

Site based teacher educators may not be as open to change in the face of current social justice research, practice, and theory. This collegial tension may result in teacher candidates conforming to their site based teacher educator's perspectives and traditional approaches for teaching (Marx, 2006). One challenge as discussed in Lee's 2011 self-study is that the power differentials with classroom teachers can lead to disagreements which hold implications for the belief structures and self-confidence of teacher candidates. This is an area for which the university supervisor has an additional responsibility to mitigate. The work of activism often

entails the intentional effort to engage with other colleagues who may not have historically participated within a social justice framework. As teacher candidates develop and refine their lens focused on equity, they will have opportunities to question inequitable institutional structures and policies and share their objectives with collaborating teachers and field colleagues. Even the simple individual practice of voicing the consistent goal of equity can be powerful transformative stimulus for other educators and stakeholders (Howard, 2006).

Another challenge is that some teacher candidates may go through a romanticized sense of self-congratulatory perception claiming a self-proclaimed goodness based on a complacent approach to social justice work; this can be counterproductive and can merely serve to reinforce social categorization that continues to marginalize certain groups (Bright, 2015). Bright (2015) acknowledges that institutional oppression is not explicitly the fault of current educators; however, the very role of a teacher is such that they are in a special situation where they can adopt a critical constructivist approach to locating and working against social justice obstacles. Admittedly, working for disruption of inequity can be uncomfortable for the teacher candidates. Something to consider is that supervisors need to continue their own deeper exploration of their beliefs and practices simultaneously as they encourage the reflective practices with their teacher candidates (Howard, 2006; Lee, 2011; Loughran, 2006).

Summary

Teacher candidates benefit from the training and guidance of a university supervisor in developing their skills for culturally responsive teaching approaches that will bring about a socially just science classroom. There are many supervision practices that assist in the development of the teacher candidates' commitment to an equitable learning environment that will provide access to resources and empower all students including students of color and

students from low-income households (Banks, 2010). However, there has not been much research devoted to the function of supervision that supports a social justice agenda with teacher candidates (Jacobs & Casciola, 2016), "We believe this is a missed opportunity as supervision can serve as an organizational function to promote teacher learning in relation to social justice and move the ideals discussed in the literature into action within the field" (p. 222).

Research devoted explicitly to supervision for social justice within the secondary science classroom has been challenging to locate. The work of Maulucci and Fann (2016) found that methods for teaching science are not neutral; rather the traditional methods propagate ideas about what counts as knowledge and how it should be taught and to whom. Furthermore, they assert that the organization of schools, the polices in place, the procedural guidelines, and the availability of resources actually perpetuate social inequalities. Based on their study, Maulucci and Fann call for expanded efforts to expose teacher candidates to opportunities for developing their sociocultural awareness as science teachers. Teacher candidates entering the science field placement need ample opportunity to dissect their own intersectionality as related with the wide variety of cultural and economic backgrounds of students in the classroom. The majority of teachers enter into the profession with the privileges of being White and from a wealthier socioeconomic class. It is critical that teacher candidates are encouraged to examine their life experiences and their assumptions about students of color and students from low-income households. Within the clinical field experience, university supervisors can facilitate teacher candidate development to effectively respect and meet the needs of each individual student in the classrooms.

Science teachers can provide their students of color and students from low-income households with a way to gain access to information as it relates to the world around them.

Through the learning of science content, students can find a pathway to develop connections for affecting change in their immediate situations. Through equitable access to science knowledge, all students can gain a sense of belonging and readiness to develop their own voice and become agents of change in their world around them (Zahur, et al., 2002).

Based on the makeup of the demographic climate of today's schools, it is critical that we prepare new teachers by cultivating their own awareness and agency for developing the skills, knowledge, dispositions, assumptions, and high expectations for students of all cultural and economic backgrounds. The work devoted to understanding identity and power structures and its relations to teaching students of color and from low-income households continues to be an area of widespread importance. Cochran-Smith, et al. (2009) emphasize the importance of teaching in socially just classrooms that provide rich learning opportunities for all students and includes broader intentions to question the social, economic, and institutional barriers that certain students may face. As Hodson (2014) states, teachers and students need ". . . to be critical, reflective, robust in argument and sensitive to diverse values and beliefs, and above all to have the courage and strength of will to do what they believe is right and good and just" (p. 94).

In order to teach science that embraces the diversity of all learners and empowers them to benefit from this knowledge, teachers must hold beliefs that all children, regardless of race or economic background, deserve free, equitable access to science learning (Moore, 2006, 2013). When the color of a student's skin or economic status operates as a major determinant in their participation in science, a substantial number of potential scientific talent is lost, and this can undermine any future creation of policy and innovation that can contribute to the field (Hanson, 2009). The complexities of supervising teacher candidates to interweave a social justice approach throughout the science classroom that ensures each student (regardless of cultural or

economic background) is guaranteed access to resources, learning, and equitable practices for academic achievement must be a consistent objective for the university supervisor. The university supervisor and teacher candidates can continuously reassess assumptions, calibrate understanding of the cultural and economic backgrounds of the wide spectrum of students in today's diverse classrooms, and collaborate to ensure that the science concepts reach each and every student in a way that will transform their individual learning and success in becoming future knowledgeable leaders in their communities.

Chapter 3 Methodology

This chapter provides a comprehensive description of the process for this study. After a brief statement of the purpose and the research questions, I will discuss the theoretical framework. This will be followed by a detailed description of the research methodology (self-study design), data collection tools and procedures, brief review of a prior associated pilot study, analysis of the data, and general overview of the self-study. The context of this study in relation to the school communities and my teacher candidates is included as well as researcher positionality. This chapter concludes with a discussion of validity, ethical considerations, and limitations.

Purpose Statement

Equitable access to a quality secondary science education is a critical concern for students of color and for students representing lower economic communities. The purpose of this self-study was to investigate the impact of my supervision practices for implementing an agenda to promote equity awareness and advocacy and activism for social justice with secondary science teacher candidates. The teacher candidates that I worked with for this study were enrolled in a Master of Arts in Teaching (MAT) program, all participating in their final clinical internships. They were all full-time teachers of record, hired by the district, simultaneously completing their university degree requirements.

I participated in this self-study as both the university supervisor and the researcher. My objective was to supervise secondary science teacher candidates to facilitate their development of teaching science within a social justice framework. I explored and incorporated targeted

practices to support the science teacher candidates to teach with a culturally responsive approach. Furthermore, I sought to discover the practices that were the most effective for enhancing the understanding and transformation in the teacher candidates' awareness of inequity and ways that they could advocate for and become activists for socially just science lessons and practices that reach students of all racial, ethnic, and economic backgrounds in the science classroom.

Based on a review of the literature (Chapter 2), cross-referenced with my previous work supervising teacher candidates, I endeavored to determine which practices I could implement to most efficiently supervise the secondary science teachers to develop their awareness of and agency for science pedagogy within a social justice framework. There are three main components that guided this process in researching my supervision practices throughout this study. I embedded supervision practices with the teacher candidates to promote1) *awareness* of identity and inequity, 2) *advocacy* for equity in the science classroom, and 3) *activism* for social justice beyond the classroom.

Through self-study, I conducted a close examination of my supervision of social justice science teaching with four science teacher candidates. The study period occurred over the course of one full semester (Fall 2020), which comprised the teacher candidates' final clinical internship. Each of the science teacher candidates taught as full time teachers in local district public high schools in order to fulfill and complete the requirements for their Master of Arts in Teaching (MAT) degree. Specifically, this self-study examined how my supervision of the teacher candidates encouraged exploration of identity and inequities in the classroom and how that impacted the development of pedagogical approaches that promote agency for social justice advocacy and activism.

The district in which this study takes place is one of the top ten largest in the United States (U.S. Census Bureau, 2019). According to the statistics in which this study takes place, more than two-thirds of school enrollment is comprised of students of color and over half of all students are eligible for free or reduced lunch. Furthermore, approximately three quarters of the instructional staff in this district identified as White (source: State Department of Education in which this study takes place, 2019). The marginalization of students of color and/or lower socioeconomic backgrounds in science fields is due in part to the ethnic, racial, and economic differences between students and teachers. In order to remedy this situation, teachers need to increase their abilities to cross this cultural gap. Specifically, preparation for new teachers entering the field must have experiences in classrooms with diverse student populations.

Through this self-study, my objective was to study my supervision practices to better understand how they enhanced the teacher candidates' awareness for identity as it relates to equity in their science classrooms and also how my practices promoted agency for becoming advocates and activists for social justice as science teachers.

Research Questions

The overall goal of this investigation to was to better understand how my practices as a university supervisor working with secondary science teacher candidates could enhance their awareness of students' identities and any inequities in science classrooms, and also to promote their advocacy and activism for social justice as science teachers. The specific research questions are:

1) What practices can I, as a university supervisor, implement to promote awareness, advocacy, and activism (AAA) for social justice with secondary science teacher candidates?

2) In what ways do these practices promote awareness, advocacy, and activism (AAA)?

3) What have I learned about my supervision for awareness, advocacy, and activism (AAA) for social justice based on my experiences with secondary science teacher candidates?

Theoretical Perspective

The human world-must be studied differently from the natural and physical world because it is so different (Guba and Lincoln, 1990). Humans have the capability to interpret the world around them and thus construct reality based on their perceptions, which are shaped by the cultural factors surrounding them (Patton, 2014). According to Lichtman (2013), use of qualitative research allows for focused study on the social interaction of humans through the use of data based on observations and in-depth discussion which involves thorough observations of people in their natural settings.

The theoretical perspective that guided this self-study is critical constructivism (Kincheloe, 2005). My goal was to seek greater understanding for how my practices as a university supervisor enhanced teacher candidates' awareness of identity and inequities and promoted an advocacy and activist stance for social justice in the science classroom. Critical constructivism encompasses all of the knowledge (including previous experiences and information learned), the interactions of the knowledge, and their effects (Kincheloe, 2005). This can inform reflection on current theories of cognition, explore how those theories came to be, understand how they shape approaches to teaching, and change those theories through investigation of educational purposes and policy, curriculum, and evaluation practices (Kincheloe, 2005).

Critical constructivism is derived from two paradigms, constructivism and critical theory. Constructivism asserts that knowledge formation is socially-driven and not objective. Humans will interpret and form meaning about the world in different ways based on their unique diverse cultural backgrounds. For example, while the moon is an established and absolute reality, interpretations and perceptions are constructed uniquely by each individual, based on the sociocultural factors around them, and cannot be considered as real in an absolute sense. A constructivist looks at the way people construct multiple realities, and the implications of how those constructions impact their perceptions and how they interact with other humans (Patton 2014). Constructivism is based on the activity of constructing meaning for an individual, as a unique experience that makes sense of the world and is considered valid (Crotty, 1998). Critical theory extends the view of how knowledge is learned and perceived as it is managed and manipulated by the dominant cultures and subcultures in power, which includes politics, religion, gender roles, racial/ethnic identities, and personal beliefs (Kincheloe, 2005).

Kincheloe (2005) utilized critical constructivism with his teacher candidates to assist their reflection and cultivation of their consciousness of themselves as prospective teachers; thus, allowing them to step back from the way knowledge is presented in the world and to consider how both explicit and hidden modes of power (linguistics, cultural aspect, race, ethnicity, class, gender, and sexual orientation) influence the acceptance of that knowledge. Furthermore, the critical constructive researcher studies how historical and social processes, and especially the power structures, convene to shape differences in how knowledge is lived and expressed, and eventually move to take critical action for change (Kincheloe, 2005).

There is no such thing as objective knowledge or learning, rather it is a uniquely created process of making sense of the world as it is situated within a sociopolitical context (Malott,

2010). Bricolage, as described by Kincheloe, et al. (2012) operates within critical theory, a commitment to critical social research, and critical pedagogy contributing to emancipatory research. Bricolage involves the process of employing methodological processes to address the needs as the research study unfolds (Kincheloe, et al., 2012).

As the researcher studying the myriad of structures that shape my own perspective, bricolage permitted me to examine the sociocultural situation in relation to my own history arriving at a heightened awareness of the many contexts that interact within the study (Kincheloe, et al., 2012). As a critical constructivist researcher-as-bricoleur, I focused on how the various aspects of the study played a role in shaping my interpretation, perspective, and transformation (Kincheloe, et al., 2012). Therefore, I had to recognize and admit to how subjectivity can lead to limited viewpoints (Steinberg, 2014).

The way knowledge is defined by the world is based on how the dominant groups of humans have established it to be. Therefore, as a critical constructivist researcher-as-bricoleur, I had to ask the following questions with science education in mind, "What is the purpose of schools?" "How do we organize them for maximum learning?" "What is the curriculum, and how do we conceptualize it?" "How do we understand the relationship between schools and society?" (Steinberg, 2014, p. 4).

Kincheloe (2005) maintains the bias within modern science is based on a Western and European perspective that is steeped in dominance and historical superiority. The contributions that came from indigenous peoples are ignored resulting in a production of scientific knowledge that was formulated by constructs of power that largely ignored and even caused harm to vulnerable humans and the environment (Kincheloe, 2005). Aspects of critical constructivism that align with the purpose and design of this self-study include teaching as a way to listen for

students' marginalized voices, learning about students' struggles based on the sociopolitical environment, building deep connections with students' communities, researching alternative sources, applying strategies to find better understanding and solutions to pedagogical problems, and finding a way to understand and meet the needs of students (Kincheloe, 2005).

Positionality Statement

In order to explicitly examine how my personal experiences could factor into my views, assumptions, beliefs, and philosophies as it relates to my work as a university supervisor and teacher researcher, I clarify my positionality, as the researcher conducting self-study. The nature of this qualitative investigation centralizes my position as researcher while in direct connection to my work as a university supervisor. Consequently, this entails a highly interactional relationship with my teacher candidates, of whom I am supervising during my self-study. The way that I designed my study, the data that I chose to collect, the methods I employed to analyze and report that data, were all invariably tied in a subjective way to my inherently biased position as both the researcher and the supervisor.

Qualitative research is based on data collection and analysis that is subjective. While a researcher might strive for objectivity, that is not possible when it comes to working with humans. By stating my positionality, this allows for a clarification of the factors that contribute to the shift from objectivity to my subjectivity as a researcher. According to Bourke, (2014), positionality provides a way for a researcher to consider how their own beliefs, experience, political stance, and cultural background are variables which are framed in a social-cultural context that can influence the research process. Furthermore, it is important that I recognize the groups that I interconnect with while acknowledging who I am as an individual moving within a complex social system.

Prior to this self-study, I spent the previous three years reviewing the research, participating in collaborative experiences with peers in my doctoral program, supervising secondary teacher candidates and practicum students, and working within the university Robert Noyce Program. These were all critical components which contributed to my knowledge and skill base. I was able to explicitly unearth and investigate my own views, beliefs, assumptions, and philosophies about students from other cultural and economic backgrounds. This undoubtedly informed my decision to focus on this area of study and will ultimately result in some level of impact on the nature of this investigation (Hsiung, 2008).

I position myself as a White, middle-class, Jewish, cisgender straight female, non-disabled, science teacher, and academic researcher. In consideration of the aspects of my background, some of which confer privilege, others which serve to marginalize, it is critical that I consider how my intersectionality relates to my work in the field of education.

As a former K-12 teacher, I am immersed in a field of K-12 educators of which the majority is comprised of White, non-Hispanic (79%) women (76%) (National Center for Education Statistics, 2018). As a straight, cisgender female (she, her, hers), I do not face any discrimination based on my gender identity or sexual orientation. In consideration of socioeconomic status, I have lived within a range between lower middle-class into middle-class. These are all areas in which I exist with the associated privileges that social stratification systems perpetuate. I fully recognize and acknowledge that some of the positional aspects of my identity markers afford me unrecognized positions of privilege and power. The other aspects of my person subjugate me to a position of disadvantage on the hierarchy of social stratification. As a female, I face certain biases relative to men based on the historical prevalence of men in positions of power in the United States. As a practicing Jewish individual, my family has

endured a spectrum of microaggressive comments and insinuations as well as overt aggressive threatening behaviors. These aspects have served as deficits in my path. However, the same experiences based on these identity aspects have provided me with perspective.

Referring to the work of Lortie (1975), I am mindful that "what students learn about teaching… is intuitive and imitative rather than explicit and analytical" (p. 62). I consider the work of supervising as collaborative, authentic, within context of daily routines, and embedded within the teacher candidate's job (Nolan and Hoover, 2005). Real-world scenarios do not fit into boxes. Instead, the complexity of the authentic real-world situation necessitates teacher candidates inquiring into ways to resolve challenges and conflicts. I see my role as a university supervisor who is supporting the development of science teacher candidates, as an opportunity to promote inquiry and problem-solving approaches that support a social justice framework in the science classroom.

As a teacher, I have worked in a range of schools including underfunded and underachieving to those affiliated with affluent students and families. The range of school settings and the first-hand observations and experiences have provided me with a wide perspective of classrooms. Schools that are at a severe deficit for resources, quality teachers, and classrooms stand in sharp contrast to the schools that serve communities of greater socioeconomic status (in my work experience, that correlates to middle class, predominantly White).

Admittedly, my stance as a teacher and university supervisor is informed and influenced by my experience as a mother. I allow that my parenting perspective has informed and shaped my interpretation and analysis and approach to my work in education. Regarding marginalization, my children and members within my religious community have had to mitigate

instances of harmful attitudes and behaviors based on our religious and cultural background. To a certain degree, I have felt the discomfort, humiliation, frustration, and anxiety that may provide me with a sharper lens for which to appreciate what those from other culturally diverse groups have experienced. I have a grounded and daily awareness that my children, my friends, and others who worship in the same faith reside in a climate where prejudice and discrimination are present in all regions of the country. I have reflected about how my situation within a smaller cultural group transfers to what I recognize, problematize, and attempt to mitigate in my supervision practices coaching teacher candidates to teach withing a social justice framework.

Pilot Study (Summary)

Prior work with science teacher candidates and a pilot study with a similar research focus served as the catalyst for this dissertation self-study. The findings from my pilot study, conducted in Spring 2019 and Fall 2019 when I supervised two cohorts of secondary science final clinical internship Master of Arts in Teaching (MAT) science teacher candidates provided the groundwork as well as incentive for continued interest and investigation (Arthur, Martinez, & Feldman, 2018, Arthur & Feldman, 2020).

Findings from this pilot study revealed that my science teacher candidates exhibited a deeper understanding of identity and awareness of equity issues in their schools. There was a range of levels of transformation in regard to the increase of agency for social justice advocacy. Expanded open-mindedness was a theme that consistently emerged. Overall, connections and implications for growth and increase of social equity awareness and advocacy were evident in the teacher candidates at the end of their clinical field internships.

However, it was a noticeable challenge for teacher candidates to enact an activist stance based on many factors. Limited time in the classroom, the slow process for building rapport of

which rendered the first cycle ineffective for supervising for social justice, the hierarchal power structure in relation to the classroom teacher, low confidence (the teacher candidates), resistance to restructuring of belief systems, and uncertainty all served as obstacles.

One of the interesting results was my own increased confidence for espousing and enacting the work for equity and social justice within my supervision practices. In some cases, this even extended to the site based teacher educators. This motivated my continued efforts for this kind of work and investigation.
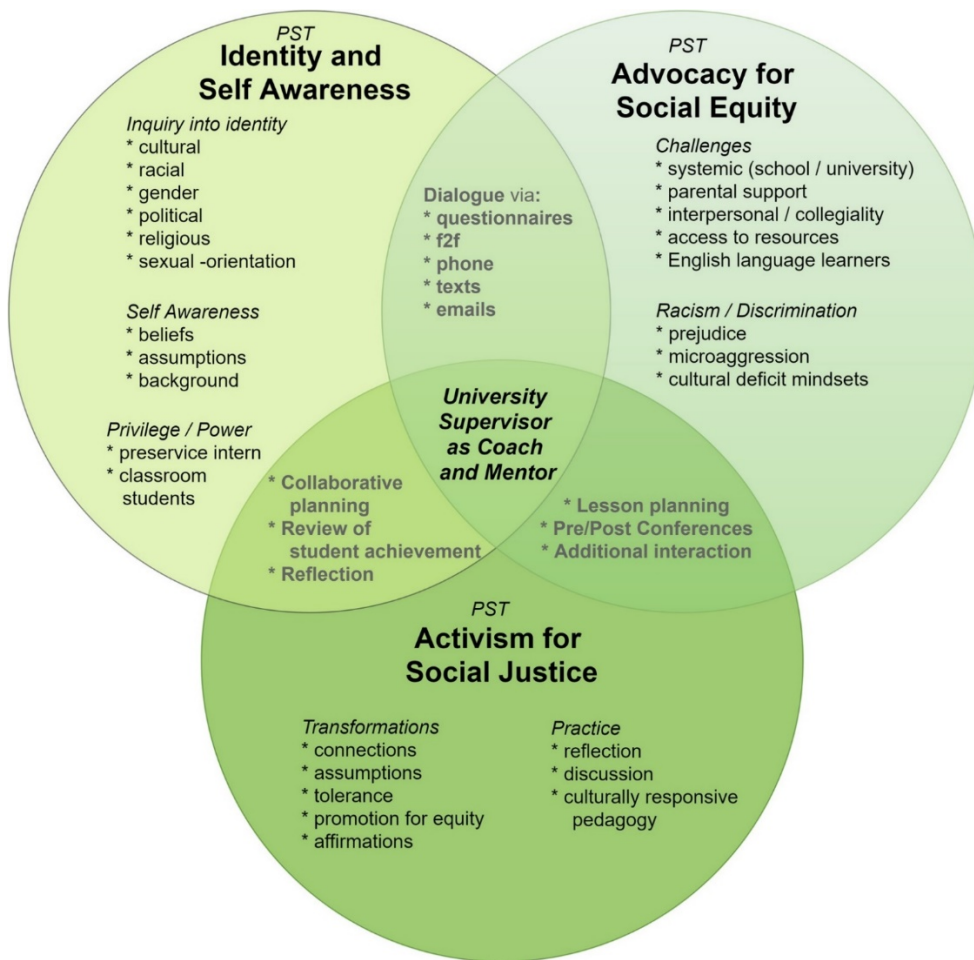
Figure 1. Framework of Supervision for Social Justice in Science

Figure 1. represents the framework that emerged based on the pilot study, which is how I came to recognize three primary themes of awareness, advocacy, and activism for science

teaching based on a social justice science framework. This framework positioned my work as the university supervisor at the conjoined center of the three main themes. Within the overlapping areas of each circle are the methods, approaches, and instruments that aided my efforts. The findings are listed in each of the circles as they relate to any growth in awareness, advocacy, and activism for socially just pedagogical practices for teaching science.

Research Design and Rationale

For this investigation, I utilized self-study methodology. My goal was to expand my understanding and improve my routines of practice for enhancing supervision for social justice with science teacher candidates. The focus was on the transformation that I, as the researcher and supervisor, would go through on both a personal and professional level through this process. By conducting this self-study, I sought to gain a deeper understanding of the meanings that I constructed in relation to how I made sense of my experiences working with teacher candidates (Merriam, 1998). Self-study of teacher education practices seeks "to understand situated human activity from the perspectives of those engaged in it" (Berry & Kitchen, 2020, p. 123).

The findings based on my work with science teacher candidates assisted in my personal development of skills and practices for social justice supervision. The flexibility of the self-study design permitted my personal growth as a university supervisor while uncovering and aligning my platform with practice (Bullough & Pinnegar, 2011). By writing about and sharing my self-study, I hope to continue my own investigation as well as exploration with others in the field. From my study, it is possible that other practitioners and researchers in the field of supervision may gain insight that can inform their practice.

Self-study was originally conceptualized by teacher educators in order to reinvent teacher education through the interrogation of their own practice (Cochran-Smith & Lytle, 2004). This

group included the work of Hamilton, Pinnegar, Loughran, LaBoskey, Russell, Knowles, Bullough, Cole, Northfield, and Korthagen (Cochran-Smith & Lytle, 2004). In 1993, a Special Interest Group (SIG) of the American Educational Research Association (AERA) established the Self-Study of Teaching and Teacher Education Practices SIG (S-STEP). This provided a research design for teacher educators to study their own practice to demonstrate how theory from studies connected with practical inquiry (Hamilton & Pinnegar, 1998). "S-STEP provided a research design for teacher educators to improve upon their reflection in ways that reveal, interrogate, and transform the knowing-in-action that Schön talked about" (Rodgers & LaBoskey, 2016).

Self-study is an interactive conceptual framework that is initiated by the researcher conducting the self-study and is intentionally centered on improvement (Mishler, 1990). It is not possible to separate the self from the research process and educational practice in self-study (Bullough & Pinnegar, 2001). Additionally, self-study often involves someone other than the researcher - the teacher candidate (Bullough & Pinnegar, 2001). Bullough and Pinnegar (2001) indicate that self-study actually focuses on the interactions between oneself and the practice that they are engaged in with others.

In preparation for my self-study, I reviewed and integrated the features as described by LaBoskey (2004), Feldman, et al. (2004), and Schulte (2004). LaBoskey (2004) points out five main features of self-study methodology: 1) it is initiated by the person conducting the study and focused on that same person, 2) it is geared towards improvement, 3) there is an interactive component during the process, 4) it is a qualitative research approach that includes a variety of research methods, and 5) validation is based upon the construction, testing/re-testing, and sharing of ideal models for the practice of teaching. According to Feldman, et al. (2004) the

methodology of self-study consists of three main features: 1) the central focus of the research is the self, 2) the experience of the teacher educator serves as a resource for the study, and 3) both roles, teacher educator and researcher, are problematized. Schulte (2004) suggests that quality self-study will include 1) comprehensive descriptions of the context, data collection, and data analysis, 2) mindfulness in the problematization of the researcher within practice, 3) explanations for how the researcher's practice has changed as a result of the study, and 4) indications for how the study can contribute to the field of teaching.

The production of knowledge in self-study is tied to both context and culture; therefore, the goal was to elicit and confront information that will create deeper understanding and improvement to teacher education (LaBoskey, 2004). Feldman (2002) deciphers the difference between the existence of objects and the nature of humans; objects are constructed to be exactly what they are, and humans are who they *are* as a result of the mix of their historical, biographical, social backgrounds. Therefore, humans are thus in a continuous state of becoming their ways of being (Feldman, 2002). Self-study allowed me to contextualize my own experience practicing and exploring supervision for social justice within authentic environments working with secondary science teacher candidates.

Teacher educators must serve two functions, they contribute to the production of knowledge, and they influence the teacher preparation process, therefore they endeavor to address questions about how to best go about contributing to the ongoing development of teachers (LaBoskey, 2004). "How do I improve what I am doing?" is an underlying question of self-study that guides the process for showing evidence for contributing to improvements in the field of education (Whitehead, 2004, p. 871). By critically reviewing and reflecting on my own practice, I used my individual experiences as evidence to answer that specific question. Ideally,

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the results from my study may contribute to the field and perpetuate further dialogue and exploration.

Self-study is grounded in social constructivism. Gaining knowledge and deeper understanding is processed based on previous experiences which are tied to personal cultural and historical backgrounds (Vygotsky as cited in Cole et al, 1978). This includes confrontation of prior assumptions through practice and interaction with others who hold alternative perspectives (LaBoskey, 2004). The emergence of new understanding of knowledge is tied to beliefs and skills within a complex sociocultural context which, connecting to Lave and Vygotsky, places the learner as an active participant in interpretations and reflections (Garbett, 2011).

Rodgers and LaBoskey (2016) call for an "education for freedom [that] requires the ability to detect oppressive systems and then to challenge and change them for the better. Thus, imaginations must be nurtured, a sense of agency activated, and the ability to interrogate and consider both multiple perspectives and justice itself developed" (p. 72). This connects with the theoretical perspective of Kincheloe (2003) where teacher reflection and research serve as a pathway to empowerment for a more just and democratic education system. Thus, a "democratic reconceptualization of education embraces a vision which takes seriously notions of social justice, racial, gender, and class equality, and alternative ways of seeing the world borrowed from people who have traditionally been ignored" (Kincheloe, 2003, p. 2).

Self-study in science teacher preparation represents a minimal proportion of the overall published research (Buck, et al., 2016; Feldman, 2016). Science teacher educators in-training gain new and innovative research skills within their doctoral programs and self-study has been used more and more to help guide and investigate their own process (Buck, et al., 2016). Specifically, Buck, et al. define self-study in science teacher education

. . . as rigorous, critical inquiry in which . . . science teacher educators – research our theoretical notions of teaching and how they are formed/informed by our own teaching experiences within the academy. The critical component for us, . . . is the centering the science teacher educator and/or their teaching experiences in the research process (i.e., data collection, analysis, and implications). This allows us to focus on evidence-based understandings of professional knowledge. (2016, p. 4)

Buck, et al. (2016) reveal a set of specific goals for self-study research in science teacher candidate preparation: 1) illuminate complexities within science teacher preparation that will perpetuate meaningful discussions that seek to address issues within the professional community, 2) focus on the construction and reconstruction of science teacher identity, and 3) serve as a pathway for support through understanding of science teacher educators in their work to increase professional knowledge. Themes of science based on nature of science, inquiry, and technology combined with areas for social justice transformation through awareness, advocacy, and activism are combined within my supervision practices for science teacher candidates in this self-study.

This self-study drew upon on a variety of data including researcher reflection journal entries, teacher candidates' feedback generated through questionnaires and conversations, the dialogue from and co-planning sessions, and review of semi-structured interview transcripts. Through the frequent and consistent use of a researcher reflection journal, I recorded my observations, interpretations, and reflections throughout the data collection period. I shifted and/or expanded my practices along the way based on the data through reflection and adaptation. I knew that it was essential that I capture as many details as possible from the various encounters with the science teacher candidates. Therefore, I recorded and transcribed some of the interactions.

Critical Friends

In order to incorporate outside perspective and accountability, I invited three critical friends to collaborate throughout the research study. Critical friendship provides opportunity to question assumptions, confront realities (Baskerville & Goldblatt, 2009) and recognize alternative interpretations of situations in practice (Vanassche & Kelchtermans, 2015). A critical friend provides "a sounding board, asks challenging questions, supports reframing of events, and joins in the professional learning experience" (Schuck & Russell, 2005). The inclusion of critical friends allowed for further triangulation of my data. Each of my critical friends pushed back on my assumptions, challenged my reasoning, and questioned my interpretations (Pinnegar & Hamilton, 2009). The critical friends I chose were instrumental to providing me with an outside examination of my personal bias as well as ensuring that any self-justification did not go uncontested (Loughran, 2007). They each related with and held empathy for my area of study and provided feedback that was both honest and meaningful (Feldman, et al., 2018).

I interacted with each critical friend individually (via Zoom, text, phone, and email) throughout the data collection, coding, and analysis time period. I shared sections of coded data, my list of first round open-ended codes, my second round of thematic coding, and section of my findings. They provided the constructive feedback that helped to ensure that how I categorized, coded, and analyzed the data clarified the most forthcoming and enlightening interpretations to thus inform the presentation of the findings and later discussion. A brief description of each critical friend follows (pseudonyms have been assigned).

The first critical friend is Maya. She is a Black female who has taught elementary school for over a decade. She is a Ph.D. candidate conducting her research in elementary education. As a critical theorist, she focuses on areas of equity for Black and Latinx students with regard to

retention. Maya is both a peer in my program and a personal friend. I was most comfortable unpacking the areas of language, descriptions, interpretations based on the data with this critical friend. As a White, middle-class female working within a research study that focuses on my supervision work with other White, middle-class teachers to develop their agency for AAA to teach science that is centered within a social justice framework, it was essential that I had a trusted friend whom I could rely upon for honest feedback. Maya assisted with the phrases and words I used in my first round of coding. She also provided me with feedback to consider as I conducted the second round of thematic coding so as to ensure I was capturing the truest essence of the meanings that emerged from the data. Whenever there was any uncertainty about the words and language to present any of the data, findings, and discussion, I could share the research I located to co-examine and discuss.

The second critical friend, Rosa, is a White female who is a professor of elementary science education at a research institution in another state. Her research focuses on STEM education and socioscientific issues in the classroom. I conferenced with Rosa throughout the data collection period, mostly in small increments with two formal meetings. The peer feedback I received from Rosa served in terms of organization and clarification as well as motivation. I found during my data collection that I was implementing numerous resources into my supervision practices. I struggled with how to keep track of what I was doing and the outcomes. Rosa set up a chart and timeline to help with accountability (writing in my journal in particular). She encouraged me to think about my observations and interactions in a truly reflective manner. In other words, she pushed me to shift my mindset away from simply recording events like a checklist. Instead, she modeled reflection with the use of my journal as a way to question and seek deeper meaning in my reflections. As a result, I used my journal as a place to record

thoughts about any new insights or surprises, when I could be more efficient and truly supportive, and how I would shift my practices. Rosa queried me with probing questions about my second round of thematic coding which helped me to clarify how to structure those themes for my Chapter 4. Through our collaborative sharing of our experiences working with students, she pointed out that I was attempting to subconsciously still 'fit' my emerging themes into what I thought I was originally focusing on (students of color and lower SES). In fact, what I have found is that (for this semester in particular) students from low SES backgrounds are a much larger challenge for teachers than we thought insomuch that it dominated much of the time with my teacher candidates this semester. Rosa continuously challenged me to reveal how the work I was doing could contribute to or change the field of supervision of teacher candidates.

My third critical friend, Martin, is a Black male who works for his district school system as a behavior specialist by providing extended services to the families of at-risk students. He is currently a Ph.D. candidate in the field of education leadership and his research focuses on equity in the education administration workplace. Martin and I have been peers and friends within our program for four years and had already frequently discussed and collaborated on social justice topics, specifically inequity for Black students. I was accustomed to his method of intentional challenging and pushback that had led to uncomfortable but insightful discussions in the past. Therefore, I purposely sought his critical feedback for my dissertation study. Martin was aware through our frequent conversations that I was feeling incomplete, unfinished, rushed, and disappointed at various points during the semester. I struggled with coding my data so that the development of the teacher candidates' awareness, advocacy, and activism might be revealed. There is a great deal of overlap and oftentimes the nuanced aspects of the supervision practices ended up being the most revealing moments of growth in AAA. I also faced frustration

in coding the data that documented how my own development and transformations as a supervisor were revealed, interpreted, and presented. Martin continued to ask for clarification and encouraged me to think about my data from different perspectives and to consider various interpretations. He stated, "The work of supervision for social justice is a process that occurs over several years. This work is a continuation that is not ever finished. One semester is merely a snapshot of what can be done, with the proper guidance. What is important is that you point out where we need to go from here" (2020, December 23).

Study Context

This self-study was conducted within a teacher educator program in a college of education at a research-based university located in an urban setting in the southeastern region of the United States. This research-intensive university is a classified as an R1 (Research 1) institution by the presiding Carnegie Classification of Institutions of Higher Education System. Their published definition of R1 is "Doctoral Universities – very high research activity" (2020). There are over 50,800 students attending this university, from 145 different countries, and almost 3,000 are students in the college of education.

Final Clinical Internship

The university supervisor functions as a teacher educator and coach with the teacher candidates (Costa & Garmston, 2012). The university supervisor supports the teacher candidate with their developing pedagogical skills, reviews and holds meetings for content lesson development and implementation, conducts classroom observations, reflects on outcomes from the observations, and includes an evaluation of the teacher candidate's progress. The job description for a university supervisor includes maintaining open and consistent communication that reinforces support, assistance, and advice within the final clinical internship participation.

The teacher candidates may contact the university supervisor at any time to discuss any matters connected to the final clinical internship. There are times when university supervisors may conduct additional visits to the teacher candidates' classrooms as needed.

Burns, et al. (2016) describe the internship as a "clinically-rich practice". The university supervisor functions as a skilled practitioner who can devote time to observation and feedback that cultivates relationships that will bridge gaps through collaboration and cultivation of learning within the community environment (Burns, et al., 2016). Through a close working relationship between the supervisor and the teacher candidate, the goal is for the internship is to be a fulfilling experience, both personally and professionally for both participants.

There is an overall timeline and set of expectations for university supervisor guidance and intervention throughout the final internship semester that is set by the university. Based on my personal review and reflection at the end of each semester with past teacher candidates, I altered my approach by lengthening the timeline. I arranged an additional meeting with the teacher candidates prior to the beginning of the semester. My rational was to reach each individual teacher candidate before their first day in the classroom in order to increase the efficacy of our time together during the final clinical internship. This was an adjustment of my own that is not a required expectation. I perceived value in creating a time and place for the teacher candidates and I to get to know each other, to understand my position as a supervisor in a supportive role, and to build trust. This will be discussed in detail in Chapter 5.

There are three formal cycles of observation and feedback with an accompanying pre- and post-conference for each. Each cycle of observation is accompanied with a required rubric for evaluation and feedback. Supervisors implement three cycles of observation and feedback with options to provide additional observations, feedback, guidance on a case-by-case scenario.

There are two formative cycles of conferences, observation, and feedback and a final, third summative conference, observation, and feedback. There is a minimum score established by the university program that is required to pass the final clinical internship.

I will describe a typical cycle. First, a pre-conference is arranged prior to the classroom observation. The university supervisor and teacher candidate meet to discuss the intended lesson plan, review the content and standards to be included, modify the lesson plan as necessary, discuss the classroom students, ensure that all students have equitable access to the content and resources, share any concerns, address any challenges, unpack potential tensions, and use inquiry to consider how to best elicit students' thinking and learning. The teacher candidate teaches the lesson, and the university supervisor attends and observes.

During the lesson observation, a variety of techniques are used to capture the various components of the classroom environment, the content, the lesson, the students, the dialogue, and the teacher candidate's approaches for implementing and facilitating the lesson. While the formative evaluation rubric is required, I do not use that during the observation. I fill that out after the lesson has been taught and after the post-conference. I intentionally structure my time this way in order to capture a more complete set of data during the post-conference to guide the process for filling out the evaluation rubric. During the actual lesson observation, the teacher candidate introduces me as a science teacher who is there to observe. I use a blank classroom observation template (Appendix D) as a way to capture and record my observations. This includes interactions between the teacher candidate and students, the teacher candidate's questioning, student comments/questions, student conversations, student work, notations of teacher position and movement in the room, attention towards the students, how students are involved and participating and at what level, and anything else that I notice.

This data recording template is not a required nor standardized tool for capturing data and it is only shared with the teacher candidate. I have found that this serves as an artifact as we debrief after the lesson. I also use a variety of other instruments to capture classroom data such as a seat-mapping strategy in which I document student participation and interaction. By diagramming the classroom, I use a system of codes to quickly indicate location of students and their level and frequency of participation. This is provided to the teacher candidate as an additional source of data for reflection and discussion during the post-conference.

The post-conference is a reflective meeting between the teacher candidate and university supervisor in which the lesson and teaching is reviewed. The various instruments used to collect data during the lesson observation serve as a common artifact to guide the discussion. Through the use of these instruments, the university supervisor can encourage the teacher candidate to seek and identify where there are any incidents and/or examples of inequity of resources, content, interaction with specific.

During the first cycle, the teacher candidates and I schedule additional dialogue in person or through other platforms such as Zoom, email, phone, and text. By opening up additional space for discussion, the teacher candidate shares information about their students in order continue our work to focus on awareness of identities and begin to promote the advocacy for teaching with a social justice lens. With the additional time together, the teacher candidate and I can continue to build towards a trusting and supportive relationship. By the second cycle, there can be more focus on collaborative examination of the classroom students and strategies to teach science that is culturally responsive and contributes so a classroom that is socially just.

I implemented three questionnaires within the final clinical internship timeline (Appendix A, B, and C). I designed the questionnaires to learn more about the effects of my practices of

supervision for social justice in science. These questionnaires, along with the observational field notes from the classroom visits, email and text messages, notes from our meetings, and retrospective interviews with previous Noyce MAT science teacher candidates (who are currently employed and teaching full time) all provided insight. The field notes taken from our prearranged community visits provided perspective about the teacher candidates' culturally diverse schools.

Master of Arts in Teaching (MAT) – Science

The college of education at this particular university, located in the southeast region of the United States, is comprised of approximately 2,200 students and 130 faculty members. Accredited by the Council for the Accreditation of Educator Preparation (CAEP), the educator preparation programs are fully approved by the state's Department of Education. The Master of Arts in Teaching (MAT) Science Education program at this university is designed to train and prepare students to teach science at the middle and high school levels. The four concentrations include: Biology, Chemistry, Physics, and Earth Science (state approved program for certification in all except Earth Science at this time). Students enrolled in the Master of Arts in Teaching (MAT) program take a course load of 39 hours that includes two courses in teaching and learning, one measurement in education course, seven methods courses, one English language learner/English as a second language course, and one final practicum semester-long clinical internship in a field school placement. The MAT students are also required to pass a state-mandated test of general knowledge, subject area exams, and a comprehensive exam specific to the university program.

Robert Noyce Scholars. The university-based Robert Noyce Scholarship Program (under which this study is conducted) is funded by the National Science Foundation (Grant No.

DUE-1439776) and offers $30,000 scholarships to students at this university each year. The scholars competed for the available scholarships by providing transcripts of proven achievement in the field of STEM, two references, and a set of essay prompts. The university Noyce committee met to determine eligibility and awarding of scholarships. This institution-based program is in its seventh year. It is a university-based affiliate of the program and includes a project team consisting of one principal investigator, four co-principal investigators, a university graduate assistant instructor, and myself - a university graduate student program manager who is also the university supervisor for the teacher candidates as well as the researcher in this self-study. The four teacher candidates that I supervised during this self-study began their program in Fall 2019.

The program is designed to assist those students who already hold a STEM-related undergraduate degree but are not certified to teach, to engage in the training and preparation to become STEM teachers in high needs public schools. Recipients of the scholarship receive award funds and other support to engage in a 14-month graduate program which results in the attainment of a MAT degree in mathematics or science education. As the MAT Noyce students enroll in their rigorous course schedules, the university-based Noyce project staff maintain regular contact to discuss students' needs and address issues. Additionally, multiple opportunities are provided to extend their classroom learning, foster community, and provide support and encouragement through Community of Practice, mentoring by the Noyce-based university supervisor, workshops and social events, and opportunities to conduct research and travel to conferences to present findings. (2019 university-based Noyce Annual Report).

My past and current involvement with this program including the prior research and pilot study, served as a motivating factor for this self-study. My objective was to examine how my

supervisory practices could increase awareness and agency for social justice issues in secondary science teacher candidates' lessons and classrooms. The Noyce scholars that I supervised during this self-study was my seventh cohort of teacher candidates. Additionally, the connection with the MAT teacher candidates aligns with my own historical work for many years as a secondary science and math teacher in a range of urban and public schools. I am committed to supporting the increase of science teachers who are prepared to teach science that is culturally responsive and socially just.

The four teacher candidates that I supervised for this self-study were each Robert Noyce MAT scholars who were enrolled in their final clinical internship semester. All four of the Noyce MAT teacher candidates were employed full time with the district and conducted a 'paid internship' in which they worked as a full-time teacher. In other words, they were each the full-time instructors of record for their respective classrooms. I assigned pseudonyms to the teacher candidates.

Seth is a White cisgender male in his mid-twenties and comes from a lower-class background. Seth indicated that he had struggled financially in adult life thus far and had even lived in his car in the past. Seth's students are mostly White with a majority of students from low-income households. Loren is a White (with Hispanic ethnicity) cisgender female and from a middle-class upbringing. She indicated that she attended mostly White K-12 schools where she took a number of advanced and AP courses and excelled academically. The students at Loren's school are predominantly of color and from low-income households. Lucy is a White cisgender female and also from a middle-class background. The majority of Lucy's students are of color and from low-income households. Sienna is also a White cisgender female from a middle-class background. Sienna taught in a high-achieving, highly sought after charter school that is funded

by a local wealthy philanthropist. The school is only a few years old and school lunch program data has not been published. The majority of Sienna's students are Black and Latinx.

The District

According to the statistics and demographic information published by this district, it is the seventh largest school district in the nation with nearly 224,000 students. There are 42 middle schools and 27 high schools in the county that serve a widely diverse population of students including Hispanic (37.1%), White (32.9%), Black (21.0%), multi-racial (4.6%), Asian (4.1%), American Indian (0.2%), Pacific Islander (0.2%), economically disadvantaged (59.0%), exceptional student education (14.4%), English Language Learners (11.1%), Gifted (4.6%), homeless (0.9%), migrant (0.8%). Their position statement on diversity states,

> [This public school district] promotes a welcoming and respectful learning environment in which the diversity of all students is valued. We recognize that the racial and ethnic diversity of our students contributes to successful academic outcomes. We are committed to the elimination of systemic disparities by implementing systems and practices that strengthen and support equitable practices. The School Board and Superintendent lead from a system-wide racial equity plan that stands on three critical pillars: 1) family, student and community engagement; 2) leadership; and 3) teaching and learning. By addressing root causes rather than finding technical solutions, the district will offer adaptive solutions to raise academic achievement and provide opportunities for all students (local district's Strategic Plan, updated January 2020).

Data Collection

In order to develop a heightened self-awareness and self-improvement for understanding how my work as a university supervisor impacted my routines of practice for implementing a

social justice approach with science teacher candidates, systematic data collection was vital (Alan, 2015). A characteristic that sets data collection in self-study apart from other qualitative types of research is that the researcher in self-study takes a central and active role in the dialogue with the teacher candidates (Alan, 2015).

A variety of data collection sources are necessary for self-study (Berry, 2008; LaBoskey, 2004). Therefore, I implemented a variety of methods to assist my collection of data. My data collection sources centered on my intent to investigate my practices for social justice science teacher supervision. Specifically, I endeavored to collect and analyze data that would 1) document the actions and strategies that contribute to effective routines of practice that I used as university supervisor, 2) document interactions between the teacher candidates and myself, 3) document the learning and development for social justice science teaching with each of the teacher candidates, 4) make explicit any challenges that emerged, and 5) gain a heightened introspective insight into my own transformation as a university supervisor.

Data Sources.

In order to provide a wide range of data that would elicit honest, grounded, authentic responses, a variety of strategies were implemented during this period of study. This also allowed for triangulation of the data later during the analysis stage. Each of the resources or strategies listed here were utilized within my supervision practices. They each provided a range of insightful data for analysis. A brief description of each of the data collection strategies follows.

Field Notes from Community Visits. Before the semester began, each teacher candidate and I visited the local community that each respective school represents. Through the use of the district boundary maps we identified the community that each field placement school serves. My

hope was that by adding a grounded connection to the students' communities, the teacher candidate could gain a better perspective of their classroom students.

Classroom Observations. All field notes and observations were recorded during classroom visits using the Classroom Observation Data Collection tool (I created this with Microsoft Word, see Appendix D). All observations notes were recorded using my personal password-protected computer. A variety of techniques were employed in order to record observations of the classroom environment, the content implementation, the lesson as it was taught, the behavior and participation of the students, the discussion and dialogue that occurred, and the teacher candidate's action of teaching and working with students. Using this data collection tool, I typed everything that I observed in the classroom. Beyond the teacher candidate explicitly teaching, I also recorded my observations of whole class, small group, and paired interactions. This included the questioning style and level, comments/questions from students, student work, notations of teacher presence and movement in the room, attention to students, level and type of student participation, and anything that seemed to be an area to consider in our post-conference. Use of this data collection tool provided a method to record classroom atmosphere, student participation and interaction, teacher candidate interaction with students, and other such relevant information that created artifacts for the follow-up post conference. In my past work with teacher candidates, I had found that this classroom observation data collection tool used in conjunction with conferences and meetings with the teacher candidates promoted a student-centered and content-focused discussion. After each classroom observation, I recorded more elaborate reflections in my researcher journal in order to retain the thick data so that it would not fade from my memory (Spradley, 2016).

Questionnaires. I included three questionnaires devoted to the social justice topics that covered within each of the three observation cycles (Appendix A, B, and C). The first questionnaire covers identity, intersectionality, and equity. The second questionnaire delves into social justice and the differentiation between advocacy and activism. The third questionnaire addresses transformations in philosophies of teaching and learning through reflection. I incorporated the data collected from the questionnaires into each of the pre-conferences and co-planning meetings with the teacher candidates.

Notes from Pre- and Post-Conferences and Co-Planning Sessions. Each of the three cycles were precluded with an official pre-conference meeting. This occurred via virtual meetings (Zoom). After each classroom observation, the teacher candidates and I met for a post-conference. Most of the time this occurred in-person immediately after the lesson observation. On a few occasions this took place at a later time via virtual meetings due to the teacher candidates' schedules. The teacher candidates and I also co-planned for a lesson. I infused a focus on ensuring that the content and method of delivery was equitably accessible and culturally responsive to all learners in the classroom. We discussed strategies to differentiate the lesson in order to reach students and connect to students' backgrounds.

Personal Researcher Reflection Journal. Many education experts including Dewey, Schön, and Zeichner have pointed to reflection as a way of knowing about our actions. Keeping a reflective journal is a widely used way for teachers to record their thoughts, ideas, and reflections (Göker, 2016). The reflective journal process can help guide reflections with a clear purpose (Mueller, 2003). The data I recorded included factual data, descriptive data, interpretive data, and inferential data, all of which helped me to "develop a more profound understanding of [my] practice situation . . . [which helped me] to reconstruct it later . . ." (Feldman, Altrichter, Posch,

& Somekh, 2018, p. 23). I started a personal reflective journal prior to the beginning of the semester. I began with a review of my past notes and reflections from previous work with science teacher candidates. I recorded considerations and questions that I had about my work in supervision for social justice up to that point. I included my updated objectives and plans for the upcoming period of self-study in which I would be collecting data based on my work with the Fall 2020 science teacher candidates. Throughout the semester of which the study took place, I reflected on the notes from all meetings and interactions, recorded any new findings and insights, and recorded my general thoughts, ideas, and questions. The personal researcher journal provided me with a platform for organizing my observations, recordings, and reflections. Within the journal, I maintained references for the details and descriptions of all meetings, conversations, and issues related to my work with the science teacher candidates. Within the dated entries, I also contemplated new insights, connections, questions, and areas for further investigation or follow-up. The personal researcher journal is one single Microsoft Word document and is stored on my personal password-protected laptop computer.

Data Collection Table

The overall goal of this investigation to was to better understand how my practices as a university supervisor working with secondary science teacher candidates could enhance their awareness of students' identities and any inequities in science classrooms, and also to promote their advocacy and activism for social justice as science teachers. Again, the specific research questions are:

1) What practices can I, as a university supervisor, implement to promote awareness, advocacy, and activism (AAA) for social justice with secondary science teacher candidates?

2) In what ways do these practices promote awareness, advocacy, and activism (AAA)?

3) What have I learned about my supervision for awareness, advocacy, and activism (AAA) for social justice based on my experiences with secondary science teacher candidates?

Table 2. indicates how each of the various data sources provided information and insight for answering each of the research questions.

Table 2. Data Sources / Research Question Matrix

RQ	Field Notes - Observation Classroom Visits	Field Notes - Community Visit / Pre-semester Meeting	Questionnaires	Notes from Pre- and Post-Conferences and Co-planning	Reflective Journal
1	X	X	X	X	X
2	X	X	X	X	X
3			X		X

Data Storage and Security

All data remained confidential at all times throughout the study and afterwards. This includes all field notes, emails, text messages, questionnaire responses, transcriptions of interviews, researcher journal, and any other sources of sensitive information collected during the period under study. The data was stored on my personal password-protected computer and in my password-protected university Box account. Box is a secure, password-protected cloud-based data storage system of which the university under which this study supports.

The online transcription application, Temi was used to transcribe audio-taped interviews. I maintained and will continue to maintain sole access to this private account. Each audio file was removed from the Temi account after downloading the transcripted text file. I immediately reviewed each transcribed interview to ensure accuracy of the recording by re-listening to the

audio file while making any necessary corrections to the transcript. After finalizing the transcription, I deleted the interview data from Temi.com. All data will be permanently destroyed five years post completion of the study.

Data Analysis

For the data analysis of this study, I applied the qualitative approaches of Saldaña (2009). Qualitative research may include the practice of developing codes that emerge straight from the data (Linneberg & Korsgaard, 2019). Coding is a construct generated by the researcher who applies a symbol that contributes to meaning and can be considered an essential link between the data and finding an explanation for the meaning (Charmaz, 2001).

In order to maintain a transparent and exploratory perspective for analyzing my data, I started with a descriptive, open-coding approach (Saldaña, 2013). According to Saldaña (2013), this approach entails iterative rounds of coding, of which codes are used to generate categories and themes, also called thematic analysis. Saldaña (2009) defines categories as "variable qualities that display the range or distribution within similarly coded data" (p. 42) and themes as "an outcome of coding, categorization, or analytic reflection, not something that is, in itself, coded" (p. 139).

As the researcher, I examined the text of the actual data to locate initial codes, as opposed to a using any *a priori* sets of codes. I started by seeking and generating inductive codes which helped to ensure I was making a connection with and giving a voice to the data of which would aid in finding themes later in the process (Linneberg & Korsgaard, 2019). This process included reading and re-reading the raw data, using notes to identify ideas, referring to resources, seeking new enlightenments, and posing questions and wonderings. Furthermore, during this initial

inductive cycle of coding, I established an overview of the data which also facilitated the search for patterns and themes in the later coding cycle (Linneberg & Korsgaard, 2019).

Codes were assigned to each data set. Codes are words or phrases that categorize information into meaningful portions of data that have been gathered during the study (Miles, et al., 2014). I established the codes as a way to condense larger portions of data by using nouns and brief phrases to signify concepts in the data that are observable (Miles, et al., 2014). The specific ways in which researchers choose to name their codes are related to the research questions and the processes they take to create their codes (Miles, et al., 2014).

I used the software program, MAXQDA to assist in my data analysis. MAXQDA is a "comprehensive program . . . used by thousands of researchers in more than 150 countries around the world" (MAXQDA, 2021). I had an introductory level of knowledge about the program based on my use in a previous qualitative research course in my program. I reviewed the tutorials to learn more about the numerous analysis tools, charts, graphs that were available to assist my search for meaning from the process. In the program, I set up four folders in which I stored all items of collected data from the study: Conference Transcripts/Notes (7 documents), Observation Notes (11 documents), Questionnaires (12 documents) and My Self Journal.

I began by using a descriptive open-coding process to analyze the data that I collected throughout the semester. I reviewed each document in the order that the events occurred. As I read through, I used the highlight function in MAXQDA to notate and designate new codes. My codes were all descriptive phrases that succinctly summarized the content/issue of the text selection. This was completed at all times with my research questions in mind. As I worked through the data coding process, I created new codes and/or used existing codes I had already

created during this initial open-coding process. I included memos for codes when I needed to notify myself of a specific topic for later focus or delineation.

I coded in two primary time periods during the semester, midpoint (all teacher candidates had completed cycle one and were in the midst of cycle two) and then at the end of the semester when all data was in (third week of November). After the midpoint of the data collection period, I sent a set of coded text (with all names anonymized) as well as my code chart to two of my critical friends for their review and commentary. We met to discuss my preliminary codes based on samples from the data. They asked clarifying questions which helped me to refine my coding to ensure that my codes were indeed capturing the data in ways to help my search for meaning and themes.

My first round of inductive descriptive coding ended up with 48 codes and 1,549 coded segments (see Appendix G for a table of coded segments and Appendix H for a bar graph representation). The MAXQDA program offers a variety of data analysis tools which assisted my search for patterns in the codes. The program culls and organizes only the coded text which allowed me to have a more direct access and interpretation of my initial inductive descriptive codes. I sent my updated list of round-one codes along with additional sets of coded data to the same two critical friends for continued inspection and discussion.

Descriptive coding leads to an inventory of categories of the data and establishes the groundwork for a second round of coding for continued analysis (Saldaña, 2009). According to Saldaña (2009), the second cycle of coding methods provide advanced ways to reorganize and reanalyze the data coded from the first cycle which develops categories and themes about the overall data. Pattern coding (Miles, et al., 2014) is a way to group the coded summaries from the first round of coding into specific categories or themes. The pattern codes are explanatory codes

that cluster the coding from the first cycle into succinct but meaningful units of analysis (Miles, et al., 2014).

Table 3. Second Round of Pattern Codes and Themes

Code Tier	Pattern Code Themes	Code Abb.
Top	University Supervisor - Supervision	US-S
Sub	Practices for AAA	P
Sub	Science Teaching	S
Top	Teacher Candidate Outcome	TCO
Sub	Awareness: Identity / Inequity (self / students)	A
Sub	Advocacy for Culturally Responsive Science Teaching (culture/ethnicity/race/SES)	AD
Sub	Activism	ACT
Sub	Challenges	C
Top	University Supervisor Transformation in Supervision	US-T
Sub	Learning	US-L
Sub	Beliefs	US-B
Sub	Practices	US-P

In my second round of coding, I created categories based on the initial code list (Gioia, et al., 2013). This process moves the researcher from having a larger number of codes to having a smaller number of higher-level themes or categories (Linneburg & Korsgaard, 2019). Thus, codes may emerge that are more analytical in nature and thus emphasize patterns and themes within the data (Linneberg & Korsgaard, 2019). In my second round of coding, I reviewed the codes from the first round to assess their commonality and then assigned them a pattern code (Table 3.). These pattern codes thus functioned "as a stimulus that develops a statement that describes a major theme . . ." (Saldaña, 2009, p. 154).

I printed out and posted on my wall the various charts and tables from the first round of coding that I created using MAXQDA. I returned to the raw data as I examined the tables and charts to identify patterns and themes and how they converged in relation to the teacher candidates and various situations and topics. This process provided me with additional insight into the data and enhanced my recognition of emergent themes. It was instrumental in clarifying the supervisory practices that addressed my research questions. I met with the same two critical friends along with a third critical friend to review my second cycle of pattern coding and the themes that I found from this process. The third critical friend and I discussed each in terms of their relation to my research questions and we refined the wording to represent the emergent themes. Table 3. exhibits the themes that emerged based on the second cycle of pattern coding.

Validity and Reliability

Judging the reliability and integrity of the research findings requires researchers to make judgements about how 'sound' the research is as it relates to the appropriateness of the application of the methods (Noble & Smith, 2015). Validity is a structure of clarified expectations and methods for assessment to use in qualitative research to evaluate the quality (Feldman, 2007). There seems to be a wide spectrum of perspectives for addressing qualities of validity and reliability in qualitative research. Some of the common, interchangeable terms include authenticity, goodness, verisimilitude, trustworthiness, plausibility, validity, and credibility can cause novice researchers (such as this researcher) confusion and frustration (Creswell & Miller, 2000). Guba and Lincoln (1989) point out the criteria that make up trustworthiness: credibility, transferability, dependability, and confirmability which can be compared to quantitative research expectations for validity, reliability, and objectivity. Of note, in his work with qualitative based action research, Feldman (2007) recommends that researchers

should be attentive to validity because of the moral obligation and political nature of the work as the practice influences other people.

Therefore, the credibility, validity, and reliability of this study addresses issues such as whether the findings of the study make sense, are they credible to those who read it, and is there authentic representation of what I am investigating (Miles, et al., 2014). Trustworthiness or rigor of a study refers to the degree of confidence in data, interpretation, and methods used to ensure the quality of a study (Pilot & Beck, 2014). Trustworthiness served as the base for validity (Mishler, 1990). Feldman (2002) argues that researchers must prove validity of their self-study research beyond basic written and published value, stating that there are moral aspects and political factors of educational research that must be considered. The intent of self-study is to go beyond the investigation of oneself; it is to provide information that can inform and improve practice for others in the field. Demonstrating validity in a self-study can be achieved by ensuring that the work is substantiated and corroborated though fair and just approaches. Furthermore, if the purpose of the scholarly work of self-study is partly to provide useful information for other educators in the field, this information could have implications for policy-making and thus becomes political (Feldman, 2002).

By recognizing self-study as a way to better understand and change my practices (Feldman, 2002), it was critical that I maintained trustworthiness and credibility. Validity of interpretations were reinforced through the inclusion of a variety of multiple data sources, cross-checking, and comparing perspectives of teacher candidates during the data gathering and analysis process (Samaras, 2011). Additionally, the detailed methods I used to collect data and my inquiry have been made transparent so that others can publicly review and critique them (Feldman, 2002).

In order to ensure an appropriate level of credibility in this study, I used a combination of strategies including prolonged engagement, persistent observation, and triangulation (Guba & Lincoln, 1989). I relied on Creswell and Miller (2000) to guide my use of triangulation by implementing and analyzing multiple sources of data to seek areas of convergence.

Critical peer review provided outside perspective that helped me to ensure that the methods, data instruments, analysis, generation of meaning, and overall interpretation of this investigation were as complete, clear, and informative as possible. Critical peers consisted of those friends familiar with my research who communicated regularly and provided rich and truthful feedback (Feldman, et al., 2018). I specifically reached out for review and feedback from a critical peer with knowledge and experience of coding qualitative data. I had the opportunity to serve in this capacity for her dissertation, so had practice for reviewing research to address coding.

Subjectivity and Bias

A qualitative researcher seeks understanding of a phenomenon within its context using a variety of data sources (Baxter & Jack, 2008). By asking questions that focus on the 'why' and the 'how', qualitative research provides a way to investigate human behavior and experience to find meaning and interpretation (Lichtman, 2012). My hope was that this study would further inform and guide my own practice as a university supervisor in a way that is transferable to others who work in this field.

For this self-study, I functioned in the dual role as researcher and university supervisor. I conducted the self-study based on my work with science teacher candidates while simultaneously supervising them. As I navigated my supervision practices for promoting awareness, advocacy, and activism for social justice with secondary science teacher candidates, I collected data that

would provide insight for my self-study. Teacher candidates were provided with a full explanation of my dual role as a researcher conducting this self-study while concurrently working as their university supervisor.

As discussed in detail in the next section, teacher candidates received and signed an informed consent form. This informed consent form described the study with a non-pressured option to choose to not be considered in my self-study for any reason and under no consequence. Through the use of my researcher reflective journal, I consistently reflected upon my personal reactions and feelings throughout the study in an effort to identify any potential instances of conflict of interest. I maintained accountability by reviewing the data as objectively as possible.

Ethical Considerations

For the stated purpose and nature of this self-study, I was not required to receive IRB approval. Please see Appendix I for the letter stating, "The IRB determined that the proposed activity does not constitute research involving human subjects as defined by DHHS and FDA regulations. IRB review and approval is not required" (Study 001346 application, 2020). However, I did proceed to collect informed consent forms from each of the teacher candidates that I worked with prior to the period of study. This informed consent form fully disclosed the purpose of this self-study as well as the option to withdraw from the study at any time (Appendix E). At no time will any personal, identifiable information regarding any of the teacher candidates be revealed and/or discussed beyond the scope of my committee. As previously described, strict measures will be taken to ensure privacy of all data and proper secure storage.

In order to establish early rapport with the teacher candidates, I began meeting with each during the Summer of 2020. I should note that I had already briefly met the teacher candidates in the past when I served in the role of the Noyce program manager. This occurred in the late spring

or summer of 2019. However, the relationships with each teacher candidate began anew under different premises. I met with each teacher candidate in a face-to-face format with the intent to establish an environment of support, trust, and rapport. I recognize the potential power differential of my role as the university supervisor with the teacher candidates. My objective was to ameliorate the atmosphere so that it quickly evolved into a collaborative working relationship.

In an effort for full disclosure with the teacher candidates, I shared my own experiences as a teacher candidate as well as novice teacher through narrative and dialogue. My hope was that they would view me as someone grounded in their reality and their experience. This included providing transparency in revealing insecurities, mistakes, and the lessons that I learned from my own experiences as a former teacher candidate.

Limitations

There were some limitations that should be disclosed. Time was a constraint, therefore there was a limited timeline during which the final clinical internship took place (one semester). Considering the scope and breadth of the concepts and issues included in my self-study in conjunction with the basic pedagogical mentoring and supervising, I realized that my objectives may have been overly expansive for the time period.

Even though this was a self-study, I still should consider the positionality of my being the researcher as well as the teacher candidates' university supervisor. I was mindful of presenting full disclosure of my objectives and agenda before the semester began. However, some participants may have been reticent at times with various topics. I did not sense any direct resistance from the teacher candidates but cannot be entirely certain. There is also an issue of power differential that must be considered. Even though the majority of my role serves in the capacity as a supportive mentor or coach, I also function as their evaluator (using the university

program formative and summative evaluation rubrics). This component of the evaluation comprised a minimal portion of my work, however teacher candidates may perceive evaluation differently since it directly affects their standing for completion of the internship.

Trepidation at providing honest and forthcoming responses and reactions may have been a challenge for the teacher candidates which might have affected the data. Therefore, it is hard to detect the true essence of trust they placed in our relationships. While there was intentional effort on my part to establish early relationship building to increase trust, I cannot know for sure if the data I collected is as open and rich as I sought.

Qualitative case study research is based on studies of a small sample size. My self-study was based on my supervision of only four teacher candidates, which may be a relatively small number. Therefore, the results and analysis that informed the discussion and its viability for transferring to other situations may be viewed as a limitation. While I enlisted the reflective and critical feedback of my peers and committee, I recognize that my own perceptions, beliefs, assumptions, experiences all factored into what I wrote in my final report. I assume that other researchers in this field may view the data that I collected and generate a different analysis.

A delimitation that I should mention is that I am choosing to focus this study solely on participants in the National Science Foundation Robert Noyce Scholars Program. I did not include any teacher candidates outside of this program.

Transferability

Transferability refers to the magnitude to which research results can be applied to other situations where the context is different (Lichtman, 2013). While the researcher sets forth a recommendation for transferability, based on purposeful sampling and thick descriptions, the burden of proof is placed on the person who wishes to apply the results from the research study

(Bitsch, 2005). Thick descriptions include detailed depictions of the investigation based on participants who were selected purposefully, and it is the researcher's role to ensure this occurs (Annay, 2014).

As discussed in the Limitations sections, there were only four teacher candidates whom I focused my work with for this self-study investigation. The nature of the study is qualitative and warrants a critical awareness of the positionality of me, as researcher, who was involved in the actual collection of and analysis of data. There has been a shift to considering transferability in qualitative research, which runs parallel to generalizability. Denzin and Lincoln (2013) argue that there is an overvaluation of formal generalization; transferability and "the force of example" are underestimated (p. 179).

My intention is that the findings from this study might be transferable to other research investigations and the work of other supervision practitioners. The multifaceted work of my supervision produced data that may provide additional insight into how supervision can promote a heightened awareness of, advocacy for, and activism for socially just teaching strategies with science teacher candidates.

The National Science Foundation's support of the Robert Noyce Scholars Program at this university provided the funding and structure to create a program for recruiting, preparing, and sending knowledgeable and effective secondary teacher candidates and new science teachers into the high-needs districts that serve students of color and students from low-income households. Dedication to equity and teaching through a social justice lens, the Noyce MAT scholars work in schools that are in critical need of qualified science teachers. This core objective and initiative to prepare high-quality teachers to teach in the classrooms that are demographically diverse in race, ethnicity, and economic status is an underlying component of the NSF Noyce program. It is with

this foundational purpose that I as the university supervisor was committed to aligning with, advocating for, and promoting equity and social justice in science teaching with each Noyce MAT teacher candidate.

Summary

In this chapter, I provided the rationale for investigating my work as a university supervisor to promote awareness, advocacy, and activism for social justice science teaching with secondary science teacher candidates through self-study. I elaborated on my purpose of this study within the theoretical framework of critical constructivism. I included a brief review of a pilot study that informed the objectives for this self-study. By including a description of self-study, I aligned this with my research questions and purpose. I illustrated detailed information about my methods for data collection as well as the data analysis process. This demonstrated how my data collection methods and analysis aligned with self-study design. In order to maintain validity and reliability, I discussed my strategies. I also clarified my subjectivity, potential bias, and ethical considerations regarding the work I conducted for this investigation. Lastly, I made the limitations explicit and considered the transferability of my research. The next chapter will reveal the findings from my self-study.

Chapter 4: Findings

Introduction

Based on the analysis of the data through two rounds of coding, multiple reviews of the raw data sources, and feedback with critical friends in order to employ triangulation, I unearthed a number of insightful findings. In order to present the findings that most efficiently and effectively represent fullest fidelity to the integrity of the expansive nature of this study, I address each of the research questions separately in the sections that follow. In the first section, I incorporate the use of a composite narrative to present the findings that emerged for the first research question, which addresses the practices for social justice supervision in secondary science. The second section addresses the ways that these practices impacted the teacher candidates with regard to their development of awareness, advocacy, and activism for social justice within their pedagogical development. For this section, I devised pseudonyms for each of the four candidates in order to share exemplars from the data. In the third section, I present the findings for my own learning, and transformations, as a university supervisor working to develop and enhance my practices for promoting AAA for social justice with secondary science teacher candidates.

Practices to Promote AAA

The first research question of my self-study asks: What practices can I, as a university supervisor, implement to promote awareness, advocacy, and activism (AAA) for social justice with secondary science teacher candidates? Based on the analysis of the data, I found that my practices for supervision for social justice with secondary science teacher candidates fell within

five main areas: 1) establishing and maintaining an open/trusting relationship, 2) incorporating targeted focus on social justice (through awareness, advocacy, activism), 3) problem-solving for challenges, 4) networking with others to expand ideas / resources, and 5) reflecting as a catalyst for shift.

For ease of reading purposes, I have combined my experiences supervising four science teacher candidates during this study into one fictitious teacher candidate who I have named, Ann. Ann is a White female from a middle class background. She described her K-12 journey as a positive experience where she earned high grades and enrolled in some AP courses in high school. She shared that most of the students at the schools she attended were White and she grew up in similar economic conditions. In order to report the findings with fidelity to authenticity for my first research question, I developed a composite narrative about the fictitious teacher candidate Ann, who represents a composite of the four teacher candidates. Since the majority of my data contained narrative modes of thought, I was able to investigate the distinctive aspects of the actions of the teacher candidates with regard to their "spatial and temporal peculiarities" (Feldman, et al., 2018, p. 204). By reviewing the narrative data for all of the teacher candidates and recreating the events of the semester through a composite story, I will display the outcome of the analysis for this research question (Kim, 2016). I used a tactic of emplotment as a technique to combine the events, actions, and happenings of four otherwise unconnected teacher candidates to produce a coherent whole story which allowed me to make sense of the data in a way that I could also report it for others to follow (Feldman, et al., 2018).

This composite narrative represents how I utilized a variety of tools and strategies to support the practices that assisted my supervision for awareness, advocacy, and activism for social justice in science teaching with teacher candidates. Written based on my supervision of

four secondary science teacher candidates during the Fall 2020 final clinical internship period, this narrative will reveal the emergence of five primary practices that I implemented. This composite narrative includes the various resources that I integrated, key instances of supervision that addressed equity and social justice in the science classroom, and the associated findings.

Before introducing the composite narrative, I include here a brief explanation for the underlying guidelines that I used to collate the data and report the findings from my supervisory work with four science teacher candidates into one composite. This includes the characteristics of data as described by Feldman, et al., (2018) which guided my decision for which data to include in this composite narrative. I acknowledge that the data is selective, theory-laden, and static. First the data is selective because I have captured only such data that I could record during the times of interaction and then subjectively chose the data to include in this composite narrative. Second, the data is theory-laden because as the researcher, I have transformed "personal experiences into data, [thus] the degree of interpretation is . . . larger" (Feldman, et al., 2018, p. 116). Third, the data is static. The events have already occurred, been recorded, and analyzed. Furthermore, by presenting the findings based on the composite narrative, I utilize the first rung of the "ladder of inference" (Argyris, 1983 as cited in Feldman, et al., 2018). In other words, I have adopted a "relatively unambiguous representation of events as they were accessible to observation" (Feldman, et al., 2018, p. 117).

In preparation for this self-study, I spent the months leading up by reviewing and reflecting on my previous practices in my work as a university supervisor. This included observation notes, transcripts of conferences, notes from conversations, emails, my self-reflections, as well as the pilot study mentioned in chapter three. I continued to read and collect ideas from the research to add to my strategies for supervising science teachers that centered on

objectives for awareness, advocacy, and activism for social justice in the science classroom. I

closely followed the news commentary from a variety of resources that covered the socio-

political landscape during a pandemic and a volatile election year. I also followed a variety of

podcasts that covered social justice in the classroom. Many of these, I saved and time-stamped

sections to send to my teacher candidates to discuss within the context of their classrooms. I also

consulted with the leader (senior pastor) of a local Black church seeking further guidance. This

preparation contributed to my practice for incorporating a targeted focus on social justice. The

following excerpt demonstrates an early practice for reflecting on previous work and how this

served as an important guide for the semester and work ahead.

> I need to embed practices for my supervision and mentoring that assist teacher candidates
>
> in their efforts to find ways outside of their classroom to get to know and understand the
>
> lived experiences of their students from racial, ethnic (including language), cultural, and
>
> economic communities that may differ from their own. Following what is happening in
>
> pop culture, reading commentaries by leaders from communities of color, listening to
>
> podcasts devoted to sharing the grounded experience of people who have suffered from
>
> bias and marginalization, engaging in discussions and dialogue with others, seeking
>
> feedback and even pushback are all ways for me to enhance my supervision and practices
>
> to use to encourage teacher candidates to know their students in ways that ensure that
>
> teaching science is equitable for all of their students. It is one thing to talk about social
>
> justice as a side topic at some point in the semester, it is another thing to make the critical
>
> importance of a socially just classroom a core component of every aspect of my function
>
> as a university supervisor. (Researcher's Journal, July 27, 2020)

I connected the ideas that I assembled from my continuing research with my prior practices in supervision work. I returned to a review of the findings from my pilot study and previous work to check for clarity and coherency with my current objectives. My overarching agenda for promoting science teaching that centers on awareness, advocacy, and activism for social justice would serve as my guide.

Before meeting with the teacher candidates, I established a list of resources and strategies to address the concepts that I wanted to cover as well as my objectives for implementation. Table 4. (located on page 134). reveals a matrix that contains the resources and strategies that I incorporated throughout the final clinical internship period. These assisted my practices to enhance the teacher candidates' awareness, advocacy, and activism in science teaching. Overlap occurred across the various resources.

Composite: Ann

Ann is the composite science teacher candidate who represents the four actual candidates that I supervised during this study. In order to set up an open and trusting relationship and to establish and maintain dialogue, I arranged to meet with Ann in the summer before the final clinical internship period. I first connected with Ann via email to introduce myself and then invited her to meet to have a chance to get to know one another and talk about the upcoming internship. This is a practice for establishing and maintaining an open and trusting relationship that I have used with previous teacher candidates. While I cannot require them to meet with me, they have always been willing and eager to meet, as was Ann. (If for any reason, a teacher candidate would not wish to meet, I would establish communication via email, phone, or video conferencing.)

Table 4. Resources and Strategies Implemented in Supervision Practices for Social Justice AAA

Resources / Strategies for Social Justice Awareness, Advocacy, and Activism Matrix			
Supervision Resource or Strategy	Awareness	Advocacy	Activism
Initial pre-semester one-on-one meeting at local restaurant	X		
Backpacks for Success Equity Simulation Interactive professional development' virtual meeting	X	X	
Book: For White Folks Who Teach in the Hood by Christopher Emdin	X	X	X
Christopher Emdin video clips	X	X	X
Individual School Boundary maps and demographic (ethnicity /SES) statistics	X		
Article: The Racial Gap in Confidence in Science: Explanations and Implications by (Plutzer, 2013)	X	X	
Identity and Intersectionality Questionnaire Q1	X		
Advocacy and Activism for Social Justice in Teaching Questionnaire Q2	X	X	X
Transformations of Goals/Beliefs Questionnaire Q3	X	X	X
Science Content Resources	X	X	
Collaborative resources for classroom use	X	X	
TED Talk: Ashley Hall (Implicit bias)	X	X	
Harvard Implicit Bias Test	X	X	
Gloria Ladson-Billings Podcast Live from Cap Times Idea Fest 2017	X	X	X
TED Talk by Jennefer Witter How Prejudiced Are You?	X	X	X
Book: Poor Students Rich Teaching by Eric Jensen	X	X	X
U.S. Dept. of Education's Civil Rights Data	X	X	
CRDC School Discipline statistics	X	X	X
Informal text messages outside of cycles	X	X	X
Email messages outside of cycles	X	X	X
Phone/zoom calls outside of cycles	X	X	X
In-person meetings outside of formal observations	X	X	X
Focus conversations	X	X	X
Cycle (1,2,3) Pre-conference meetings	X	X	X
Cycle (1,2,3) Post-conference meetings	X	X	X
Co-planning lesson together	X	X	X
Informal observation notes	X	X	X

This meeting lasted approximately two hours and allowed me to lengthen the preliminary

period of time that we could get to know each other and therefore the amount of time that I

would have to work with her. We met at a locally owned restaurant where many families at her high school might also frequent. I had conducted prior inquiry into locating locally-owned, low-key, 'mom-and-pop' restaurants where community members often dined. I should also point out that I ensured that we each were practicing CDC guidelines considering the time period in relation to COVID-19.

I used this time together primarily so that we could get to know one another, which was a practice for establishing and maintaining an open and trusting relationship. I asked probing questions about her experiences in K-12, pastimes, goals, and philosophies, and assumptions for teaching secondary science. I interweaved my own experience in education as well as information about myself into the conversation. I also responded to questions and comments. This informal meeting was unhurried, relaxed, and enjoyable.

I utilized this initial meeting with Ann and the first portion of the final clinical internship to implement a variety of resources to explore and discuss concepts such as self-identity, identity of classroom students, intersectionalities (of self and classroom students), and areas of inequity in the classroom and/or school. This was an example of my practice for incorporating targeted focus on social justice. Based on the findings of my work with teacher candidates in previous semesters, the first step was to collaboratively investigate the concept of identity and the aspects of inequity in the classroom and schools with Ann. We considered our identities in relation to how we experienced each of our own K-12 education. We also explicitly talked about the role of family and community in shaping our personal identities and those of our classroom students.

To assist my objectives for the meeting, I brought a variety of resources to help begin the conversation about awareness of identity of ourselves as teachers, of our students in our classrooms, and for inequities that persist in classrooms and schools. This is a practice for

incorporating targeted focus on social justice. I provided sections of articles devoted to social justice science teaching, a copy of the book, *For White Folks Who Teach in the Hood* (Emdin, 2016), and a set of the school boundary maps and school demographic statistics unique to Ann's school. We used the school information to help guide the conversation towards examining the demographics of the students. I encouraged her to share her own personal educational upbringing. We further explored more details about the community that her school serves. We examined this while considering the fact that approximately 79% of teachers in the United States are White and middle class.

We took time to consider the cultural mismatch between teachers and students in schools where a majority of students are of color and/or from low-income households. Ann is teaching at a highly culturally diverse school (including language) and the majority are enrolled in the free/reduced lunch program. Ann engaged in the conversation and asked questions. She mentioned having read and resonated with the concepts in *Dreamkeepers* (Ladson-Billings, 1994) in one of her courses. I used this as a connection to talk about Ladson-Billing's work in culturally relevant pedagogy. We discussed how to ensure that our science lessons are culturally responsive (Gay, 2000). This tied in with Emdin's book that I had provided to Ann. We discussed socioscientific issues (SSI) in the science classroom. We considered how inquiry-based approaches to teaching the science content and SSI can bridge the curriculum to making science meaningful and applicable for students of diverse racial/ethnic/economic backgrounds. While Ann seemed receptive to and engaged in the conversation, I recognize that my subjectivity prevents me from having a full understanding of just how much impact the discussion of these topics had (this is discussed further in Chapter Five). The excerpt from Ann below reveals her receptivity to our conversation early in the semester.

The resources on teaching science in predominantly Black schools was really

encouraging. I knew going into this year it would be hard. I was also thinking about

having students choose to write a rap or a poem about the differences between physical

and chemical changes. I would love to have them do something that impacts their

community. I will also be looking into the online Science magazines. I really want my

students to start reading about science. I know a lot of them could work on their reading

skills. (Ann, email, 2020)

After that first meeting, Ann and I began communicating frequently through text

messages and emails. These conversations covered topics related to her upcoming final clinical

internship, her school as she attended the teacher training and classroom preparation, and science

content resources. I was intentional in ensuring that I established a frequent open channel of

communication with Ann before her first day began. My objective was to build trust and position

myself as a support structure. This aligned with my practice for establishing and maintaining an

open and trusting relationship.

Another strategy/resource that I used to generate contemplation about students' identities

and backgrounds before Ann's first week with her students was through an online meeting with

all of my current teacher candidates. This addressed my practice for incorporating targeted focus

on social justice. I also invited in one of my previous science teacher candidates from two years

earlier; Maria (not real name) who currently teaches in a high school classroom similar to Ann's.

Like Ann's school, Maria teaches high-needs students who represent a predominantly Black

demographic that includes a smaller number of Latinx and White students. Most of the students

in both schools are from low-income socioeconomic communities.

Maria presented her strategies to ensure that the science content is taught in a way that is equitable for all of her students. She provided examples for ways that she has made resources accessible for all students. She reported that some students come to school without paper/pencils. She owns a class set of calculators and tells her students "It's ok to need something. Take a calculator to use for class and please return it before you leave" (Maria, 2020). Maria pointed out another area of common disparity - transportation. Most of the students in both Ann's and Maria's high schools rely on buses for transportation. Maria recounted a time in Spring 2018 when she had scheduled a course test. There was a severe storm in the area that brought torrential rain and flooding in many neighborhoods where students live. She canceled the test because she had learned from another storm earlier in the semester that, "when the rain is really bad, not all buses can get to the students' communities because of flooded streets. They just don't show up. Nobody brings them. They don't have anyone with a car who can drive them to school or pick them up. So, we just lose that day with those students" (Maria, 2020). Throughout the time in this meeting, the group talked about the importance of knowing, understanding, and being responsive to the backgrounds of their students. Ann followed up by asking how she will find out which of her students will require help with supplies and understanding for economic challenges.

In this same meeting, we all participated in a modified version of the *Backpacks for Success* simulation (Billingsley, et al., 2019) adapted from the Noyce Regional Conference (I had previously attended this in Mobile, Alabama). This was another strategy to support my practice for incorporating targeted focus on social justice. Participants adopted the identity of one of the characters in the simulation. They took turns role-playing the cultural characteristics and challenges that described their character to the whole group. They were tasked with clarifying

what they needed from their teachers. This was an opportunity for the participants to engage in dialogue with their peers who were also in secondary science final clinical internships.

Ann's character represented a Black high school student named Dequantarion from a low-income family. She stated that Dequantarion

> needs recognition of his responsibilities and struggles in his challenging home environment, thus understanding for low performance in school. Sometimes he is tired, and teachers need to give him space and be ok with that. Dequantarion does not have the physical supplies and digital devices to support his learning. He feels overwhelmed and depressed, and it might be best to connect him with counseling at the school. (Ann, 2020)

From this role-playing simulation, Ann revealed an increased awareness of the critical issues that some students bring into the classroom each and every day as well as empathy for the deficits and disparities that some children may face which can negatively affect their learning.

This group simulation created an atmosphere in which the teacher candidates could safely discuss sensitive, challenging, and uncomfortable issues with the others thus contributing to my practice for establishing and maintaining an open and trusting relationship and incorporating targeted focus on social justice. My goal was to present the group simulation in such a way that the teacher candidates would unpack the real and critical issues of culture and socioeconomic status in relation to classroom students. Ann specifically pointed out that she would like to learn how to shift her class content so that it supports students applying the information in meaningful ways in their own lives and communities that can help specific to COVID-19. She suggested that the content she would be teaching would be easy to easy to connect to the pandemic and how biology can help inform their communities.

Another participant in the group pushed back by suggesting consideration for students feeling embarrassed about their backgrounds. Some students may not want their personal culture or economic situation to be a focus point. The group discussed this issue within the context of being aware of their students' backgrounds while presenting the science concepts in ways that students could adopt in meaningful ways. The participants came to a consensus that when teaching the science content, it must be conducted in a way that is affirming and sustaining, not an isolated type of incident which may be uncomfortable for some students. So, teaching science that is socially just needs to be done sensitively and with tact. By facilitating this modified version of the *Backpacks for Success* simulation (Billingsley, et al., 2019), I learned that I could stimulate dialogue about social justice approaches to teaching between teacher candidates in a way that promoted interest and awareness.

As described in chapter one, the final clinical internship time period is divided into three cycles. Each cycle includes classroom observation accompanied by an official pre-conference and then a reflective post-conference. In the pre-conference, the content and lesson plan are reviewed, objectives are presented, and strategies for teaching are discussed. Additionally, attention is paid to the needs of the students, areas of concern are problematized, and plans for assessment are reviewed. During each observation (cycle) I attend at least two classes that the teacher candidate conducts. I record notes that can be referred to after the lesson during the post-conference. After the observation, the teacher candidate and I meet to review and reflect on the observation. We refer to my observation notes as well as any tools I used to track data (e.g., student interaction seat chart). The teacher candidate reflects on areas of strength and areas of growth while I facilitate this reflexive process and help the teacher candidate to set goals for the next lesson.

During the first cycle (approximately within the first month), the full-time teacher candidates (who are Master of Arts in Science Teaching students) established their classrooms, got to know their students, and taught the content. In my prior experiences with teacher candidates, this is a highly interactive time between the teacher candidate and myself. This was the case with Ann. She and I communicated frequently via text, email, Zoom, and phone calls during the first cycle. She opened up about her uncertainties and concerns as she met her students and got to know them. This provided me with many opportunities to incorporate the tools and resources intended to support her development of awareness, advocacy, and activism.

I should mention and clarify the role of the site based teacher educator SBTE here. There is a triad model for the final clinical internship between the teacher candidate, the SBTE, and the university supervisor. With the full-time, MAT teacher candidates who are the hired district teacher of record, they are paired with a school based teacher whom they work with in a mentoring relationship. This is not the traditional model where the teacher candidate joins the class of another teacher. Rather this is a colleague who has volunteered to mentor the teacher candidate while maintaining their own full course load and school responsibilities. The triad meets briefly twice a semester, and all other communication is spontaneous and happenstance unless intentionally planned. Due to the nature of this self-study focusing on my practices as a university supervisor, I did not include data from interactions with the SBTEs.

The first week of school began and all teachers and students met online only, per the district mandate due to the COVID-19 pandemic. Immediately a number of issues came to light. The district-wide online platform, Canvas, crashed multiple times throughout that first week. All teachers lost communication with students frequently. Students did not all show up for class. By the end of the first week, Ann reported that approximately one third of her students regularly

skipped classes or did not ever report at all during the initial week of online-only class meetings. At this point, Ann and I met via Zoom to investigate this issue and problem-solve. An excerpt from that conversation:

> A bunch of kids zoom bombed my class today. They pretended to be other kids and got in and used a lot of inappropriate language. This is a huge part of why going online for the first week has been really hard. I had to meet my students (those who showed up) for the first time ever over Zoom. I had no way of getting to know my students and they can't get to know me. (Ann, via Zoom conference, 2020)

In this scenario, I utilized the practice of problem-solving for challenges. Ann was already visibly upset, including tears. She specifically referenced our earlier review of the demographics of her school and our discussions about awareness of our students' identities and backgrounds in order to teach them. She expressed concern for how she would get to know her students' backgrounds if she could not even see them. We brainstormed ways she could get to know her students the next week when a portion of them would return to school in-person. Unfortunately, she reported knowing already that a third of her students would remain online going forward. Gaining insight into her students' lives and making connections was already a challenge. Teaching, and planning to teach, for simultaneous online and in-person instruction became a significant challenge for Ann.

At this point, I realized that I needed to inquire into what other science teachers were doing to mitigate these issues. A practice that I regularly rely upon is networking with others to expand ideas and resources. I stay in regular contact with prior science teacher candidates and current science teachers in order to collaborate about ideas and

strategies. I reached out to one of my former teacher candidates, Donna (not her real name). Donna is a Black, cisgender female who identifies as a gay member of the LGBTQ community. She teaches chemistry at a local charter school where the majority of her students are of color and from low-income households. She has actively shared my interest and efforts in teaching culturally responsive science and seeking pathways for greater equity in the classroom. We had collaborated on science instruction in the past and had just recently attended a lecture by Gloria Ladson-Billings together. I consider her a critical friend in the field of secondary science education. She has taught and teaches similar groups of students as Ann. I asked her specifically about some of her methods for connecting with her students especially now during COVID-19 and simultaneous online and in-person teaching.

Donna shared her strategies for connecting with all of her students and in particular, her students of color and students from low-income households. She recommended that Ann find out what her students were interested in, including video games, hip hop, even popular games like 'Among us' (the current widespread teen social game). She emphasized the importance of "knowing what students are talking about and what generates excitement. Be able to toss in some connected concepts and one-liners into your verbiage. At first it throws kids off that you know something that is important to them, something you can actually talk about. Then you can start connecting the science" (Donna, 2020). By networking with other science teachers in the field, I increased perspective and gained additional insight for ideas, thus increasing my confidence for incorporating the language of social justice with my teacher candidates as a result.

The majority of Ann's students were of color and from low-income households. This presented an authentic opportunity for me to implement strategies to approach the concept of implicit bias in the classrooms and schools. Implicit bias is a concept that I have found emerges within conversations about identity and intersectionality, and especially when considering areas of inequity. I engaged the practice for incorporating targeted focus on social justice within the conversations that Ann and I held. There are two TED Talks that I regularly ask my teacher candidates to review and discuss and I shared these with Ann as well. These are listed on Table 4. (p. 133). I also shared the Harvard *Implicit Bias Test* and suggested she try the test multiple times over different times and consider their results (I never ask them to report their results to me).

After our first observation (cycle one), I included the concept of implicit bias into my supervision. Ann shared her thoughts about implicit bias, recognizing that this is more prevalent phenomenon than maybe she had considered before. Ann and I discussed ways that all of us continue to hold implicit bias. We connected this concept to how teachers might perceive their students of color and students from low-income households. I used transparency to share my own recognition for my need to continuously reassess my beliefs about what children are capable of for learning and to make sure that I am not forming assumptions about a student or group of students that is not appropriate or equitable. A personal example I shared referred to a student who keeps her head down in class. She is tired as a result of home conditions versus my assumption that she was not interested or being defiant. I further shared that my perception of that child guides what I am willing to learn about, and how I adjust my effort for working with that student. After my own transparency about my work to address and redress my personal implicit bias, Ann engaged in further consideration as seen here

[Ann] reported that she had always labeled herself as unbiased, but now, along with our continued discussions about the issue of implicit bias, she realized more that every person has bias at some level and much of that is a result of society. I wondered as I often do, if I am pushing an uncomfortable topic too far and let her know that she could always shift topics and I hold no judgment. She claimed she appreciated the encouragement to recognize implicit bias to ensure we are not treating students based on stereotypes or fixed mindsets. Specifically, she expressed that it is important to bring [her subject] in the real world into her classroom in a way her students can use the information. (Researchers Journal, 2020)

I was cognizant of the potential uncomfortable space that bringing up topics such as bias might place Ann. I watched for visible cues (body language) and stayed alert to Ann's dialogue to monitor for any tension. While there was never a formal statement before any particular conversation that indicated that I was going to cover social justice issues, I did interject spontaneous phrases to check in and make Ann was aware that a) I also understand that this type of conversation can be uncomfortable and b) our conferences are safe spaces, and she should always feel free to change the subject. For example, simple phrases such as "hey I know this is a sensitive topic and can be uncomfortable for all of us, please know you are in a safe space with me, and my role is to listen to you (Ann) and ensure that I am supporting your work." There were certainly times when I detected that Ann was hesitant to discuss issues related to students of color. Grappling with terms to use was one example (i.e., Black, students of color, African American).

One of the tools that I used to capture a baseline for Ann's perspective was through the use of my first (of three) questionnaires. I include a questionnaire during each cycle with all

teacher candidates (Appendix A, B, and C). The questionnaires are the revised editions of

questions/prompts that I designed and used with previous teacher candidates. I implemented the

practice for incorporating a targeted focus on social justice through this questionnaire, prompting

teacher candidates to consider how their identity and background aligns with or differs from their

classroom students. Furthermore, this instrument asks teacher candidates to consider their beliefs

about their students and how students learn and to consider equity for their students. Ann's

responses provided background information about her assumptions and beliefs. This instrument

helped to reveal how I could plan to supervise to best support her understanding and

development for awareness, advocacy, and activism for social justice in the science classroom.

> I recognize that there are many stereotypes for students based on their ethnicity. For
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> example, Indian and Asian students are stereotyped as high achievers while Hispanic and
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> Black students are put into lower achievement categories. If teachers hold these
>
> stereotypes, they may put more effort into certain students while they expect less from
>
> other. Students in lower SES areas are also stereotyped as lower achievers and I feel that
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> this limits the effort put into their curriculum. I want to be sure that I explicitly show my
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> students that I hold the same expectations for all of them. I believe that every single one
>
> of them can succeed and I am not sure they have all been told that before (especially in a
>
> science class). (Ann in Questionnaire One, 2020)

The responses from the questionnaire provided a point of reference and key

considerations to address in our ongoing conversations. I needed to make sure I was

establishing a truly safe, open, and trusting space for our discussions. If Ann was just

telling me what she thought was the right thing to say, then this work would not manifest

itself in her teaching. Therefore, I made sure to regularly cycle back to discussing ideas

about identity and equity. Ann became more aware of and more apt to point out issues of inequity in her classroom and school as she observed them. For example, Ann recognized later in the semester that in her school, the advanced placement (AP) classes had a higher concentration of wealthier and White students whereas her classes (regular level) consisted of predominantly students of color. True to Ann's response in the questionnaire, she reported holding high expectations for in-class work from her students because she was seeing them engage when they were successful.

In addition to all of the communication, we arranged for a formal pre-conference meeting before the first classroom observation about one month into the semester. By this point, I had been regularly integrating a variety of practices to supervise for a socially just science teaching (i.e., establishing and maintaining an open and trusting relationship, incorporating targeted focus on social justice, problem-solving for challenges, and networking with others to expand ideas and resources). Ann and I discussed the lesson objectives, procedures, strategies to check for student learning, and areas of potential concern. In our pre-conference, Ann reported that she realized that the traditional structure for classroom management, coursework, and grading was not going to match her current situation. She had spent the first month adapting within the combined in-person and online class structure to find ways to get to know her students. While the racial/ethnic makeup of her students had been apparent when she first met them, it took her some time to realize the challenging economic situations that many of her students went home to after school. Most of the students at her high school are from low-income households. Some of her students worked after school. Others had to pick up siblings and then care for them each afternoon and evening. Many of her students did not have high-speed Wi-Fi service at home, let alone a computer that they did not have to share with other family members. And a few of her

students even had young children of their own. Ann revealed her increasing awareness in the following response

> I am beginning to realize what it will take to make sure that every student can be successful in my class. One of my parents told me that they have been homeless for two weeks and she doesn't know how her child will get to school. I really need to take a step back from my own experiences and learn about theirs in order for them to be successful. (Ann, in Questionnaire One, 2020)

After I observed Ann's lesson, we met for the post-conference. Utilizing the practice for reflection as catalyst for shift, Ann and I discussed the content and pedagogical implementation in the classes I observed as well as other classes up to this point in time. Ann reflected about student engagement and participation, pointing out her concern that her students did not turn in homework. She did acknowledge that the in-person students were almost always on task when in her classroom. She expressed not understanding the reason behind this on an individual level, but she did indicate that the general level of expectations for any homework at the school are very low, stating, "kids at [this school] just are not really expected to do or turn in homework at all." She reported feeling disappointed because she had started off the school year with strict deadlines and a structure for late work. We talked about how she can adjust in order to meet the needs of her students. She shared that she realized that she needed to discard and redesign her original plan. We talked about ways to set up assessments on what she can see and do while in the classroom with students. She decided that any work from out of class would just be a bonus.

After this observation, I returned to the practices of problem-solving for challenges and reflection as catalyst for shift by following up with the book, *Poor Students, Rich Teaching* by Eric Jensen (2016). Each of my teacher candidates receive this book or a PDF of Jensen's work

from me. The chapters and activities in this book address how poverty impacts students' ability to learn, access to opportunity and achievement, and ways to mitigate that. It was critical to ensure that my teacher candidates understood that poverty is a "chronic experience resulting from an aggregate of adverse social and economic risk factors" (Jensen, 2016). Students of poverty suffer the effects of stress, experience cognitive gaps, and receive less emotional support compared to wealthier students (Jensen, 2016). We briefly reviewed the concept of neuroplasticity and how students' brains can construct new connections and networks for learning based on their exposure to teaching. By establishing a classroom that is healthy with high-expectations that support an atmosphere of hope, confidence, curiosity, reflection, expectancy, camaraderie, and celebration (Jensen, 2016), there can be a pathway for reaching students who come from low-income households.

We continued to reflect and discuss the economic situation of many of Ann's students and how she would need to shift her classroom expectations in response. Ann shared that she was becoming more and more knowledgeable about her students. She reported realizing that the traditional framework of homework and test expectations was not going to reasonable for her students. She changed the structure of assignments for her classes. She did not include the homework component and gave grades on the work that they completed during classroom time.

By the second cycle (entering into the second month of the internship period), Ann revealed that she had received some pushback from her students regarding COVID-19. When we met for our second pre-conference, Ann shared that some students claimed their parents did not believe that COVID-19 was serious or real. The challenge of science denial is one in which I addressed using the practice for problem-solving for challenges. We now more commonly recognize that science denial is not only dangerous to public health by posing as a blockade to a

science- based educated society of citizens, but a threat to our democracy (Darner, 2019). We returned to the article from the beginning of the semester by Plutzer (2013), *The Racial Gap Confidence in Science: Explanations and Implications.* Ann realized that she needed to be prepared to address this topic in her class, understanding that there might be sensitivity to certain scientific ideas. Earlier in the semester, Ann revealed that she was aware of faith and beliefs from families being an issue:

> I also want to make sure that my students who practice a faith and my students who do not feel comfortable in my classroom understand that the material I am teaching them is not attacking their beliefs, but rather in a completely different category. I want their parents to understand that I am not placing my points of view onto their children, but rather show students how to research information to support their own opinions. (Ann, Questionnaire One, 2020)

In this scenario, I resorted to the practice for problem-solving for challenges and incorporating targeted focus on social justice. Ann and I reviewed the Plutzer (2013) report. We talked about skepticism of science as well as confidence in science. "African Americans, compared to Whites, are starkly underrepresented in scientific and technological professions, are especially reluctant to participate as research subjects, and they express attitudes that are skeptical of science and scientific institutions" (Plutzer, 2013). With COVID-19, Ann was presented a clear challenge that would be potentially problematic. Understanding her students' cultural and economic backgrounds in this situation alerted her to the need to approach the topic with sensitivity while still maintaining the rigor of the curriculum. We spent time on this issue because we wanted to ensure that we were connecting the science (biology) to students in ways that were

culturally responsive and that they could use to enhance their own lives beyond the classroom.

One of strategies I used within my practice for incorporating targeted focus on social justice was co-planning a science lesson with Ann. In our pre-conference, we continuously sought ways in which students could apply the content knowledge and show their understanding while in the classroom (since homework was not an option). Co-planning a science lesson served as an excellent opportunity to connect the various science based online resources with the curriculum by implementing tasks that afforded students ways to authentically exhibit their understanding. Planning for activities in which classroom students could make connections with the content in ways that they perceived as meaningful to them was a positive incentive and proved to be productive for many of Ann's students.

An example includes a lesson on cell biology that Ann connected with the 1951 story of Henrietta Lacks (Skloot, 2010). Ann was able to include authentic explorations of student health by framing it within a social justice lens. The timing of the COVID-19 pandemic provided a contextual backdrop for her students to study cells, bacteria, and viruses in relation to personal and public health. I shared resources online that added to the Henrietta Lacks story that could promote deeper thinking about the equity of the Lacks family situation with regard to her cells. Students juxtaposed their understanding of biological concepts with current issues in public health and examined areas of inequity for how this virus disproportionately affected different communities. They explored the history and background of medical research and the controversial debate of the commonly named HeLa cells (named after Henrietta Lacks, although some might argue that reducing the name to an acronym is dehumanizing). Students learned about the science related concepts as they connected them to the Henrietta Lacks story. At the

end of the lesson, students worked on creating their own TED Talks video clip in which they each addressed their opinion on the ethics of the Henrietta Lacks cells and connected this to what they learned about and can apply to their own lives.

I observed Ann's classes where students debated and worked on their TED Talks in which they addressed the issues that from the Henrietta Lacks story based on their understanding of cell biology. Afterwards, Ann and I reflected on her lesson about cell biology in the post-conference. Ann discussed her awareness for the way her students of color, students from low-income households, and low proficiency English speakers were engaging with the science lessons. She talked about the ways that she was working to connect the science to her students that was culturally responsive to their backgrounds. At this point I observed her stance emerge as a teacher advocate for a socially just science classroom. Through the use of all five of my supervision practices, I could explicitly see how Ann's awareness of the diversity of her students was becoming a core component for how she planned and taught science that was culturally responsive and centered on social justice.

We were approaching the midpoint of the final clinical internship period. I had been keeping a journal since August, recording my reflections, questions, and ideas based on the interactions I had so far with Ann. My practice of reflecting as a catalyst for shift was becoming more common in how I planned and adjusted my supervision. After each experience communicating with Ann, I learned something new or different which caused me to adjust my next steps for supervision. With the tumultuous start to the semester as a result of COVID-19, my original tentative timeline for implementing social justice resources had to be altered. I still incorporated the resources generally as I had planned, however finding time to review and connect the concepts was more challenging this semester as a result of the pandemic. I found that

by reflecting on work with prior teacher candidates, my familiarity with the resources I used, and by anticipation of potential areas of need or concern based on the conversations with Ann, I was more adept at shifting and quickly incorporating a variety of resources and strategies in response to any given situation.

I considered my agenda for awareness of identity and inequity in the classroom and my objective to promote advocacy in my teacher candidates. I returned to my journal and reflected on what I had written earlier.

We [Ann and I] have not had as much opportunity to discuss science content as I normally would. We spend a significant part of the time for [Ann] to share/download about all of the challenges so far this semester. I am trying to balance being an empathetic listener while keeping the priorities of the science curriculum and classroom students' learning as a top priority. I have been offering suggestions in ways that I hope, will not overwhelm her. At this point, I am a bit concerned about [Ann's] stress level. I am scheduled to come in observe her classes soon (with a pre-conference before). I will make a note to be more intentional about addressing the economic backgrounds of the students as well as the needs of ELL students. (Researcher's Journal, 2020)

Ann and I returned to the culturally responsive framework various times throughout the semester. One of the lessons she planned and implemented required students to design and present an analogy that connected items or concepts in the world around them that they can use to break apart and represent the components of an animal or plant cell. When I observed her classes, almost all students were highly engaged in their work and with their groups. Ann and I reflected in the post-conference that the students were engaged in the task and their work reflected connected ideas for how they viewed the animal or plant cell. For example, they

designed analogies using the parts of a cell phone, their church, the football field, the components of a city or a school, one student even connected it to a popular book by Rick Riordan.

Considering that the students who experienced success with this lesson were predominantly lower achieving, Ann expressed pleasant surprise. She noted their high-level of attention and participation as well as the creative products. We reviewed the student work. We discussed the collaboration that occurred, some of the students' dialogue, and creative insights students made. She also shared the positive responses from students when they received a high score for their grade on this assignment. The practice for incorporating targeted focus on social justice contributed to Ann's shift for advocating for her students to learn and achieve academic success in class and not based on homework or out of school expectations. The emphasis on getting to know and understand the students' backgrounds resulted in Ann's awareness of what she could and could not expect for out-of-school work. Ann realized that she could advocate for her students' achievement by using creative, culturally responsive, in-class tasks as a way to assess student learning and achievement. From this, a key insight I learned is that taking time to focus on the positive outcomes from culturally responsive teaching is a key action to include in my conferences with the teacher candidates.

Ann continuously had additional students added into her class rosters weekly since the beginning of the school year. However, by end of the first quarter, students who were virtual were allowed to switch from online learning, returning to in-person learning at the school. Ann received 20 new students during the week October 26 and then another eight more students the following week. She reported that she received no accompanying information, no grades or records, and not even names of teachers for any of the students. Meeting the new students for the

first time ever, the former virtual students who joined her classes in-person had just finished Unit One. She was beginning Unit Four. The new students joining her class were substantially behind. When she attempted to contact her administration and teachers who had taught the students (after she procured the information from her students), she was answered with silence. Again, she was not even provided any grades for these new students.

This required the supervision practice of problem-solving for challenges on many levels. She was essentially starting at day one with her new students, despite it being the middle of the semester. She needed to get to know them, connect them with her classroom environment, and formulate a plan for catching them up. In planning for lesson activities, Ann included small group collaborative work that allowed her to get to know the students on an individual bases as they worked with their groups. Mindful that this is all while trying to maintain safe social distancing which was an impossible expectation for the classrooms. Worried about the potential of spread of the virus, Ann struggled with how to safely set up collaborative groups. Recalling that her non-science classroom being too small (not a lab-equipped room), the students were already sitting within three feet or less of each other. She decided to allow them to work in small groups and enforced proper wearing of masks at all times.

In addition to this challenge, there was an increase in the number of English Language Learners (ELL) added to her classes. Most of them spoke Spanish and were either no English proficiency (NEP) or limited English proficiency (LEP). This excerpt from my journal reveals details of the challenge.

> [Ann] and I discussed the two students, who are sisters. They just showed up in her class recently, do not speak any English at all, and attendance is inconsistent. Unable to reach a parent, she said she was also informed that there is not a case worker or resource person

at her school to assist with her ELL students. She is not aware of any online programs

that teach Biology in Spanish. I have also looked but could not find anything that is free.

I have reached out to former interns to find out if they used anything in particular but

have not yet heard back other than to use transcribing apps. (Researcher's Journal, 2020)

This presented a significant concern for ensuring that students were all equitably gaining

access to learning and resources. Ann specifically grappled with whether to pause the class to

allow the other students to catch up or continue where they were in unit four. She was concerned

that any efforts for her ELL students might go by the wayside due to lack of time.

By this point, with all of the new students added in and extra time that went in to finding

ways to connect to her ELL students, Ann was experiencing feelings of despair. She reported

crying in her car on the way home after school multiple days. She seemed disappointed with the

outcomes in her classes. I realized that the time I spent supervising needed to fall more heavily

within an emotional support approach.

I reached back to a practice I had implemented from earlier in the semester, establishing

and maintaining an open and trusting relationship. I sensed that it was time for somewhat of an

intervention. We met for coffee one day after school where I just listened to her and encouraged

her to release her frustrations. This was followed up a couple of weeks later when we went out

for pizza on a Saturday evening. She seemed disappointed with how things were going in her

classroom. The practice for reflection as catalyst for shift was especially useful at this point.

Over pizza, we reviewed the progress of numerous students who Ann had made gains

with over the semester. I specifically pointed out the connections she had made with her students

and their high-level work ethic while in the classroom. She revealed that while she was initially

disappointed with having to shift her classroom structure based on her students not being able to

do schoolwork at home due to a variety of economic reasons, she realized that this actually

forced her to better understand the experience of students from lower-income communities. We

reflected on her in-class students' general overall high output for class work. She talked about

how her students responded when they received good grades for their work completed in class.

She made the connection between how awareness of the students' diverse backgrounds and lives

were essential to knowing how to teach them. As a result, she shared that she was aware of how

she had shifted into an advocate for teaching science that was more socially just for her students.

One of the supervision practices I implemented throughout the semester, problem-

solving for challenges, included seeking wireless devices such as laptop computers,

phones, and tablets that Ann could use with her students. Ann was provided only one

desktop computer by her school and lacked any devices for students to use. I also

regularly reached out to former science teacher candidates to seek ideas and resources for

teaching science in classrooms with English Language Learners as well as ideas for

science lesson ideas for a socially distanced COVID-19 classroom. The practice of

networking with others to expand ideas and resources became increasingly prevalent as

the semester progressed. In fact, by the third cycle of the semester, I had established a

private online networking group for all (current and past) Noyce STEM teachers from

this university. I designed and established this shared space in order to promote more

direct communication between the science teachers so that they could have a common

place to network.

Ann reported having a few students missing class due to in-school suspensions (ISS).

When this occurred, students were removed from their classes and could not participate in

classroom instruction or activities with their peers. This has served as a challenge in the past as

well as this semester for students who were already academically behind. Ann was frustrated about catching these students back up whenever this occurred. I learned that this as an ideal opportunity to implement the practice for incorporating targeted focus on social justice by reviewing the *Discipline, Restraints/Seclusion, Harassment/Bullying* report from the School Characteristics vs. Discipline Data: U.S. Dept. of Education's Civil Rights Data Collection (2018). This database provides statistics about districts as well as individual schools. We reviewed the demographics, absentee data, staffing information, financial data, in addition to the discipline reports. As a comparison, we also reviewed the discipline reports for a local predominantly middle class (higher SES), predominantly White high school. This is an excerpt from Ann's response.

> I could *not* believe the data. In my last questionnaire I talked about how my African American student, B, talked about how all his teachers "picked on" him. This data is so supportive of what he was saying. Looking at the higher SES school, where only 7.5% of the school is black, black students account for 38.5% of out of school suspensions! It's really hard for me to conceptualize this, let alone have data that points so specifically to a broken system. The data for [my school] isn't so terrible until you look at the out-of-school suspensions and expulsions, where 75% of expulsions are black students. It is on the individual teacher to treat students fairly in their own room. (Ann, email, 2020)

Ann's statement was an indicator that she had shifted to an advocate stance for her students.

Coupled with the work she was doing to catch students up who were pulled out for ISS along with this insight into the data that clearly reveals the inequity of students of color in disciplinary actions, she reconsidered her own approaches for discipline. For example, she had students who would put their heads down and sleep during class. She realized that sending them

to detention, which only added to the other detentions assigned by other teacher, would lead to in-school suspensions. She came to understand that assigning them detention would actually prevent students from having access to her class, which she claimed being a significant problem. For her students of color, they had already come to her reporting that they felt like they were punished unfairly compared to White students. As we discussed this, she shared her concern about contributing to the existing system of failure by assigning detention to her students of color who were receiving detentions and in-school suspension disciplinary actions from other teachers. She indicated her intention to be a teacher who could convince students to want to be in (not out of) her classroom by making her classroom a place that they could feel welcome and safe. She referred back to this data and our discussions of this issue again throughout the semester.

By the third cycle (about the third month), Ann had gained quite a bit of ground for building rapport and trust with her students. She was still struggling with finding ways to match the curriculum to her English Language Learners (ELLs). However, she had been creating and implementing a variety of lessons by this point that advocated for all of her students to engage in science that was culturally responsive. Considering that students still did not turn in homework, attendance was sporadic for some, and additional students were added into her classroom on a weekly basis, overall, Ann was actually observing and reporting progress. In each conversation with Ann, I devoted a significant portion to reflection by reviewing the positive progress in achievement that many of her students had made thus far. There were still plenty of students who were in challenging situations, but Ann acknowledged her successes and balanced those with the challenges that persisted. I found that the practice of reflection as catalyst for shift was an impactful strategy in supporting Ann's confidence and persistence.

By this point in time, Ann's confidence and her stance as an advocate for her students was more evident. She was well aware of her students' personalities and knew much more about their home lives. She was planning and teaching lessons that were culturally responsive. Her framework for teaching the curriculum, assignments, and assessments was equitable and strengths-based. In our meetings, Ann was more apt to identify struggling learners and to initiate ways to reach them. She was shifting from waiting for the information to be handed to her to developing her own agency for finding ways to ensure that her students were all benefitting from the way she was teaching.

We cycled back to one of our earlier discussions about reality pedagogy (Emdin, 2016). Ann wanted to try out some of the ideas from Emdin's work. She assigned a project in which students could bring in creativity to connect the science topics with a project that they could choose and control. We co-planned for a lesson that gave students opportunities to share their interpretations of the science content through alternative assignments and assessments. This was an example of my practice for incorporating targeted focus on social justice.

The students in Ann's class were assigned a project in which they had to represent their understanding of the science concepts (atoms and atomic history) through the creation of their own original hip hop song, rap song, or poem. Students were given an option to perform their artistic renditions of the science assignment. This performative opportunity proved to be a highly motivating activity for many of Ann's students. For Ann, there was admittedly some initial trepidation with setting up this kind of alternative project, worried that other faculty might disapprove. However, she received her site based teacher educator's approval, thus implemented the project. This is another example

of Ann's advocacy stance for her students, but her fear of upsetting other faculty was notable. She was willing to make a number of structural and conceptual changes within her classroom and with her expectations for her students, thus allowing her to teach science with fidelity to equity. However, she shared that she did not feel confident to be an activist for change in the larger school community.

After the completion of lesson and project, Ann and I met to reflect in a post-observation conference. The songs that students submitted (and some even performed) exhibited depth of rigor representing both content and creativity. Some of the students' work was especially surprising in light of the fact that they had not performed well on other academic expectations. Ann reported increased rapport and deeper connections with her students. We were both thrilled with the outcomes. Ann reflected how creating opportunities for her students to learn and talk about the science topics in a platform that they identified with had presented greater opportunity for students to provide evidence for their learning.

Towards the end of the semester, during our post-conference after classroom observations for cycle three, Ann shared an area of concern with me that she did not know how to handle. She reported that a few Black students in her classes came to her complaining of unfair treatment by other teachers. They reported to Ann that they did not get noticed and they were in trouble more for the same behaviors as their White peers. The following is an excerpt from that conversation.

> A lot of Black students, a lot. I have quite a number of Black students in my class that will tell me stories of this teacher doing that, this teacher treating them like this or that, this teacher being like that. And they all have collectively kind of agreed even on an

individual basis, that they are all not given the same opportunities, not given the same

respect and understanding. And they see my classroom as a safe space. And that's why a

lot of them float in and out of here. I recognize that I'm one of the few safe spaces that

they have. So as far as equity goes, …not a single one has expressed that they feel treated

the same as White kids. I think they all struggle. (Ann, 2020)

As Ann became more and more familiar with her school, she noticed and pointed

out areas of inequity that bothered her. She pointed out the disparity between regular

level classes (which she teaches) and the honors and AP level classes. When she asked

her administration on more than one occasion to address this issue, she reported being

dismissed and ignored. The issue remained through the end of the semester. The

following is an excerpt from one of Ann's responses on a questionnaire.

So, I don't have any access to any of the science labs. In fact, here at [Ann's school], only

the AP classes have access to science lab classrooms. The rest of us do not have science

lab classrooms. The other science teachers are all located together, but I am here by

myself in a separate building because there was not room for my classes. My students are

predominantly Black and Hispanic, most are from poorer backgrounds, even the White

kids, like the one you interacted with today that has serious cognitive issues with a 504

plan that is not feasible for supporting him. I have noticed that the regular level biology

students are assigned to non-lab, non-science classrooms. At this school, the AP kids are

more affluent. Obviously, there is not equitable access to quality science education here

for all students. I kind of don't want to think about it too much because we are getting

close to the time each day when I start crying. I do try to advocate for my kids by

teaching science in ways that engage them and make them think how science is a way to

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improve their lives. And I know you talk about being an activist in my school but how can I expect anyone to listen to me when I can't even be provided with a science classroom or a classroom close to the other science teachers or a support person for all of my ELLs or any communication from my school administration on all of my students who are failing? (Ann, 2020)

Here Ann revealed that she felt strongly about advocating for "her kids" (the students in her classes), however she did not feel confident in speaking up at faculty meetings or taking significant actions outside of her classroom. In fact, she referred to implicit bias in relation to reflecting on her own work as well as interpreting some of her colleagues' comments later in the semester.

In the third questionnaire, I specifically asked the question, "As a Noyce Scholar, you will be teaching science in a 'high-needs' district. What areas will you continue to work on to enhance your skills for embedding a culturally responsive approach to teaching science?" Ann responded,

I would really love to incorporate social justice themes and more SSI (socioscientific issues) into my curriculum, but it seems to be harder and harder to find time for "extra" things as we get deeper into the content. For example, I read about one chemistry teacher who did a unit on the soil quality in their community with respect to environmental racism. I would love to do something impactful like that with my students, but it doesn't seem like an obtainable goal at the moment. As I develop my skills and my content, I would like to work towards bringing my students needs and concerns into the classroom. When possible again, I would like to incorporate local guest speakers and community-based projects to advocate the importance of STEM to the surrounding community. There

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is a TED Talk by a teacher I saw in one of my classes and one of the lines that stood out to me was something like "students won't learn from people that they don't like." I want to be a teacher that students respect and enjoy learning from. I understand that is something that takes time, but I think that once I break that barrier, many other barriers will come down too. (Ann, 2020)

After the semester had wrapped up, I met with Ann one more time to celebrate the end of the final clinical internship. In this meeting I asked Ann some follow up questions, letting her know that I would use her insights to guide my own reflection for how to shift my supervision practices with future teacher candidates. We reexamined the many challenges including students skipping class for days on end, students out with COVID-19 or quarantining due to exposure, few to no planning periods because she had to cover other teachers who were out (substitute teachers were not allowed in the schools), trying to build relationships with her students in an online learning environment where she could not even see many of them, technological challenges such as Zoom locking up, Canvas crashes, students falling further and further behind, students not doing any homework or studying, sporadic additions of students to the rosters after the first quarter, no communication from the online teachers when students were brought back to in-person learning, students joining her class late in the semester who were critically behind in the curriculum, little support from administration, no support for ELL students, no devices to use in the classrooms for students, very little counseling availability and support for troubled students, lack of parent involvement or even communication, lack of strict guidelines for social distancing in the schools, stress of being held accountable for student grades, constant district evaluations, added duties before and after school because

the district cut funding and jobs halfway through the semester, and so on. We also

discussed the positive outcomes that emerged as a result of having worked through those

challenges. Ann recognized the successes of her students and acknowledged her role in

supporting their success, especially her students of color and from low-income

households. As Ann and I reflected on her development, I also acknowledged how my

own reflection as catalyst for shift has proven to be a transformative practice of

supervision throughout the semester for me.

The practices that I implemented helped me to supervise and support Ann's development

into teaching science that is based on equity for a socially just classroom. I found that five

primary practices emerged as being the most impactful on my supervision for social justice with

Ann, a secondary science teacher candidate. Based on the work with Ann during her final

clinical internship, I implemented the following supervision practices 1) establishing and

maintaining an open and trusting relationship, 2) incorporating targeted strategies to focus on

social justice teaching, 3) networking with others to expand ideas and resources, 4) problem-

solving for challenges, and 5) reflecting as a catalyst for shift.

Ways Practices Promoted AAA

Research question number two further examines research question one about practices by

asking, In what ways do these practices promote awareness, advocacy, and activism (AAA)? I

referred to my data analysis and an additional review of the overall data in order to address the

findings for this question. From the second round of pattern coding (Saldaña, 2009) during my

data analysis, I discovered overarching themes that emerged with regard to my supervision

practices for promoting AAA for social justice with science teacher candidates. These themes

came about as a result of the five practices presented from the findings of research question one

(section above). This section will present the ways that the supervision practices promoted my

agenda for supervision of science teacher candidates within a social justice framework.

To address the findings for this research question, I created a simple overview Table

5.This provides a guide. The first column lists each of the five practices that assisted my

objective of supervision for awareness, advocacy, and activism for social justice with secondary

science teacher candidates. The second column lists the main themes that portray the ways that

the practices I implemented promoted my objective. The third column provides a list of the

sources of contextual evidence that support each theme. Following Table 5., the quoted samples

of contextual evidence along with brief commentary are provided.

Table 5. Matrix of Supervision Practices and Ways they Promoted AAA for Social Justice

Supervision Practice	Ways practices promote AAA for Social Justice w/ secondary science teacher candidates	Evidence
I. Establishing and Maintaining an Open / Trusting Relationship	1. Nurturing Open Dialogue	*Researcher Journal (8/12/20) *Final clinical internship survey
	2. Fostering Awareness of Identity	*Researcher Journal (8/3/20) *Questionnaire One prompt #1 (8/24/20)
II. Incorporating Targeted Focus on Social Justice (Through Awareness, Advocacy, Activism)	1. Encouraging Dialogue about Social Justice Issues in the Science Classroom and School	*Researcher Journal (11/20/20) *Cycle Three pre-conference (11/4/20)
	2. Enhancing Teacher Candidate Awareness of their Classroom Students' Identity	*Researcher Journal (8/4/20) *Questionnaire Three prompt #1 (11-9-20)

Table 5. (Continued)

II. Continued	3. Promoting Culturally Responsive Science Teaching	*Researcher email (8/21/20) *Researcher email (9/27/20) *Cycle Two pre-conference (10/14/20) *Questionnaire Two prompt #3 (10/19/20) *Researcher email (8/6/20) *TC email (8/8/20) *TC text 10/4/20 *Questionnaire One prompt #2 (10-17-20)
	4. Investigating Equity in the Science Classroom and School	*Researcher Journal (11/20/20) *TC email (8/5/20)
III. Problem-Solving for Challenges	1. Problematizing Areas of Inequity	*Researcher email (9/27/20) *TC email (9/27/20) *Researcher email (10/3/20) *Questionnaire Three prompt #3 (11/9/20) *Researcher Journal (9/30/20) *Questionnaire One prompt #4 (9-9-20) *Researcher email (10/20/20) *TC email (10/27/20)
	2. Promoting Advocacy for Teaching Science that is Equitable	*Researcher email (8/17/20) *Questionnaire One prompt #4 (9-15-20) *Cycle Three post-conference (11-10-20) *Questionnaire Two prompt #2 (10/19/20) *Questionnaire Two prompt #2 (10/17/20)
	3. Shifting into Activism to Enact Change for Social Justice	*TC email 10/20/20 *Questionnaire Three prompt #3 (11/9/20) *Questionnaire Three prompt #3 (11/14/20)

Table 5. (Continued)

IV. Networking with Others to Expand Ideas and Resources	1. Augmenting Supervisor (my) Learning and Supervision	*Researcher Journal (9/30/20) *Interview with School Board Member (12/13/20) *Notes from meeting with the reverend (7/6/20)
	2. Extending New Resources and Strategies to Assist Supervision for Social Justice in the Science Classroom	*Researcher email (10/13/20) *Cycle Three pre-conference meeting (11/4/20) *Researcher Journal (11/28/20)
V. Reflecting as a Catalyst for Shift	1. Increasing Teacher Candidate Learning	*Researcher Journal 11/20/20 *Questionnaire Three prompt #3 (11/9/20) *Cycle Three pre-conference (11/4/20) *Cycle Three post-conference (11/10/20)
	2. Expanding Supervisor (my) Learning	*Researcher Journal (11/4/20) *Researcher Journal (11/20/20) *Researcher Journal (11/28/20) *Researcher Journal (11/28/20)

While I used a composite narrative approach to report the findings for research question one, I will not be using this to report the findings for the second and third research questions. Instead, in order to present the findings for the second research question, I have assigned pseudonyms to each of the four teacher candidates. Within the quoted texts from the data, I use the acronym, TC instead of 'teacher candidate'. In this section I provide exemplars from my data that illustrate the ways in which each of my practices of supervision in some way or at some level, promoted awareness, advocacy, and activism with the science teacher candidates. In the previous section, in response to the first research question, I provided details and examples of

how I enacted each of my practices. The following sections present the findings of the ways that the practices promoted AAA with the science teacher candidates.

Practice - Establishing and Maintaining an Open and Trusting Relationship

Through the analysis of my data, I found that this supervision practice led to my nurturing of open dialogue with the teacher candidates. This was an integral practice for fostering their awareness of their identity and intersectionality. An early strategy I used was to meet with each of the teacher candidates individually in a face-to-face setting. For each meeting, I made sure to follow and practice the CDC guidelines of wearing face masks and sitting socially distanced.

Nurturing Open Dialogue. Early in my study, I reflected on the previous semesters in which I had supervised cohorts of teacher candidates. With the most recent three of the cohorts, I had met individually with each teacher candidate before the semester began. I did not do so for the three cohorts before then. The first excerpt below comes from my journal.

> I noticed a significant increase in key aspects of a strong relationship (trust, interest, inquiry) earlier on with the TCs whom I was able to get to know earlier. For this cohort, the early meetings seemed to have had the effect that I hoped. They all continued to text and email with me almost daily in the final weeks of summer leading up to their orientation day at [university] before they started teaching. When the semester began, my TCs already knew me, and I knew them. (Researcher Journal, August 12, 2020)

As my reflection indicates, getting to know the teacher candidates before the start of the semester was a way to nurture the development of trust and encourage open dialogue.

The following excerpt from the final clinical internship survey by Seth provides a window into how this practice supported him.

As for support, you were one of the biggest supports I had for the past year of teaching, and your kind words at the end of every observation when I was stressed had a way of calming me down. Whatever you did, whatever mindset you have, it worked really well for me. I know you work with a lot of different people and a lot of different things work out for each individual…. What worked for me were all the text messages and conversations and just letting me talk. It was in those talks about so many things that happened this semester that I was more able to incorporate your agenda for social justice. (Seth, Final clinical internship survey)

As can be seen in Seth's survey response, his reactions to my use of texts and emails early in the clinical experience supported the dialogue with him. Similar data from the other TCs also supports this.

This next excerpt from Sienna's response in her final clinical internship survey points out how the frequent and open dialogue promoted her receptivity to working and planning her lessons together.

The most useful aspects included our many conversations during my internship where we could think through and process the content together. Because of the demands of the crazy world, I was not able to use as much of the resources as you provided that I would have liked, but the smaller chunks and the shorter videos felt more manageable. Talking about these issues all really made me stop to think about my own bias and past experiences that can help me grow in the future. (Sienna, Final clinical internship survey)

Fostering Awareness of Identity. During the initial meeting prior to the beginning of the semester and internship, I met with each teacher candidate face-to-face at a local restaurant that many of the families from their school might frequent. During this meeting, we talked about our

own identities through our conversation about our own cultural and academic backgrounds and experiences. I provided each teacher candidate with a copy of their school demographics and the boundary maps for student attendance. Using these resources, we talked about the importance of recognizing the students' identities.

Loren's school boundary serves students who live in an area where there is a significant majority of Black and low-income students. During our initial meeting at a local restaurant, I used part of this time to explore concepts of identity. In my journal entry about our meeting, I noted that the racial makeup of the clientele appeared to reflect the demographics of the school boundary. We began by talking about Loren's experience working abroad last summer before she began the Noyce program. I then reviewed with her the information about her school that I found in Great Schools (https://www.greatschools.org/).

> This school is rated below average in school quality compared to other schools in Florida. Students here perform below average on state tests, have below average college readiness measures, are making below average year-over-year academic improvement, and this school has below average results in how well it's serving disadvantaged students. Large disparities in suspension rates exist at this school, which is concerning. (Great Schools, 2019)

> Additionally, the equity rating received this review, "A worrisome sign: Disadvantaged students at this school may be falling behind other students in the state, and this school may have significant achievement gaps" (Great Schools, 2019). I noted the following in my journal "Loren and I spent time sharing our high school experiences in relation to the demographics of our schools. We talked a bit about our own identities and started thinking about the identities of Loren's students" (Researcher Journal, August 3, 2020).

The excerpt below is from Loren's response to the first prompt in her first questionnaire. This prompt asked the teacher candidates to think about their identity based on their backgrounds (e.g., ethnicity, race, socioeconomic, cultural, gender, ability, any other areas that comprise their identity) and then to write down how their experiences are similar to or different from their students who may be from other ethnic/gender/cultural/SES backgrounds.

> There are many ways that I, or my life experiences, differ from my students and their lives. I think the most obvious is that a majority of my students are minorities. Being a white passing-Latina who never learned Spanish, I never had to deal with the complex mix of oppressions that people of color, and other minorities, deal with on an everyday basis. Additionally, I was raised in an upper middle class family. I am teaching at a Title 1 school, where students are having a completely different experience than I had . . .
> (Loren, Questionnaire One, August 24, 2020)

In this quote from Loren, we see her exploring her own identity experiences in relation to those of her students. Loren had shared this about her background in our initial face to face meeting as well. Based on our discussion from the meeting, it is evident that Loren has given this consideration. Here she explicitly states how her growing up in a more economically privileged scenario is something that she recognizes as a difference from her students, revealing her mindfulness of socioeconomic status and how that impacts experience in school.

The supervisory practice for establishing and maintaining an open and trusting relationship was beneficial for the teacher candidates. I accomplished this by nurturing open dialogue at all points throughout the final clinical internship period. I established frequent communication through virtual meetings, in-person meetings, email, text messages, and phone calls. By becoming familiar with each other, trust was established thereby providing me with a

more open and receptive environment to infuse my supervision with an agenda for social justice in science teaching. We were able to openly discuss the potentially sensitive topics of identity and implicit bias through my consistent efforts to address identity of self and of classroom students and to investigate potential implicit bias.

Practice – Incorporating Targeted Focus on Social Justice

From the analysis of my data, I found that I engaged in the supervisory practice of incorporating a targeted focus on social justice to promote awareness, advocacy, and activism with the teacher candidates. The following themes emerged within this practice.

Encouraging Dialogue about Social Justice Issues in the Science Classroom and School. Based on my practice to establish and maintain and open and trusting relationship, I was able to connect with teacher candidates in a way that fostered rapport and trust. As a result, I implemented my supervision practice to incorporate a targeted focus on social justice beginning early in their final internship period. This next section presents the findings that came from the analysis of this practice.

The excerpt below demonstrates how I engaged in dialogue with the teacher candidates about social justice in their classrooms and schools. Sienna and I had this conversation during her cycle three pre-conference.

> Sienna: I had some really interesting questions today. After the election, students asked me who I voted for. I said, "I'd go to for Kanye", because I was not even gonna address it. Some of the students asked me if they came out with a COVID-19 vaccine, if I would get it.
>
> Me: That's a great SSI topic that you have already tied into your HeLa pbl! [Note: HeLa refers to the lesson on cells, bacteria, and viruses that Sienna taught by infusing the story

of Henrietta Lacks based on the 2010 book, *The Immortal Life of Henrietta Lacks* by Rebecca Skloot. Sienna's school supports teaching through use of project-based learning, pbl. Socioscientific issues are "the deliberate use of scientific topics that require students to engage in dialogue, discussion, and debate. They are usually controversial in nature but have the added element of requiring a degree of moral reasoning or the evaluation of ethical concerns in the process of arriving at decisions regarding possible resolution of those issues. The intent is that such issues are personally meaningful and engaging to students, require the use of evidence based reasoning, and provide a context for understanding scientific information" (Sadler, 2004; Zeidler, 2003).]

Sienna: I was like, all right, we can have this conversation. I can't tell you yes or no to get the vaccine. That is not my call. The only thing that I can say is that whenever it comes to vaccines, scientists have to go through so many trials before they come onto market that they've been tested on. They've gone through testing before they even come to human trials.

Me: So, you are encouraging your students to take ownership of the science content in ways that can benefit them. The students learned it, practiced it, completed the assignments. They own this content in their mind. Now they have formulated an opinion about it. Even empowering your students to aspire to go into the field of science - they can start thinking about how they're going to share this information with other people around them.

Sienna: Yeah, as a science teacher I always tell the kids to do the research. They know how. Do your reading, cross-reference, and don't believe only one source. Always read at least three, if not more and go with the majority and then still ask questions. So, I tell

them they need to gather data, find out what other knowledgeable people in the field of science, including me, your science teacher, think that's you collecting data so that you can make a wise decision. You're going to go home to your family who don't have access to a science teacher and you're going to become their expert because you're now going to be the one who's in this biology class that talks about these things. Studies the structure of a virus studies the structure of a vaccine. You can teach people in your family that a vaccine is just a weakened virus. There's no chemicals. No additives. (Sienna, Cycle Three pre-conference, November 4, 2020)

This transcript of this conversation reveals dialogue that is targeted on social justice issues in her science classroom.

Enhancing Teacher Candidate Awareness of their Classroom Students' Identity. In addition to exploring our own identities, I included efforts to talk about the identities of classroom students. The following excerpt from my journal shares insight from a meeting I had with Sienna before the beginning of the semester.

Sienna is teaching at a charter school that just opened two years ago and is the result of the very generous donation of [local philanthropist]. I know that it contains a diverse student population which reminds me of my youngest son's experience at his school. Demographic statistics were harder to locate due to the relative newness of the school, but so far, we do know that there is a larger Asian and East Indian population at this school as compared to other local public schools. The district this school is located reports statistics for demographics of students: White (36%), Hispanic (25%), and Black (23%), Asian (8%). We discussed not only recognizing our own identity (and the privilege of being White, middle class), but we talked about how she can learn more

about her students' identities. Noting that her school is a highly sought-after charter school, Sienna's assumption was that there would be more support from her students' families and communities. This is a similar assumption I would make based on my experience with multiple local charter schools. However, this is an assumption and we agreed that we would need to find out more. She pointed out her intention to get to know her students' identities as soon as possible. (Researcher Journal, August 4, 2020)

The following is an excerpt where Sienna discusses the importance of knowing her students' identities. This comes from her response to a prompt from the third questionnaire in which the teacher candidates are asked to clarify beliefs about teaching science to students from different backgrounds.

I think that one of the most important things I need to do as a science teacher teaching in a diverse classroom with students from many ethnic and racial backgrounds is to bridge the science confidence gap which we read in that article you gave us. I need to see students' identities and their backgrounds as assets rather than challenges. I want my students to trust in me and trust what we are learning to be true and beneficial to their lives. I need to bring my students' lives and my curriculum together. Additionally, I need to believe in each student as their own person and support them as individuals. (Sienna, Questionnaire Three, prompt one, November 9, 2020)

As revealed in Sienna's response, she recognizes the need to know her students' identities in ways that she can incorporate their background cultures as "assets rather than challenges."

Promoting Culturally Responsive Science Teaching. Throughout the semester, I incorporated a range of resources and strategies (Table 5.) that specifically targeted a culturally responsive science pedagogical framework.

In an early email from August 21, 2020, I sent the teacher candidates access to a digital science magazine for secondary students. In the email, I suggested that the teacher candidates connect their students with the current events in the magazine in ways that students can connect within their own lives including topics in chemistry, biology, physics, and environmental science.

> As we have already discussed, science is an excellent pathway for students to make connections to their own lived background cultures and experiences. Furthermore, by inviting students to make those connections and bring them to your classroom, you can bring about a culturally responsive and sustainable science classroom through the authentic natural process of encouraging your students to learn and apply science content to their own lives. Some of you are already incorporating some culturally responsive ideas for your lessons. (Researcher email, August 21. 2020)

In another email later in the semester, I sent the teacher candidates the digital science magazines, *AAAS Science Weekly* and *AAAS Science on Tap* to promote continued use of science current event topics in ways that their students could connect with that would bring about culturally responsive topics.

> Topics such as hurricanes (climate change), fuel emissions and air quality (California's new mandate for no emissions for cars), vaccines (and access to and who goes first and who is considered test groups – ethics? trust issues? skepticism?), and candy/food consumption (nutrition) are all science topics that can be taught within a culturally responsive framework - how do our students' communities suffer inequitably in response to a range of science-based issues and challenges in the world? (Researcher email, September 27, 2020)

The teacher candidates reported including the magazines at varying levels (from sharing with students on a regular basis to using an article only on occasion).

Sienna, who teaches at a charter school that incorporates project based learning, decided to tie in the Henrietta Lacks story with her biology lessons on cells, bacteria, and viruses. Henrietta Lacks is the basis of the HeLa cells controversy. Sienna incorporated the 2010 book, *The Immortal Life of Henrietta Lacks* by Rebecca Skloot into her lessons. She integrated medical ethics, topics related to COVID-19, and social equity into her biology lessons. The following excerpt is from a recorded and transcribed pre-conference meeting.

> Yeah. They definitely were chatty, and they've been passionate about medical rights. They are feeling very strongly about how the Lacks family should have been treated. So yeah, that was good to see. But I am seeing my students connecting the science content with their personal views of values or morals or ethics and philosophies, and then connect it to what they know growing up in their lives, that's pretty awesome. (Sienna, Cycle Two pre-conference, October 14, 2020)

From this passage, Sienna reveals how she is witnessing her students make connections to the science content in culturally responsive ways that connect to their personal lives.

Lucy had to shift her teaching style and expectations early in the semester in response to the very low economic background of her students. She also had a high percentage of Black and Latinx students in her classes. An excerpt of Lucy's response about culturally responsive science teaching from her second questionnaire follows.

> One strategy for culturally responsive teaching I used was the availability of choice for my students to complete assignments that are more meaningful to their lives. For projects such as the cell city, I encouraged students to choose an analogy topic that they were

interested in. Many chose topics about sports, church, cell phones, etc. They can be

difficult analogies to make, but I provided them with extra help to make it work because

those are topics they knew really well so I wanted to connect the science that way. I also

allow students to share ideas, background stories, etc. in class which often prompts

multiple different opinions being shared about something we are covering. All input is

entertained equally, and I've worked to establish the type of class culture where students

are willing to share and be respectful with each other despite their different backgrounds.

(Lucy, Questionnaire Two, prompt three, October 19, 2020)

Before the semester began, I provided each teacher candidate with a copy of Christopher

Emdin's book, *For White Folks Who Teach in the 'Hood . . . and the Rest of Y'all Too.* The

email excerpt below was a follow up regarding use of the book. I encouraged the teacher

candidates to share how they might use the concepts from the book with my support and/or co-

planning. I also included three additional resources in this email.

I have included here a few of his talks. He is an incredibly motivating science teacher

devoted to helping teachers develop content and pedagogical practices that are culturally

responsive (Gay, 2000; Ladson-Billings, 1995) and sustaining (Paris, 2010). (Researcher

email, August 6, 2020)

Loren, in particular, embraced much of the reality pedagogy that Emdin discusses in his

book. The following is an excerpt from an early email in response to the book and resources I

sent all of the teacher candidates.

I just finished watching the videos you sent. I found Emdin to be a very enthusiastic,

informative speaker! From his book talk, I loved the students sharing their raps and the

cognitive behavioral specialist sharing his experience. I think that what he was saying

about STEAM is very important. Art includes culture, and we need to bring it to the students, and have the students bring their culture and art to us as well. One line that I thought encaptured his whole presentation was that we need to showcase the students' excellence. (Loren, email, August 8, 2020)

Loren's early enthusiasm for the concepts in Emdin's book continued throughout the semester. She posted daily inspirational and/or thought-provoking quotes by a range of current popular hip hop artists on her classroom board and she applied other ideas and strategies from the book. In fact, this text message from Loren came later in the semester after she created and conducted an assignment with her classes based on the Emdin book.

I had my students write a rap or poem about atomic history and they came out awesome. I will send some of the atoms rap assignments to you. I was so excited to have students create such originals! Listen to [name removed]'s rap, it's so good and I would never have expected him to show that much knowledge. (Loren, text message, October 4, 2020)

As this text message exhibits, Loren had been not only receptive to the resources and ideas I shared for promoting culturally responsive science teaching, but she was implementing them more frequently with larger assignments.

In a response to a prompt about beliefs and cultural backgrounds, Loren shared more about her use of the Emdin book.

I've learned that the best way to keep students interested is by bringing the content to them. I need to relate the information to their lives and scaffold it from what they already know to what I need them to know. A great example I found in Emdin's book was that he tried to teach friction through the concept of marbles. Students just didn't get it. Then, he compared it to the subway instead, the students were able to reach that connection and

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grasp the concept. My students' culture needs to become a vessel for their learning.

(Loren, Questionnaire One, prompt two, October 17, 2020)

My supervision practice of incorporating targeted focus on social justice for promoting culturally responsive science teaching resulted in teacher candidates using the resources and ideas that I shared in their own planning and teaching. Their awareness of their students' cultural identities was an impetus for their advocacy of socially just lessons and activities in their science classrooms.

Investigating Equity in the Science Classroom and School. I provided a copy of the article, *The Racial Gap in Confidence in Science: Explanations and Implications* (Plutzer, 2013) to the teacher candidates to read at the first initial face-to-face meeting before the semester began. We referred to my highlighted copy in conjunction with a review of each teacher candidate's school demographic data and school boundary maps.

Loren responded to the article by email soon after I gave it to her. The following is an excerpt from her email.

> I just finished the article you gave me. It was really eye-opening. I knew that minorities, especially African Americans, were underrepresented in science, but I think it's also important to know why and I want to learn more about that this year. I had knowledge of the inequalities and segregation of schools, but now I better understand how culture can affect some's skepticism of science. It was particularly interesting to read about the alienation model and how the general distrust in institutions bleeds into science. Also, I really loved in the conclusion how the author states that this underrepresentation is "unrealized human potential. (Loren, email, August 5, 2020)

As can be seen by Loren's comments, she made a connection with the concepts as a result of my supervision practice for targeted focus on social justice for investigating equity in the science classroom. Through our review of and consideration of areas for potential racial inequity in the science classroom, the teacher candidates learned new information and insights that could help them teach science that was more socially just for all students.

I found that my supervision practice for incorporating targeted focus on social justice was most evident through four primary processes, which emerged as themes. By encouraging frequent and consistent dialogue with the teacher candidates about social justice issues in the science classroom and school, the teacher candidates increased their awareness of their students' unique identities. I infused a variety of culturally responsive resources and strategies. This contributed to the teacher candidates' receptivity to developing their advocacy for teaching science through lessons and activities that were equitable to all students of all cultural backgrounds. This also led to the teacher candidates to question and seek to find out more about how equity factored in their science classroom.

Practice – Problem-Solving for Challenges

Challenges emerged for all of the teacher candidates by the first week of school. As the semester progressed, challenges continuously came to light and ended up becoming part of the conversation on social justice and teaching for equity. Strategies that I used to help the teacher candidates manage challenges included identifying the underlying causes, problematizing them in ways that the teacher candidates could try a variety of teaching strategies to remediate the issues, supporting their advocacy for their students of color and students from low-income households, and eventually encouraging them to take activist steps to promote change in their classroom and school.

Problematizing Areas of Inequity. Challenges that emerged for the teacher candidates during the final clinical internship often provided fertile ground for seeking and problematizing situations of inequity. Lucy was struggling with a high number English Language Learners (ELLs) in her classes, many who were added late and often did not attend class on a regular and consistent basis. In a follow up email to Lucy, I tried to find out if she had made a connection with any support staff at her school to assist with her ELL students. I shared with her that one of my prior teacher candidates found some online English resources to use with two of his students who had joined his class after a move from Guatemala. I requested a copy of her curriculum guide so I could help her locate resources. I also inquired about the other students in her class,

> If your ELL students are still trying to understand and read basic English, it could be a challenge to present the level of science that you are teaching. Are there other students in the class that you would feel comfortable setting up to be their peer translators? Another one of my former teacher candidates found a great deal of success doing this over at [another high school in the district]. Sometimes there are students willing to do this quietly, they usually sit to the side so that other students can still hear you. Although we need to be careful about physical spacing. (Researcher email, September 27, 2020)

In the following email, Lucy shared the continued challenges.

> I just found their home language is listed as Spanish "non-English proficient" but when I tried to get help from anyone, I don't have a case manager to contact. I know our textbook has Spanish readings and assignments I can use with them in class, but they can't read academic Spanish. They're sisters and joined the class a few weeks late, so they keep to themselves. I have numerous bilingual students in the class, so I'll try

changing the seating chart to move them near those students. But they are really behind

and only falling more behind. (Lucy, email, September 27, 2020)

In Lucy's response, she points out her concern that her students are "falling more behind" as a

result of the challenge in communication.

The teacher candidates had to manage discipline within their classrooms beginning early

in the semester. As the challenges of managing students who were disruptive in class emerged, I

shared resources via email about implicit bias for the teacher candidates to review and reflect

upon. In particular, I shared two TED Talks, *Implicit Bias* by Melanie Funchess and *Implicit*

Racial Bias by Ashley Hall. In my message to the teacher candidates, I shared some of the key

points to consider.

Ms. Funchess encourages everyone to seek awareness of and make intentional effort to

address implicit bias which can be a transformational act. Specifically, she recommends

1) Do your own personal work (to explore implicit bias… in your community, school,

classroom, etc.) (*awareness*), 2) Make connections with people and learn more about

people who don't look like you (*awareness* and *activism*), 3) When you have privilege,

use your privilege to promote equity (*advocacy* and *activism*), 4) Intentionally and

deliberately engage in non-biasing activities, learn about bias, share with others

(*advocacy* and *activism*). Finally, Ms. Funchess shares the African Zulu and Xhosa

combination of the word, *ubuntu*. "I am who I am because of who we all are… and we

are all who we are because of who I am." This is something that is applicable within each

of our individual classrooms. I know that collaboration and small group work is not as

easy to implement during times of COVID, but we can use subtle cues as reminders to

our classes that each student is a critical component of the larger system. (Researcher email, October 3, 2020)

I followed up with the *Harvard Implicit Bias* (in existence and use since 1998). I suggested that the teacher candidates take the online test (on their own, privately) a few times over the semester and to pause and reflect introspectively about assumptions.

The following is an excerpt from a questionnaire prompt that asked the teacher candidates to consider how they might advocate and become activists for their students of color and students from low-income households when they teach science.

Often, students of color, especially those who "act out," are seen as uninterested in school. Like many, I previously might have believed that students who don't pay attention in class are simply uninterested in school. They don't care and so I might pay more attention to the students who showed interest or effort. However, now I realize that I could not be more wrong. Students who seem uninterested in school could be that way for a number of ways. They might be tired; they might have taken care of their younger siblings the night before. They might be hungry; it's hard to work when you haven't had a meal since lunch the day before. Or the student may have just been let down by the education system and have given up. It is my job as the teacher to discover what is keeping that student from learning, and to do my best to work around that. (Sienna, Questionnaire Three, prompt three, November 9, 2020)

It is evident from Sienna's response that she is reassessing her assumptions about students and behavior. She takes this a step further by expressing her intentions for how she will adjust the way that she teaches.

Access to technology and devices was a critical area of inequity that ranged from school to school, classroom to classroom. I have been in some schools in the district where there are tablets and other devices in the classroom for students to use. However, Lucy was experiencing a dearth of devices and equipment in her classroom. This excerpt is taken from my journal.

Lucy seems exhausted… in fact she lets me know this regularly. I am worried about her emotional state of being. She expressed being surprised at all of the challenges in her classroom and lack of support in her school. She is in a small, non-science classroom in the building for English Language Arts (ELA). This building is completely separate from the science building where all of the other science teachers are located; so she feels isolated. She only has the one desktop computer which is her teacher computer and there are no other devices for her students to use.

We barely discussed her lesson beyond going over the basics. She wanted to discuss the issues with students and behavior and her many 504s and ELL students. I know that I can find some used laptops and iPads or whatnot for her since I was able to do this for [another TC's] classroom last summer. I will post on my Facebook page to find some used Wi-Fi enabled devices for her. (Researcher Journal, September 30, 2020)

Lucy specifically identified this lack of technology and devices as a source of inequity in her classroom and school earlier in the semester. The following excerpt comes from Lucy's response in a questionnaire that prompted teacher candidates to describe factors that they have detected in their classroom or school that creates an imbalance of power.

The major source of inequity right now in the school is access to technology and the internet. The school is relying heavily on Canvas to communicate with students and provide learning materials, however all of the extra laptops are checked out to e-learners

and students do not have access to the library or computer labs. So, students of higher

SES have access to the extra resources online outside of school, and lower SES students

only have access to this material while in the classroom and I do not have any computers.

(Lucy, Questionnaire One, prompt four, September 9, 2020)

While I was able to donate a number of devices to Lucy for use in her classroom which she

reported being helpful, this did not alleviate the challenge of the many students who still did not

have access to devices and high-speed Wi-Fi at home.

Discipline was a challenge that persisted with all of the teacher candidates. I followed up

with the conversations I had been having already with my teacher candidates with an email that

contained some information about discipline and demographics for our schools This is an excerpt

from this email.

Based on some of the challenges that we have all been discussing, I have included some

information from The U.S. Dept. of Education's Civil Rights Data Collection

Website (https://ocrdata.ed.gov/). This portal provides an incredible amount of data about

districts as well as individual schools. Attached to this email, I have included your

specific school's report. Data includes demographics, absentee statistics, staffing

statistics, financial information, and more. I would like to direct your attention to

the Discipline*, Restraints/Seclusion, Harassment/Bullying* report included for each school

(listed at the bottom of the page). As a frame of reference, take a look also at the files for

the discipline reports for a predominantly middle class (higher SES) high school and that

for the predominantly lower SES high school. Use the file for the higher SES school to

compare your school's discipline reports. Let me know your thoughts and let's look at

this together the next time we talk. (Researcher email, October 20, 2020)

The teacher candidates shared their thoughts on the data in conversations later in the semester after my email. This is an excerpt from Lucy's email where she asked additional questions for investigation based on this data.

The discipline data is interesting and disturbing. I also found somewhere in those websites that the school has really high (20+%) chronic absences. Do you know if this is a widespread issue in the district? The data was from 2017, so it wasn't a COVID related problem. So, is this a problem in my school and does it affect mostly my black students? (Lucy, email, October 27, 2020)

Challenges naturally emerged for the teacher candidates throughout the semester. These challenges provided important considerations that we could investigate in terms of how equity factored in each. By problematizing each scenario through a lens for social justice, the teacher candidates were able to gain insight for how equity, and inequity, played a role.

Promoting Advocacy for Teaching Science that is Equitable. Sharing resources that promoted awareness and advocacy for equity is a practice that I used throughout the semester. I found that I adjusted both the timing and the actual resources based on the challenges that emerged in the teacher candidates' classrooms.

As previously mentioned, before the final clinical internship period began, the teacher candidates and I had each met one-on-one to explore their schools' demographics and community maps. I knew they would all be teaching in culturally diverse schools. I had already initiated the conversation that explored identity and gave them resources to review for teaching students of color and lower socioeconomic status. After the August 5, 2020 annual National Science Foundation Noyce Summit, I sent an email out to the teacher candidates that contained resources for teaching STEM that is socially just as well as the powerful keynote speech. I

requested they listen to the keynote delivered by Dr. David E. Kirkland, Ph.D., J.D. about equity in STEM teaching and pointed out some key quotes for them to consider. The email also included other resources for equity in teaching science. An excerpt of that email reveals where I began to promote an advocate stance for teaching science that is equitable for students of color and students from low-income households:

> Key quotes to introduce you to Dr. Kirkland:
>
> -"Children are not broken; our systems are. Move at the speed of trust." (2020)
>
> -"Teachers are human rights workers, and our classrooms are progressive vineyards thirsty for liberation's laborers. Classrooms are never neutral sites. They are contested spaces, where the imbrications of competing interests wrestle daily for ethical real estate. Just as they can harm, classrooms can heal. In this light, classrooms matter. Healing and humanizing classrooms matter most. They have the power to move our assumptions away from the stale and negative deficit assumptions that strip away Black humanity and toward those complex narratives of people that build humanity and nurture sensitivities toward that humanity in ways that abolish pre-existing internal and external contracts of bigotry and violence. In such spaces, teaching takes on a new meaning. Here, teaching means teaching the mind as well as the heart. It means teaching for justice, which is always and only about teaching (to) love."
>
> Please let me know your thoughts after you listen to Dr. Kirkland's message. (Researcher email, August 17, 2020)

I followed up by referring to this Kirkland keynote when I next met with each teacher candidate.

Seth responded that he appreciated Dr. Kirkland's speech in a text message. The following reflective thought is from Seth's first questionnaire addressing a prompt that asks teacher candidates to identify imbalance of power in their classroom and/or school.

> I need to recognize that each student has different needs, learning styles, dreams, and backgrounds. Treating all students the same only benefits some and can create an unfair learning environment. This can create a power imbalance within my own classroom between those being successful and those who are left behind. I see some teachers try to assume all the power but rely on discipline, so the kids rebel to try and take the power but then administration attempts a power steal to fix the situation but do so poorly making the teachers yearn for more power which...vicious cycle ensues. Main factors that I see: a) no one wanting to actually listen to a student's perspective and b) everyone feeling like they aren't respected enough making them desperately cling for power. (Seth, Questionnaire One, prompt four, September 15, 2020).

Seth reveals his awareness of power differentials that serve as obstacles to his students. He shows that he advocates for his students because "treating all students the same only benefits some and can create an unfair learning environment." He also makes an early connection to discipline. Later in the semester, Seth identified discipline as an area of inequity in his school as he learned more from his students of color feeling as if they were not treated fairly. The excerpt from his cycle three post-conference reveals his observation:

> I have quite a number of black students in my class that will tell me stories… this teacher treating them like this or that … they all have collectively kind of agreed …that they are all not given the same opportunities, not given the same respect and understanding. And they see my classroom as a safe space. …not a single one has expressed that they feel

treated the same as White kids. I think they all struggle. (Seth, Cycle Three post-

conference, November 10, 2020)

Throughout the semester, I consistently connected information from a variety of

resources with the teacher candidates as they encountered challenges in their science classrooms.

One problem that emerged early on was the lack of access to technology for students. This was

an issue both in the classroom and for students on a personal level. Lucy realized that assigning

work that required access to technology would not be fair for all of her students because many

did not have adequate access at home. She also noted that there were not computers at her school

available for students to use. She talked about how she mitigated the issues of inequity and how

she advocated for her students in a questionnaire response that prompted teacher candidates to

detect gaps in social equity in their classrooms and/or schools.

> The gap of social equity in my classroom is most apparent between students of very high
>
> SES and students of much lower SES with respect to their access to technology. I
>
> currently mediate this gap by not requiring students to use personal electronics in class,
>
> and I do not assign some of the virtual science labs that other teachers in the school are
>
> using. Without current access to computer labs, it would not be equitable to assign virtual
>
> science labs for homework knowing many of my students would have no way to
>
> complete it. (Lucy, Questionnaire Two, prompt two, October 19, 2020)

Loren had noticed that her students who were pulled out for disciplinary reasons (most

often in-school suspension), were falling behind in her class. She had mentioned it to me in

person and then a couple of days later, followed up with this response (excerpt below). This was

the catalyst for my researching the district and school specific disciplinary statistics which I sent

out along with the demographic statistics for further discussion with all of the teacher candidates.

In Loren's response, she reveals how she recognizes that by shifting her approaches for discipline, she could advocate for her students of color who had complained of unequal treatment. Loren responded to a questionnaire prompt with the following insight about how she advocated for her students who she recognized may have been treated unfairly based on their race.

> There is a difference in treatment between two of my louder students in my 8th period. One is an African American boy, and the other is a white girl. While I do my best to correct them in the same manner, my male student, B, always claims that all of his teachers pick on him. My female student, J, has never made an accusation like this. And I believe B when he says this. I know that there have been many studies that say that African American male students are more likely to be disciplined than their white counterparts. I think that it is important that I remind myself of this when B is misbehaving. He has probably been let down by many of his teachers, leading him to get so defensive when I correct him. One way I have mediated that gap is by pulling him to the side when I do need to correct him to avoid embarrassing him in class. Additionally, I let him know that I am on his side and that I want him to be successful in every way. (Loren, Questionnaire two, prompt two, October 17, 2020)

Shifting into Activism to Enact Change for Social Justice. By the end of October, the teacher candidates had revealed awareness of the role of identity and implicit bias as they increasingly got to know their students. They were also showing evidence for upholding an advocacy stance for equitable science lessons and activities in their teaching. My relationship with each of them was centered on trust and openness. They were each advocating for their

students of color and students from low-income households by teaching science that was equitable and culturally responsive.

As they managed challenges, they were beginning to recognize areas of inequity in their schools and bringing it up in our conversations. Becoming an activist in a new school was understandably a rigorous expectation. I was cognizant of the sensitivity regarding my encouraging them into an activist stance. We were also in cycle three, approaching the end of the internship. Regardless of the time constraint, I did detect small indications of some of the teacher candidates' shift into activism for social justice in their classrooms.

As mentioned above, I had sent the discipline and demographics data for the individual teacher candidates' schools along with a comparison with a local school with a predominantly White student population. This was in response to some of the teacher candidates reporting that their students who were missing from class or disciplinary action were falling behind. When I sent the data, I knew they would make the connections between the percentage of students of color and the higher percentage of in- and out-of-school suspensions. The evidence from the reports was clear that this was the case. Loren made connections with what she saw occurring with her students. She worked with her students who would normally have been sent to detention by taking alternative approaches that avoided punishments that would result in the removal of her students from her classroom. The following is an excerpt from her email.

I could *not* believe the discipline data. In my last questionnaire I talked about how my African American student, B, talked about how all his teachers "picked on" him. This data is so supportive of what he was saying. Looking at the higher SES school, where only 7.5% of the school is black, black students account for 38.5% of out of school

suspensions! It's really hard for me to conceptualize this, let alone have data that points

so specifically to a broken system. The data for [name of school removed] isn't so terrible

until you look at the out-of-school suspensions and expulsions, where 75% of expulsions

are black students. It is on each of us individual teachers to treat students fairly in their

own classrooms and stand up against others who don't. (Loren, email, October 20, 2020)

Loren's response reveals her surprise as well as concern for the evidence that revealed

her Black students were disciplined at a higher rate than White students at her school as

well as the other school with a smaller population of Black students. She explicitly stated

her responsibility as the classroom teacher to "stand up against others" who do not "treat

students fairly" which reveals her transition into activism.

After the third cycle, I met with each teacher candidate for their final post-conferences.

All had exhibited varying levels of awareness and advocacy for social justice in their science

classrooms. With each teacher candidate, I asked them to consider how they might shift into a

stronger stance of activism for social justice teaching in their science classrooms and in their

schools. I should note that at this point in the timeline, all of the teacher candidates were

expressing feeling exhausted from teaching during a pandemic. They also reported falling behind

in their university-based internship projects. I did not detect as much motivation for activism

from any of them.

In the following excerpt from Seth' response to a prompt in the third questionnaire, he

addressed how he might see himself continuing into an activist stance for social justice in science

education.

The more I think of this [activism for social justice] the more I realize I don't necessarily

do this in a general sense. When it comes to diversity I always allowed students freedom

to ask questions and encouraged them to make a relation to the lesson to whatever they wanted. As for social justice . . . I didn't really teach anything along these lines though. Maybe not when I'm a first year teacher, haha. I'm still finding out who I am, who my students are, and I struggle with following through with any social justice movement. I recognize I don't have the mindset, so I respect those that partake in big social movements like that. (Seth, Questionnaire Three, prompt three, November 9, 2020)

Seth was up front and honest about where he stood on the social justice continuum from awareness to advocacy to activism. His response honestly addressed the prompt that asked where the teacher candidates saw themselves in regard to activism in their schools.

Lucy talked about how she planned to take more of an activist approach as she continued teaching. Below is an excerpt from the third questionnaire that asked the teacher candidates how they saw themselves as activists for working in high-needs districts to continue their work for embedding culturally responsive approaches to teaching science.

I plan to continue my advocacy and activism for social justice in science education by continuing to develop and reflect on lessons that make the science content relevant and accessible to all students. I will continue to teach with the assumption that all students are capable of succeeding in science regardless of background. When possible after COVID, I would like to take further steps by reaching out to the community and incorporating local guest speakers and community-based projects to advocate the importance of STEM to the surrounding community. (Lucy, Questionnaire Three, prompt three, November 14, 2020)

Shifting into an activist stance from heightened awareness and increased advocacy was the next natural step in the progression for social justice teaching in science that I had

envisioned. I did not observe emergence into activism until the end of the semester and the evidence for this was minimal. This is discussed in Chapter Five.

Overall, the supervision practice of problem solving for challenges is where a significant amount of the evidence for how my supervision for social justice in science teaching fell out. Challenges persisted for all of the teacher candidates at various points throughout the semester. By problematizing these challenges, we unpacked the factors that contributed to problems and issues for the classroom students. By breaking the challenges down to better understand the areas of inequity that play contributing roles in challenges, the teacher candidates were able to address these in their classrooms and begin to recognize similar social justice concerns in other areas of their classrooms and schools. Through this process, I found I was able to promote the teacher candidates' advocacy for teaching science that is equitable for their students. While I can report observing their increase in advocacy for their classroom students, I observed only a mild shift into a stance for activism for enacting change in their schools.

Practice – Networking with Others to Expand Ideas and Resources

Throughout my own training and work as a university supervisor, I was always supported by the interactions with other supervisors, with my peers in my program, and with my research partners in equity-based studies. I noticed that this practice of networking with others in the field to share ideas and resources had become a regular approach to my supervision for social justice. I made it a point to document those times when reaching out and networking with others played a role in my supervision of the science teacher candidates.

Augmenting Supervisor (my) Learning. I had continued my relationship with some of my prior science teacher candidates, each of which had developed into more of a professional friendship. The former teacher candidates all were teaching in their science fields in high-needs

schools. It is with this group of former teacher candidates (current teachers) that I sought

feedback and additional ideas. I had supervised them in the past implementing similar practices

for social justice that I used in this study, I had just not ever clarified nor refined them until now.

I connected with a key resource who is a local community leader as well as the reverend

of an African American church. I met with him prior to the semester in hopes of gathering

additional insights and ideas for how I could supervise science teacher candidates for social

justice. The excerpt from my journal below displays some of the content and new strategies I

learned from that meeting.

> [The Reverend] and I discussed the challenges of youth from traditionally marginalized
>
> communities and the struggles they face on a daily basis just based on the color of their
>
> skin and the location of their homes and communities. He made the connection between
>
> schools and schooling. [He] shared stories of his childhood and the teachers that he
>
> remembered. Specifically, he told me about one teacher who ended up also being a
>
> member of his local worshipping community who knew his grandmother. That
>
> connection was a powerful reminder to him as a child that his education did not just
>
> happen in the classroom, rather what happened in the classroom extended into his
>
> personal life. His point was that when teachers are involved in their students' lives
>
> outside of their classroom, they can build bridges and make important connections to
>
> promote the education of a student as a community endeavor and not just something that
>
> happens only in a classroom. He invited us to services, but they are only on zoom for
>
> now because of COVID-19. In the meantime, he emphasized that we needed to get out
>
> into the classroom students' communities – go to the restaurants they eat at, go to the

local events, go to their sporting and musical activities. (Notes from meeting with the Reverend, July 6, 2020)

One former teacher candidate in particular has always been close and we have collaborated on a number of lessons, problematized issues in her chemistry classroom, and co-investigated and discussed social justice topics in relation to teaching science. In particular, we have held multiple discussions for how to support new teachers to teach in ways that are welcoming to all students and make the content relative to students of all cultural backgrounds. By attending a speech by Gloria Ladson-Billings hosted at our university, we bonded over a shared commitment to culturally responsive science teaching. Her feedback on my supervision has been critical in bolstering my practice for gaining new insight, ideas, and resources. The following excerpt from my journal reveals one of those interactions.

> We talked about how we can piggyback on socioscientific issues as a conduit into areas for making the science content culturally responsive and sustaining for all students in the classroom. She talked about ways teachers can connect with their students on their level, whether it's hip hop, or video games, or 'Among us' (the current favorite teen game going around). I had not considered other popular culture realms such as video games and social games – I need to follow up on this with my current TCs. She said that it is important to at least know what the students are talking about in their worlds and what generates excitement. Use their language and then toss in some one-liners and zingers into the classroom verbiage and it throws kids off that you know something that is important to them and can actually talk about it. She reported that kids really respect and respond to that. (Researcher Journal, September 30, 2020)

Each time I reached out to this particular former teacher candidate, she was always willing to share ideas and discuss challenges. Her strategies were based on her own experiences implementing culturally responsive chemistry planning and teaching. A significant realization that came from my self-study was the importance of my relationships with prior teacher candidates. The continued dialogue eradicated any power differentials and elevated our professional friendship in a way that allowed for an even more open, honest, and trusting space to unpack challenges and support each other.

One thing was clear; the COVID-19 pandemic added an extra layer of stress and work on the teacher candidates. Teachers across the district were reporting varying levels of frustration and exhaustion with the scenario. I observed this unfold throughout the semester with the teacher candidates. In fact, by the end of their internship period, I was especially concerned for two of them in particular. I reached out to a local school board member whose specialization is mental and emotional health to discuss my experience supervising teacher candidates for social justice during the pandemic. We met at a local Starbucks. Below is an excerpt from my reflection on our conversation.

Key insight from the conversation with [the school board member]:

With regard to emotional aspects of teaching during the pandemic, tell my TCs that what they are experiencing is valid and let them know I am listening. Let them know that what they are observing regarding poverty and students struggling as a result is hard to see unfold in their classrooms and they need to know that even just by being present for their students, they are bringing those students love and care that many of them may need. Share with them that I am speaking to professionals in the field because I want to be a better support structure for them. Let them know that I want to do better to listen and

understand but I also need to help them to stay focused on the positive results of their work. This is for their own mental health.

[She] gave me some prompts to use to keep my TCs focus on the positive. Ask my TCs, "List one area where your student(s) experienced success today.", "List 3 ways in which your students are learning or making progress." She pointed out that I do not always need to be the cheerleader and the sole source of talking about the positive aspects of my TCs' work/teaching. By shifting the onus for positive mindset to the TCs, I could more effectively encourage them to focus on their positive impact on their students. She suggested that I include this as a strategy for each and every time I meet/talk/text/communicate with my TCs. This will shape them to be prepared to have these reponses ready to answer for me and this will shape their mindset to keep the positive outcomes of their work in mind even when situations for their students and for themselves are incredibly challenging. (Researcher Journal, December 13, 2020)

The practice of networking with others to expand my learning of new ideas and resources proved to be integral to my supervision. These opportunities to share and discuss my experiences with others augmented my learning and enhanced my practices. I also was able to discuss some of the challenges in ways that the others provided an alternative perspective and pushed me to think in different ways.

Extending New Resources / Strategies to Assist Supervision for Social Justice in the Science Classroom. All of my teacher candidates struggled in communicating with their English language learners (many of their students were low to no proficiency level). I was working on this challenge with each of them one-on-one. I realized that what I was learning in the work with one teacher candidate could carry over to assist other teacher candidates. I needed to find an

efficient way to share the apps and tools with all. It is critical that we consider the linguistic challenges and lack of resources that ELLs face which serves to marginalize them from science (Lee, et al., 2013). I composed an email in which I addressed tools to help translate websites and notes for our English language learners. I also included a variety of resources to help promote the awareness of the many Latinx scientists in the field that the teacher candidates could share within their classrooms. The excerpt from the email below was sent about midpoint in the semester.

> This is a call to us, as STEM teachers, to ensure that we are recognizing the talents and interests that your young Latinx students bring to the classroom. With this being National Hispanic Heritage Month (https://hispanicheritagemonth.gov/), consider highlighting the many contributions of Latinx scientists to history and society today…, please share this article in your classroom which shares 100 current Latinx scientists contributing to their fields. (Researcher email, October 13, 2020)

Loren responded by printing some of the images and descriptions out to post in her classroom.

The following excerpt shows how Sienna was able to use some of the resources I shared with her.

> So, there is another student whose language barrier came into play. The tools and the apps that you showed me seemed to help her with some of her assignments so she's on the cusp which is better. She's really been putting in a lot after the first nine weeks. Using the translator apps for the websites helps too. I think she kind of put her act into gear a little bit more now that we are better at communicating. And so, I think it's kind of helping her. Because I think that part of her issue last semester, last nine weeks was really just not putting in the effort that she needed to because we just couldn't understand each other. (Sienna, Cycle Three pre-conference, November 4, 2020)

Sienna reveals her transformation in her beliefs about what this student could do based on the outcomes of her effort to enhance the communication with her student through the apps.

As previously mentioned, I have found the research and strategies of reality pedagogy (Emdin, 2016) to be instrumental in guiding my supervision as well as supporting my teacher candidates. In addition to the book that I provided to each of my teacher candidates, I followed his work online and through social media (Twitter). I implemented his strategies to supervise the teacher candidates to create lessons and activities that are culturally responsive to their classroom students' backgrounds. Loren was the most receptive to the ideas in the book and actively embedded them into her lesson plans. The excerpt below from my journal specifically addresses how Emdin's work impacted my supervision.

> Through Emdin's work, I have learned more about how to connect reality pedagogy and the culture of hip hop with education, and specifically science education. When [teacher candidate] set up the hip hop / rap assignment for atoms and atomic history, she reported most students engaging at very high levels, even students who had not done any work in her class up until that point. Emdin makes a salient point in that we need to know our students, know who they are. Music is an excellent segue into their lives. If we can talk about some of the cultural aspects that students identify and admire, then we gain access to their trust. Tying science concepts into the classroom in a way that allows students to grasp and apply the ideas from their perspective has potential for transformative teaching. (Researcher Journal, November 28, 2020)

Here my journal entry reveals my increased understanding about how to supervise teacher candidates to include their students' cultural choices for music as a connection to the science

content. This is based on the work of Emdin, whose ideas Loren and I followed when designing this project.

The supervision practice of networking with others to expand my learning for new ideas and resources provided me with a way to integrate successful strategies with the teacher candidates. I found that frequent communication with each teacher candidate helped to ensure that I could transfer the additional ideas for how to implement strategies to promote awareness, advocacy, and activism for social justice in the classroom.

The practice of networking with others to expand ideas and resources to assist my supervision for social justice in the science classroom played an important, but perhaps not obvious, role. Networking often was based on managing challenges as they arose during the internship period. By reflecting on my practice, I realized the necessity of forming a network with others in the field. This was especially important because supervision can be a lonely process. While calibration meetings at the university provide brief opportunities to connect with other supervisors, we generally only work with the teacher candidates due to time constraints.

Practice – Reflecting as a Catalyst for Shift

My journal became the default space for collecting and organizing my notes, observations, ideas, and new points to consider. Recording the interactions, insights, new perspectives, emerging challenges, and other aspects of my supervision work proved to inspire deeper reflection. It is this journal that served as the medium for me to review and reflect on my supervision as it unfolded based on each interaction with my teacher candidates and outside resources. This explicit practice for reflection prompted additional consideration for my supervision strategies and approaches.

Increasing Teacher Candidate Learning. Reflection served as a catalyst for a change in the way that I supervised as a result of the teacher candidates' own learning. Early in the semester, I included two video clips that directly addressed implicit bias along with a suggestion that my teacher candidates take the *Harvard Implicit Bias* test. While I recognized and shared with them the imperfections of this test, I asked them to use it as a way to become more introspective about their identity and how they perceived the identities of students from different cultures. The following excerpt is from my journal reveals my reflection about how I address implicit bias.

> Around the middle of September, after each TC's cycle one, I sent the Ashley Hall TED Talk and the Melanie Funchess TED Talk; both addressed implicit bias. I also sent the Harvard Implicit Bias online test. (Note to me: emails were all on an individual timeline at this point, so I was tailoring each of the resources and strategies I used for each teacher candidate in a way that was unique to their situation and needs). I wanted to wait until my TCs had all spent a few weeks with their students at this point before delving into talking about the hidden biases that we all most likely carry. I wanted them to think about this topic in relation to their classroom students as they got to know them. (Researcher Journal, November 20, 2020)

Loren reflected on what she understood about implicit bias and how she planned to continue her advocacy and activism for social justice in her science teaching in this excerpt from her third questionnaire.

> I previously would have labeled myself an unbiased person. I now know that every person has bias simply because of who we are. It is important for us to recognize our implicit bias so that we can ensure that we are not acting on stereotypes or fixed

mindsets. This is important for social justice teaching to ensure that all students'

emotional and academic needs are being met and that we are addressing the concerns of

the outside world in our classroom. It is important that I bring chemistry into the real

world and the real world into my classroom for all of my students, not just those teachers

might think will be most successful. (Loren, Questionnaire Three, prompt three,

November 11, 2020)

As seen in this excerpt, Loren recognizes her shift in self-awareness of implicit bias. She

then extends her advocacy of teaching socially just science by clarifying that she is not only

meeting her students' academic needs, but also their emotional needs by connecting the

chemistry into their world in a way that she is "addressing the concerns of the outside world in

our classroom." Upon further reflection on Loren's response, I realized that the emotional aspect

of the classroom students is an area that I have not talked about with my teacher candidates. This

led me to investigate more about social emotional learning (SEL) and how I can incorporate this

going forward.

Sienna had been teaching about cells, bacteria, and viruses within a project based

learning set of lessons based on the Henrietta Lacks story. In our cycle three pre-conference, we

reflected on what Sienna had learned about her students' backgrounds and identities and how she

had unpacked some implicit biases she held at the beginning of the semester. She pointed out

how her assumptions for what students know and what they learn at home did not match the

reality of her students, especially her students of color and from low-income households. This is

an excerpt from the pre-conference with Sienna talking about the final project she was planning

for her students, the creation of their own Ted Talk.

I also realized some students may have already known what TED Talks were if they were in a family who watched educational talks like that or were in a family who had a high level of educational background. But some of them didn't have any idea what a Ted Talk was, and I realized that not all students come to school with the same access to education at home. I realized that I had students who did not have family members who talked about science and watched videos like TED Talks at home. (Sienna, Cycle Three pre-conference, November 4, 2020)

Sienna openly shares her prior assumptions before teaching and then her shift once she realized that not all students knew or had seen a TED Talk before. She adjusted her lesson leading up to the project by including sections of other TED Talks. In each, she pointed out the main characteristics of the TED Talk and created a guide for students to follow. Upon reflection, I realized that I too had assumed that all students knew what TED Talks were. In my mind, kids are all on social media and I had lumped TED Talks into the group of apps they use. This caused me to pause and reconsider which apps I would recommend science teacher candidates use in the future. I conducted a search online to find out how other science teachers were using social media. Tik Tok has become a popular platform for teenagers, and I found some science teachers using Tik Tok with their students' assignments. Flipgrid is another way to encourage students to create audio/video science presentations.

Like the other teacher candidates, Seth also recognized early on that his students were not doing homework as a result of real world challenges. His original assumption that the students were just lazy or not motivated shifted as he got to know his students and realized how many of them had a number of responsibilities outside of school. In this excerpt he talks about his implicit

bias about his students who were not doing homework and the importance of getting to know their backgrounds before forming assumptions about what they could and could not do.

> The only thing is a lot of teachers in this school will very much treat the kids as if they don't work, don't have jobs outside of school, and I found out that most do. I didn't know my kids had jobs and other things going on until I got to know them and I realized that they weren't just being lazy and defiant. Some teachers here give a lot of homework. I am one of the very few teachers that don't give a lot of homework and it shows because the kids who work after school, they're dying, dying. (Seth, Cycle Three post-conference, November 10, 2020)

Seth reveals how he adjusted his classroom expectations for homework once he realized that his students were not "lazy and defiant." After reflecting about this shift in Seth's assumptions about his students, I found myself wondering if I need to implement a strategy for explicit discussion of the adult responsibilities that many low-income students have outside of school. And if I should address this as early as possible each semester. Three teacher candidates discovered and adjusted their classroom assignment expectations based on learning more about their students' lives and background experience after the first month or so had passed. I realized that I had missed a critical lesson and possibly by addressing it earlier could have helped to prepare the teacher candidates for the reality of students from low socioeconomic backgrounds.

Each of the exemplars above reveal how, through reflection, I learned more about how to shift my supervision practices based on the learning of the teacher candidates. This is to say that I refined and enhanced my practices as a result of reflecting on the teacher candidates' shift in their assumptions and teaching practices in order to enact a more socially just science classroom.

Expanding My Learning. The process of reflecting on each aspect of my supervision provided me with a pause to review events and find deeper insight, create new ideas, and seek additional areas for investigation. Taking the necessary time to review my notes, consider the outcomes and any alternative paths I might have considered, has led to a deeper understanding of my supervision practices for social justice in science.

I reflected on the third pre-conference with Sienna where we discussed the realization that many of her students had not been exposed to TED Talks as we had assumed. In this excerpt below from my journal, I can detect an expansion of my own understanding of classroom students.

> Sienna addressed this by showing a variety of sample TED Talks segments to her students and then explained to them the point and process. Going forward, I could find resources that teacher candidates can use to bring a more culturally relevant connection between the science content and educational videos that include current events and topics that interest the students. I also realized that we cannot just simply call out to inquire which students do or do not know what a TED Talk is. Some students may be embarrassed about sharing their lack of access or experience with resources such as these. This is something to bring up in future conversations with my teacher candidates when we talk about access to and familiarity with information. (Researcher Journal, November 4, 2020)

Taking the time to review this conversation led me to realize that teacher candidates may need to find ways to gain insight to what types of media and programs their students have access to and watch at home. I, myself, had assumed that all students knew what a TED Talk was; I thought it was a fairly ubiquitous form of social media. Upon further investigation, I discovered

that programs such as VOX are more readily used and recognized by secondary students. If I had not taken the time to reflect on this, I would not have learned about this resource for information that aligns more with students.

At the end of the semester, I compiled all of the email conversations between the teacher candidates and me into one document. I reviewed and coded the emails and followed up by reflecting in my journal. In the previous semesters, after the end of the internship period, I had never gone back through to review my emails. This excerpt from my journal exhibits some of my updated thinking and learning that resulted.

Email has always been a conducive medium for transferring information and resources. I tried to incorporate different colored text, horizontal lines, images to assist in making the longer emails easier to navigate – especially when I included explanations and suggestions for any particular activity or idea. All of the TCs were very responsive during the first month or so but I noticed that the turnaround time on responses dropped off after the first cycle and then gradually declined as the semester progressed and they were busier and busier (and increasingly expressing feelings of being overwhelmed and stressed out). It was at about this same time that I can see where I was sending less emails to the whole group. I had shifted to tailoring the emails to a one-on-one basis as I realized that each TC needed different types of support for teaching for social justice based on their unique schools and classrooms. I do not think I realized I was doing this as it was unfolding but taking this time to collate the emails into one document allowed me to reflect on this mode of communication that I had never really considered in the past. (Researcher Journal, November 20, 2020)

Tailoring the messages and resources for social justice in science emails came about naturally as I responded to each individual teacher candidates' issues as they arose in their classrooms. As this excerpt from my journal reveals, reflection was how I came to realize I was doing this. From this I learned that my role as supervisor should also include anticipating the different ways that I can engage with the teacher candidates that will enhance my efficacy for promoting social justice in their science pedagogical practices. I also organized my resources and ideas by theme on my computer so that in the future, I can quickly retrieve the resources that have proven to be effective as specific needs arise.

As previously mentioned, I had reviewed, responded to, and incorporated the information from the questionnaires from each teacher candidate as they came in throughout the semester. At the end of the semester, I went through them all in their entirety in an effort to seek any missed opportunities for insight and deeper knowledge. After a complete re-reading of the responses, I compiled my reflections in my journal. This excerpt shows some of the ways I learned from the final reflection of the questionnaires.

> Overall, the three questionnaires over the semester were incredibly insightful for guiding how I supervised to infuse a social justice framework within my supervision. Based on the honest, eye-opening, and revealing level of content shared with me in the questionnaires this semester, I think I have found a good mix and number of questions to use with my future TCs. I do think that my involvement and earnest efforts to develop a trusting relationship with each of them before sending out the questionnaires was critical to their being forthcoming. The other positive aspect of the questionnaires is that the TCs are incredibly busy, so time is very limited, and this gave them ample space to think about and respond to the prompts. However, the questionnaires ask some rigorous and

possibly uncomfortable questions regarding identity, equity, social justice. I wonder if

they were more comfortable answering them in written format and not in person. Maybe I

should have explicitly asked them that question. Would some of them have preferred

more of an in-person direct interview? Time constraints again though. (Researcher

Journal, November 28, 2020)

From this reflection, I learned where I could be more efficient, intentional, and impactful with

the questionnaires. I also posed the question about needing to find out if written versus in-person

questions would provide more open and revealing insights. The opportunity to reflect on this

strategy provided me with additional areas to consider in future semesters.

At the end of the semester, as I reviewed my notes, emails, text message, and journal, I

considered how I could modify my practices for supervision of social justice in science. There

were a number of challenges that emerged over the semester. Some were normal challenges that

come about during most final clinical internships. However, the pandemic brought to light just

how much classroom students had been impacted, especially those from culturally diverse

backgrounds. While certainly a struggle for my teacher candidates, this provided more data for

me to consider my knowledge and skill for supervision practices. The excerpt below comes from

one of the final entries in my journal.

Through the work with my TCs, we unearthed the challenges for many students from

low-income households and students of color. This included access to resources,

connections to information (science skepticism), transportation, technology (both in the

schools and at home), parent involvement, and challenges faced by ELLs. As a result of

the pandemic, an earlier awareness emerged for all of the TCs regarding equity. The TCs

and I both had to be prepared and engaged to recognize and manage these issues from the

first few days of school. The TCs realized quickly that applying an equality-based (as opposed to equity) approach to teaching will not sufficiently provide the most optimal learning environment for students who are not as privileged financially and/or maybe speak a different language at home came up early in my conversations with all TCs. For the most part they swiftly shifted their teaching to a more culturally responsive and sustaining approach with fidelity to standards for equity. For me, I realized that my previous general timeline for integrating social justice practices with TCs from past semesters no longer applied. As the supervisor, I needed to be engaged with and receptive to my TCs more frequently. I needed to be ready to adapt to any emerging situations quickly and easily within each of the TCs' classrooms. (Researcher Journal, November 28, 2020)

This excerpt from a final reflection of my data at the end of the semester reveals how I learned the importance of flexibility in my work as a supervisor. I noted that I had a general timeline for how I would implement the various resources and strategies throughout the semester. I had organized the resources and plans for integrating them in a folder on my computer and this included notes I had jotted down to help guide when to send each. A key new learning for me as a supervisor was the importance of remaining available and connected with the teacher candidates throughout the semester, especially as it became progressively busier and more challenging. It was during these most challenging times that I had to pivot and revise my supervision in order to maintain the social justice framework.

The practice of reflection presented me with intentional space and time to review, reconsider, and revise my strategies for supervision based on new insights and learning. Reflection conducted a pathway to gain deeper understanding which assisted in enhancing my

supervision for social justice. This included the learning that came directly from my supervision as well through the vicarious experiences of the teacher candidates as they discovered and managed new information. As a result of devoting time explicitly to reflection, I found I was more apt to shift my methods, remind myself of issues to follow up, try alternative intervention strategies, incorporate novel ideas and resources, and even promote deeper reflection on the part of my teacher candidates.

My Learning about Supervision for AAA

In this section, I will present the findings for Research Question Three: What have I learned about my supervision for awareness, advocacy, and activism for social justice based on my experiences with secondary science teacher candidates? To answer this question, the review of and the coding of my self-journal proved to be the most revealing and insightful source of data. By returning to the data after reviewing my journal, I discovered areas of learning that were not evident at the time of the events. The amount and depth of new information that I have gained was illuminated through this process of self-study. This section is divided into three broad categories: 1) new resources, 2) inequities in the system, and 3) shifts in my supervision practices that resulted from working with science teacher candidates.

New Resources

I learned about new resources during this period of study; both tangible programs and intangible insights and ideas. Each resource helped to support culturally responsive science pedagogy. Implementing novel ideas for culturally responsive teaching, how to use new technologies, and the importance of networking provided additional pathways for enhancing my supervision practices.

Novel Ideas for Culturally Responsive Science Pedagogy. Through my supervision for awareness, advocacy, and activism for social justice I became aware of novel ideas that the teacher candidates used based on a culturally responsive framework. They implemented innovative activities within their lessons in order to connect the science topics with their students' backgrounds and lives. Some examples include having students design analogies of the science concepts based on their communities, defend their position about controversial science-related issues, debate the ethics and equity of science-based scenarios, compose hip hop and rap songs to represent their understanding of the science content, interact in real-world reenactments of forensics cases, devise nutrition plans for fictional or real characters, and prepare video presentations that presented and adopted a position on a science topic. Through each of these attempts to plan and teach science that connected to the lives of the classroom students, I recognized the potential for new culturally responsive lesson ideas to adapt and share with future teacher candidates.

The collaborative review of classroom student work with the teacher candidates provided a source of affirmation and encouragement for the work I had been doing with supervision of science teaching that is centered on social justice. Loren utilized Emdin's (2016) reality pedagogy framework from the book that we had read. Instead of traditional science classroom quotes (e.g., Einstein, Faraday, Rutherford), Loren posted quotes from popular music artists on her board. She and I reviewed her students' rap and hip hop creations that they created based on atoms and atomic history. The student work was rigorous in creativity and depth of content and context. Some of the students created audio files of their hip hop music and performed for their peers in class.

Loren and I met to discuss the outcomes. She reported feeling excited, specifically about the high quality of work that students turned, especially from those who normally would not turn in any work. We discussed creating lessons and assignments that students could identify with and that would embrace and sustain their cultures within science ideas. I learned that in order to teach secondary level students, a segue into their lives can be through music. Overall, as I noted in my journal, "I learned that I can support the TCs by encouraging open-ended, non-traditional assignments such as the hip hop atomic songs" (Researcher journal, October 5, 2020).

Technology. Due to the blending of in-person and online students, the teacher candidates and I quickly realized the need for new strategies to connect all of the students. Some of the new resources I discovered included technology programs and applications such as Google Classroom, Flipgrid, Band, Jamboard, Bitmoji Classroom, Kahoot, Nearpod, Microsoft Virtual field tip creator, language translation apps, and TED Talks.

This can be seen through my interactions with Sienna, who had the most online learners throughout the semester. About half of her students attended in-person and the others joined online. The school she taught in had classroom Wi-Fi enabled tablets for students to use. While this is not a ubiquitous situation for schools in this district, it did present an opportunity for Sienna to incorporate a number of applications for connecting both groups of students (in-person and online). By observing and reflecting on the outcomes of the classroom lessons with Sienna, I learned how Google Classroom is a versatile platform that pairs well with Canvas (the academic program for grades, assignments, messaging, etc. used across the district). Many other online applications supported the simultaneous in-person and online teaching.

Finding a way to connect with students from culturally diverse backgrounds is more challenging with online learners. Sienna used collaborative apps such as Jamboard, Flipgrid, and

Bitmoji Classroom to post prompts that elicited responses from students that connected with their backgrounds and encouraged further exploration and discussions between students. For example, Sienna posted the following prompts on Jamboard to engage students in conversation: "1) Why is it important for you to understand how the cells in your body work? 2) Do you think science education helps you to take better care of yourself? 3) What skills do you need to advocate for yourself?" The following contains some of the students' comments from my observation notes:

> Many students' responses included the importance of vaccines and contributions to medical knowledge. Isaac said he would be questioning a lot more and doing more research on his own because he wanted to be able to help someone in his family if they needed it. Kevin asked a question about people with low blood cells and wondered if giving blood was ok. Abdulla said it is important to be aware of and to be knowledgeable and understand what it means to be informed about medicine and science. Zeke pointed out that science is a gateway; he suggested that knowing more about science can help him to help others. (Cycle One observation notes for Sienna, October 1, 2020).

Other collaborative apps that I learned about such as Jamboard, allowed students to consider their peers' perspectives and build off of each other's ideas. Sienna also used the Jamboard collaboration space to review student responses as an entry point for connecting the lesson with what students knew and what they wanted to know. Many of the students recognized that they needed to become informed in ways that might help their families. I noticed that all students were able to provide their answers simultaneously, even though half of the class was online. I learned that applications such as Jamboard are ideal methods for connecting with and

increasing the number of students who can have a voice in the discussion, both online and in-person.

Sienna also incorporated TED Talks with her science content. She went beyond merely presenting the video clips. We discussed how students can use platforms like video to express their voice about important scientific topics. In this project, the classroom students adopted a stance about medical ethics, equity in the field of science, the importance of understanding health issues, and connected it to their cell biology curriculum. They worked in groups to create their own version of TED Talks to share their understanding of the science and how it impacts their lives. From this, I realized teachers can extend the use of videos such as TED Talks beyond merely watching. Performative platforms such as video and social media (TikTok for example) are ideal spaces for student-generated work and opportunity to express their opinions, and their voices. I will continue to encourage teacher candidates to use video and social media applications as a method for students to demonstrate their learning and their connection with the science content.

Throughout the semester, the teacher candidates and I explored a variety of new computer programs and apps for translating and communicating with English Language Learners (ELLs). Each teacher candidate used different translation programs depending on their students and classroom situations. This often required trying different options to find the best fit for individual students. For example, in Seth's situation, he did not recognize the needs of his ELL students until later in the semester. He had expressed frustration about the lack of information and support to teach his Spanish-speaking students. Based on the work with the other teacher candidates who had already implemented a variety of translation apps and programs to convert notes and websites, I was able share the most effective new programs with Seth. Through the

process of searching, integrating, reviewing, and sharing the various translation programs with the teacher candidates, I learned more about the most ideal resources to support teaching students who are learning English.

Networking with Others in the Field. Some of the new ideas I learned were adapted from my experience from one teacher or teacher candidate to another. This led me to realize that with the requirements of social distancing during the pandemic, teachers are siloed in their classrooms more than ever before. Collaboration had been reduced due to the COVID-19 safety guidelines. The online and in-person teaching was a critical challenge for the teacher candidates. I realized based on a review of my text messages, that I was spending a great deal of time transferring ideas between my communications with other Noyce science teachers (former candidates I supervised) and the current teacher candidates. This was a recurring phenomenon prior to COVID-19; however, the pandemic actually instigated a heightened recognition of this. I learned how to create a private Facebook group (see screenshot of the Noyce networking Facebook introduction page in Figure 2. located on page 219). I connected multiple Noyce science teachers including the teacher candidates whom I was supervising at the time. This ongoing social networking platform presents an online network for the teachers and teacher candidates to share resources, ideas, challenges, and other items related to science teaching. During this academic year during the COVID-19 pandemic, this served as an effective networking tool for the teachers to stay connected, especially as many were expressing feelings of isolation due to the restrictive social distancing guidelines.

My search for, discovery of, and implementation of a variety of new resources in collaboration with the teacher candidates during this study period proved to be the catalyst for the learning in the work of social justice supervision I described in this section. In the next

section, I present the increase in my own learning about certain inequities within the school system and the science classroom. These areas of deeper understanding have played a role in how I have adjusted my practices to supervise for awareness, advocacy, and activism with the science teacher candidates.
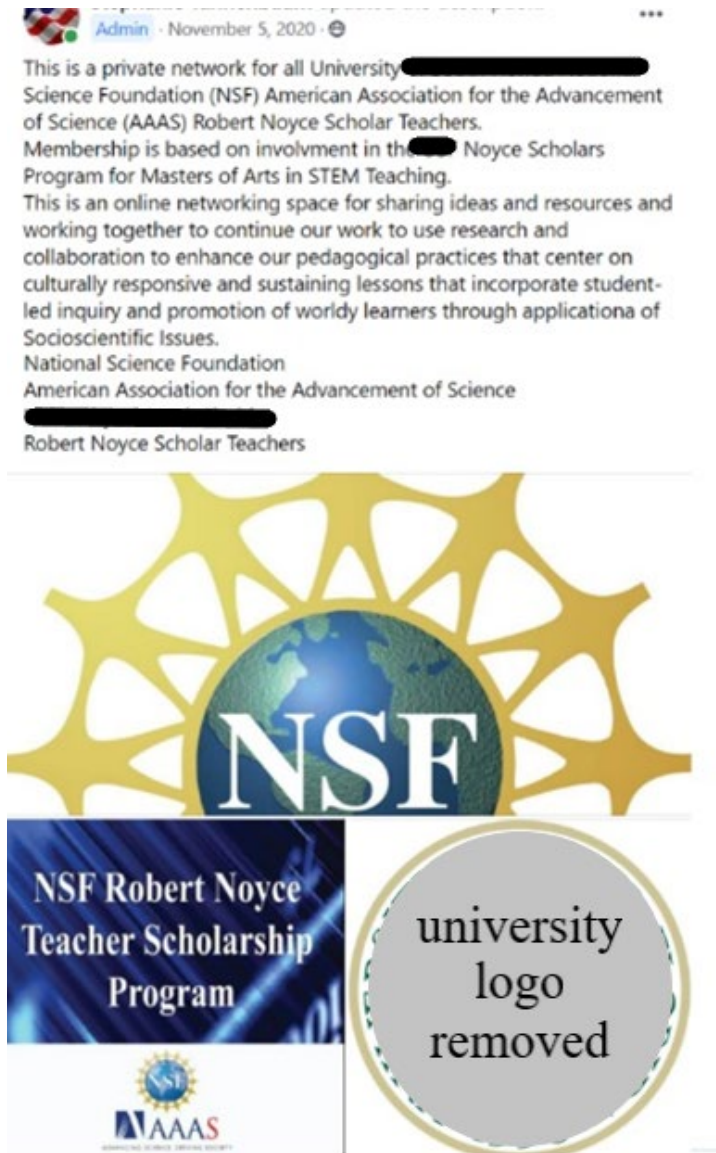

Figure 2. Facebook University Noyce Network Group – Introduction Post

Inequities in the System

At this point in my journey as a doctoral student in the field of science teaching, I had gained considerable insight into the work that needs to be done to supervise science teacher candidates to teach within a framework of social justice. The collaboration within coursework, an extensive review of the literature, and prior work with former cohorts had already provided increasing recognition of the inequities in the school system. Furthermore, these experiences had prepared me to supervise science teacher candidates to become aware of their students' culturally diverse identities in relation to the inequitable representation of access. Through the self-study process, I centered the focus of the research lens onto my own personal learning. This created a space for me to reflect rigorously on what I thought I knew and understood, how to dig deeper for more knowledge, and how that could impact my practices for social justice science supervision.

Prevalence of Students from Low-income Households. I was already aware of the prevalence of students from low-income households in this district based on regular review of the demographic statistics and collegial conversations with other teachers and practitioners. However, I experienced a heightened recognition for this critical concern through the eyes and experiences of the teacher candidates. During this COVID-19 pandemic, lower socioeconomic status and the impact on students was distinctly more obvious and problematic. The pandemic brought into sharper view the large number of students whose families and communities are economically challenged for both the teacher candidates and for me. I realized that many students often hide their economic conditions and as teachers, we may never realize how their families may be financially struggling. Poignantly, I realized that in the past I had not applied

due diligence to supervising teacher candidates to be prepared to work with students from low-income households.

Despite having reviewed the district demographic reports revealing the majority of students in the schools representing lower SES, it was not until the teacher candidates were working in their classrooms that they rapidly became aware of just how significant the challenge was for students from low-income households. As the greater distinction between middle- and lower-class students came to light, I personally realized more than ever just how adept many low-income students have been at hiding their socioeconomic status. The teacher candidates and I reviewed some of the research about the effects of poverty on learning. For example, we referred to the work of Jensen (2016) to reinforce how low-income students need strong instructional support, a positive relationship with their teachers, and a sense of security in the classroom (I had provided each candidate a copy of the book or PDF files of the chapters).

With the economic challenges in this district, the curtain was pulled back exposing in sharper contrast the stark reality of the low SES demographics of students. This is a challenge that teacher candidates were quickly alerted to as a result of the COVID-19 pandemic. Prior to this academic year, I now realize that I had not devoted supervision practices to support teacher candidate awareness of and advocacy for their lower-income students. The pandemic caused the families of many students to suffer from critical economic crisis in ways that could not be hidden. I had to adjust my practices to better prepare and support the teacher candidates to mitigate this particular problem.

Lack of Support for English Language Learners. Up until this semester, my assumption was that support staff and resources for ELLs was readily available within all of the district schools. I learned that this is not the case. At two of the teacher candidates' schools in

particular, they were informed that support staff do not exist for their ELL students. I had to scramble to search for appropriate science programs online that the teacher candidates could use with their ELLs. A critical realization for me is that there is a dearth of resources that specifically address secondary science for non-English speaking students.

An additional challenge is that almost all of the ELLs that my teacher candidates teach are from low-income households, including some who are from migrant communities. I had already been aware of this connection between many of the English language learners and socioeconomic status based on literature reviews and personal experience. However, it had not been as prevalent and persistent a problem for the teacher candidates as it was during this semester. In my recollection from experiences in the past, the schools provided resource teachers and programs to support ELLs. I am unsure as to how much the lack of resources and support for ELLs could be attributed to the pandemic, to the recent budget cuts in this district, or to something else. I observed the teacher candidates struggling with communication and connections to science teaching resources more than I have ever witnessed prior to this semester.

As mentioned in the first section about new resources, I discovered a number of applications that were helpful for translating notes and websites. The teacher candidates implemented these at varying levels of success. This process was frustrating at times because the translation programs are not always a match with the specific dialect that students speak. Most of the ELLs spoke a particular dialect of Spanish. We found that the translation programs converted the notes and websites to an academic form of Spanish that did not always transfer to the individual ethnic dialects of the students (e.g., Columbian, Puerto Rican, Guatemalan, Mexican). After a third post-conference with one of my teacher candidates, I reflected in my journal on the outcomes.

Lucy reported that most of her ELLs had been able to stay somewhat on course through the use of the various translation programs we found to convert the notes, activities, assignments, and websites (all in Spanish for her ELLs). However, the two sisters who speak no English only made marginal progress. Over the entire semester, there was not an ELL resource person at her school (I was informed that they had been let go due to the district budget cuts). The other problem is that with many students online, those who would traditionally sit with the ELL students to help translate were not present in the classrooms. In this situation, there were not any other students in this particular class section who could speak Spanish. Lucy developed vocabulary sheets so that the ELL students could start learning the science words in English. She showed them some Kahn Academy videos. Even though they were not in Spanish, they were lab-based, and the visual components of the lab were feasible for at least visually representing some of the science. She also gave them diagrams to use. (Researcher Journal, November 16, 2020)

While I was aware of the need to supervise teacher candidates to construct accommodations and modifications for ELL students, I had not realized that there are minimal free resources to support ELLs specifically with the secondary level science curriculum. Furthermore, my assumption that there are staff members supporting teachers of ELLs at every school proved to be incorrect. I recognized the need for additional support in order to effectively communicate with ELLs. This is an area for which I relied on ideas and resources from other science teachers shared within our network.

Student Discipline. Loren noticed a critical disparity in discipline for students of color at her school. She pointed out specifically a situation where two students in her 8th period were both commonly talkative in class to the point of disruption. She reported that the Black male student

claimed his teachers picked on him and assigned him frequent in-school detentions and suspensions. The White female student had not received disciplinary action to Loren's knowledge. She shared that both students are commonly known for their outspoken, oftentimes disruptive, behavior. Loren stated,

> I think that there have been many studies that say that African American male students are more likely to be disciplined than their White counterparts. I think that it is important that I remind myself of this when [Black male student] is misbehaving. He has probably been let down by many of his teachers, leading him to get so defensive when I correct him. One way I can mediate that gap is by pulling him to the side when I do need to correct him to avoid embarrassing him in class and keep him from having to miss class due to detention or suspension. Additionally, I will try to let him know that I am on his side and that I want him to be successful in every way. (Loren, Cycle Two questionnaire, October 17, 2020)

I connected Loren's observation with our earlier conversation from the pre-semester meeting when we reviewed the school data. I went back to my notes and reviewed where we had read the Great Schools (2020) report pointing out that Loren's school

> rated below average in school quality …. Students here perform below average on state tests, …[and] has below average results in how well it's serving disadvantaged students…. [with] Large disparities in suspension rates …. where disadvantaged students … may be falling behind other students in the state, . . . (Great Schools, greatschools.org, 2020)

Loren started noticing some disciplinary disparities by the middle of the semester. I learned that while I thought I was doing an adequate job of providing resources to promote

teacher candidates' awareness of inequities, it is often not until a scenario representing an actual inequity occurs in their school that there can be recognition of the seriousness of the issue. In particular, I learned that I need to follow up with probing questions that are specific about the resources and data that we look at. In this case, I waited until my teacher candidate recognized the problem. On one hand, I could have intentionally addressed discipline earlier in the semester. However, without a contextual situation in which the teacher candidate observes the problem themselves, it may be better to supervise for equity through the challenge as it emerges as observed and reported by the teacher candidate.

Effects of Absenteeism. Lucy brought up a concern about absenteeism in her classes. She regularly experienced large numbers of students missing class without any excuse. She also had a number of students out because they had either contracted COVID-19 or were under quarantine (the quarantine requirement was 10 days). Many online students did not log in, or if they did, were not staying online and connecting with the class. Students who logged on kept their audio/video off. It was often difficult to discern which students were actually engaged in the lesson. Many students left the room, engaged in other activities (e.g., video games), or even fell asleep. This particular district does not allow teachers to require video to be on. This has been a serious challenge for many teachers. Lucy grappled with keeping students on pace with the science content.

In the following excerpts from an email exchange on October 27, 2020, Lucy and I discussed the absenteeism problem. We were in the process of co-planning a lesson when she shared that she had been struggling with the number of students missing class.

Lucy: I also found … that this school has really high (20+%) chronic absences... Do you know if this is a widespread issue in the district? The data was from 2017, so it wasn't a

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COVID related problem then. But there's definitely a lot more students missing school now.

Me: For absenteeism, I suspect the number is way up across the district. Before COVID-19, yes it was more school specific. I found this link [link] for this district. It shows 10.2% of students in the district were absent more than 21 days in the 2018-19 school year (before COVID-19). It looks like for the same time period, this school's attendance was much higher than the district number.

Do you have an approximation for the absentee rate for your school overall this year so far?

Lucy: I don't have actual data on absenteeism this year, but anecdotally it feels very high, way higher than the number from last year. Just 10% of my classes are absent more often than they are in attendance. That number is not including the other students who basically disappear for two weeks on quarantine and will not join online. This also does not include the rest of the students with high absence rates. The students may just not have access to log in.

Lucy wanted to know how absenteeism statistics at her school compared to other schools in the district. Absenteeism is not a concept I had addressed with teacher candidates before. I realized the importance of investigating this phenomenon. Like the other teacher candidates, Lucy was finding out that many students work after school and/or care for younger family members. With the high number of absences, Lucy attempted and failed to locate and communicate with many of the students' parents or guardians. As the number of missed student days increased, she observed their grades decrease. Accountability for absences proved to be a significant challenge in reaching students who missed classes.

Together we conducted additional research to find absenteeism data. Prior to COVID-19, the data was school specific. However, the data for Fall 2020 reported higher across the board. The absence rate emerged to be a critical problem, one that I had not recognized before. I learned that the absentee reports provide important information about how students are attending school and at what frequency. In preparation for working with future teacher candidates, I also need to do more work to find out how the district locates parents or guardians when teachers cannot reach them.

Shift in my Supervision Practices with Science Teacher Candidates

In this section I examine the deeper understanding that I gained from this self-study while supervising science teacher candidates within a social justice framework. This includes how I have shifted my practices and approaches based on the insights that surfaced after the work was completed. The reflection and analysis of my data and journal promoted deeper introspection about the nuanced aspects of the outcomes that emerged based on the work with the teacher candidates. The main themes in this section include 1) how my expectations for AAA with teacher candidates have changed, 2) insight into teacher candidate commitment to social justice, 3) recognition of mental and emotional health aspects, 4) increased time with teacher candidates, and 5) rise in my own confidence and agency for social justice supervision.

Expectations of AAA with the Science Teacher Candidates. Upon reflection, I learned that a such a complex framework of social justice awareness, advocacy, and activism for supervising secondary science teachers could not reasonably be expected and achieved within the time frame of one single semester. The teacher candidates all revealed increase in their awareness of how identity and equity factor into their classrooms and schools. This was evidenced by the many conversations throughout the internship period. Receptivity to the

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discussions about identity and equity was consistently high and everyone shifted into higher

frequency of use of the ideas as they connected with their students. Furthermore, all of the

teacher candidates advocated for their students as their awareness grew. They altered their lesson

planning and implementation in order to teach with a greater impact to students of color and

students from low-income households. They each expressed a stance for advocacy within their

classrooms by continuously seeking ways to meet the needs of their students. This included

significant changes to their science teaching frameworks. They altered traditional assignments to

create culturally responsive lessons and activities. They adjusted their classroom expectations

and management to provide a more receptive space for all students, especially those who might

not have achieved as much without the teacher candidates advocating for them in the science

classroom. However, my expectation for teacher candidates to become activists may have been

unrealistic.

In the comment here, Lucy is clearly aware of the disparity in access to science resources

for her students of color and students from low-income households, of whom represent the

majority of her lower level biology sections. She had already discovered that the science labs at

her school were reserved for the AP classes and some honors classes (predominantly White

middle class students).

> Obviously, there is not equitable access to quality science education here for all students.
> . . . I do try to advocate for my kids by teaching science in ways that engage them and
> make them think how science is a way to improve their lives. And I know you talk about
> being an activist in my school but how can I expect anyone to listen to me when I can't
> even be provided with a science classroom or a classroom close to the other science
> teachers or a support person for all of my ELLs or any communication from my school

administration on all of my students who are failing? (Lucy, Cycle Three post-

conference, November 16, 2020)

I sensed the pushback regarding activism. Lucy's point was valid and thought-provoking

for me. I realized that in promoting a continuum of awareness into advocacy leading to activism,

I may have pushed too much too quickly. Her awareness of the inequities in her school increased

as time went by. Lucy advocated for her students by making her classroom more conducive to

their backgrounds and learning styles. She made impactful efforts with positive outcomes as she

increased her implementation of culturally responsive science teaching. However, juxtaposed

with the lack of support from her administration, her emotional stress level by this point in the

semester, and also her (from what I can sense) frustration with my 'pushing' the activism part of

my agenda, I found myself re-thinking my original objectives. How much of an activist can a

teacher candidate become inside the space of only one semester, not to mention as beginning

teachers? Would it have been better if I had focused on awareness and advocacy, leaving

activism for future longer-term work and potential research study?

I had included activism within my original set of objectives for awareness, advocacy, and

activism because this is the realm that one shifts into when enacting the stance for advocacy

based on insight and awareness of the social injustices at work within a system. My belief was

that if I could support the teacher candidates' access to knowledge about science for social

justice and encourage their confidence to make changes in their classrooms, they would continue

to do so beyond their classrooms, seeking to affect greater change within the larger system

(school). I had set an overarching goal of promoting their agency for becoming teachers working

for change.

However, I realize now that I needed to be more mindful of how to target the resources and strategies for promoting social justice in science teaching to each individual teacher candidate and unique situation. In other words, maybe I instituted too many resources for social justice too broadly with all of the teacher candidates. Was my practice of utilizing so many social justice themed resources the proverbial 'mile wide, inch deep'? Maybe I need to adjust so that I am more specific and targeted with the resources that I implement to better address the needs of each individual teacher candidates' scenario.

I also learned that embedding awareness and advocacy of social justice in teaching science aligns well with the work of lesson planning and teaching. The teacher candidates revealed varying levels and patterns of advocacy for their students. I had to consider that they were new teachers of record in each of their respective schools, simultaneously undergoing their value-laden final clinical internships with the university. I realized that activism requires a solid foundation of position, a firmness of stance, strength of confidence, and a system of support. I learned that my expectations for them to shift into activists working to effect change in their schools may have been too rigorous of an expectation. Encouraging the teacher candidates to become activists for social justice was not realistic within the constraints of time and the comfort level of the teacher candidates position as new teachers during the final clinical internship period. Continuing this type of work and study beyond the final clinical internship time period might help me to address the aspect of activism with more efficacy.

Teacher Candidate Commitment to Social Justice. I discovered during my data analysis that as the study period progressed, I seemed to be disappointed at times with how some of the strategies and resources were panning out. I questioned whether I was assuming that the teacher candidates were as motivated as I for transforming their science classrooms into socially

just centers for equitable learning for all students? I was cognizant of the fact that my teacher candidates were all struggling with a range of challenges at their schools and in their classrooms.

I had been incorporating resources based on leading ideas and strategies in the field of social justice and education. My assumption was that teacher candidates were as energized to listen to, learn from, and apply these resources as was I. On a positive note, they reported reading and listening to many of the resources. Each teacher candidate made unique connections to the resources based on their classroom situations. I also sensed that all of the teacher candidates had become more active for considering their students of color, students from low-income households, and ELLs when preparing and teaching lessons. They also advocated for their students as evidenced by the culturally responsive activities that they included in their lessons at varying levels.

When considering the reflective conversations with the teacher candidates, I am not sure if they all were able to consistently see the benefits of their efforts. This is their first time as full-time teachers. I realized that they may lack a frame of reference for the work that needs to be done to ensure that there is equity in the science classroom. I wondered if perhaps they view the infusion of social justice framework as routine. For me, I viewed the successes they achieved with making their science content connect to the lives of their students of color and students from low-income households as exciting transformative actions. However, I did not detect that same sense of excitement from all of the teacher candidates. This excerpt from my journal after a cycle two post-conference reveals a moment when I questioned my assumptions regarding teacher candidates' authentic interest in the social justice strategies I had been using.

Loren shared with me that [the internship program coordinator] had come in for an unannounced informal observation. She was upset because her students "went off the

rails". Loren puts a great deal of pressure on herself to be 'perfect'. This led me to wonder if she is seeing the benefits of the work to understand students' identities and to implement culturally responsive lessons and activities in ways that support her students versus doing this because she perceives my emphasis on social justice. She is consistently responsive to my resources, ideas, and our discussions. She applies almost everything we talk about into her lessons. Am I applying practices for social justice based supervision in ways that the teacher candidates find intrinsically valuable to their students and to their personal development? I wonder if my excitement might even have been confusing for them at times. I should consider my frame of reference for having observed teaching for the past two decades, having context with which to compare. (Researcher Journal, October 16, 2020)

Through this reflection I learned that my lens for social justice supervision may have been skewed by my idealistic expectations. I wonder at what level the teacher candidates' response to my social justice supervision was based on an urgency to please me and/or to address internship expectations?

Mental and Emotional Health. A critical learning that emerged that impacted my practices for supervision was the higher-than-ever levels of mental and emotional health issues. All of the teacher candidates were managing their teaching experiences as full-time teachers of record while completing their final clinical internships. Based on the nature of the paid internship, they were essentially going through their first semester of full-time teaching which included all of the work responsibilities of their fellow faculty. While all teachers were working additional hours to prepare, plan, implement a variety of teaching strategies to teach both in-

person and online simultaneously (due to the COVID-19 district guidelines), I realized that this was a pedagogical practice that the teacher candidates were not prepared nor trained to tackle.

A number of additional challenges pervaded the internship period for all of the teacher candidates. The realization of the high percentage of students from low-income households emerged as one of the most distressing issues that the teacher candidates regularly addressed and problematized in my meetings and conversations with them. Shifting their original course frameworks to accommodate the needs of students who did not have resources nor after school time to engage in the science content required a constant adjustment to the class curriculum, lesson plans, and expectations. I learned that the teacher candidates were not only uncomfortable with shifting the class expectations and assignments, but they were also not prepared to know how to do this, or whether they were even allowed.

Another persistent challenge for the teacher candidates was finding ways to teach secondary level science to the high number of ELLs. The lack of in-school support staff along with the increased number of online learners created an additional challenge to mediate. All of this required a great deal of additional time and dedication to searching for alternative ways to reach the students. Attendance was an additional challenge that inhibited the teacher candidates' ability to meet the needs of their students of color and students from low-income households. Getting to know the students who were not in-class on a regular basis was particularly difficult thus making it hard to gain a better understanding and connection with the classroom students' identities. I learned how to shift for online science teaching alongside the teacher candidates. In fact, I actually learned more from the teacher candidates as we navigated teaching during the pandemic at the same time.

All of the teacher candidates revealed their awareness of systemic barriers for equity in teaching science at some level. What I had not realized before was just how emotionally distressing this was for the teacher candidates. The work of social justice is complex, it involves purposeful searching for, empathizing with, and attempting to rectify the systemic barriers that students of color and students from low-income households face. As I reviewed the data again, I realized I missed a significant critical issue. I had forgotten that I had been working in the field of education, specifically through a critical lens for social justice, for many years. My reactions to areas of inequity may not be the same as younger teachers entering the field, oftentimes who are mitigating this for the first time. I wondered if I had missed, and even negated, the emotional strain that teacher candidates may experience as they become more aware of the issues of inequity in their schools. I learned more about myself as a university supervisor with regard to what my professional responsibilities are for supporting teacher candidates at an emotional level.

Lucy admitted to crying in her car after school by the second month of school. Seth became physically sick claiming the stress of everything happening in his classes and at his school was taking a toll on his mental health. Loren was grappling with feelings of exhaustion and disappointment with her students' work and participation not matching her expectations which were directly tied to her high energy and work input. Shannon struggled with her online learners; she had the largest number. She expressed feeling disconnected and not really reaching them, therefore not knowing them enough to truly be culturally responsive in her science lessons.

I realized that I needed to balance both supervision and emotional support. I addressed the issues of mental and emotional health in my meeting with the district school board member, whose professional realm of expertise is centered on her work as a Licensed Clinical Social Worker (LCSW) in the field of mental health therapy. She had known about and encouraged my

work and during this meeting we engaged in open and honest dialogue. I shared my struggles about my supervision. I was concerned about the mental and emotional health of the teacher candidates. I was not clinically trained specifically for providing the kind of empathetic and constructive support beyond the usual levels of supervision that I had studied and practiced over time. The school board member acknowledged that teachers have never trained for teaching during a pandemic. She revealed that there is an emerging crisis in terms of mental health for teachers. She encouraged the supervision practices for raising awareness of the inequities that pervade the education system but also pointed out the importance of seeking the successes and celebrating them with the teacher candidates.

My self-study was a key component for my own shift in supervision practices that supported the teacher candidates' development into teaching that is more centered on equity and social justice. While I was aware that supervision requires a certain level of flexibility and adaptability for each teacher candidate, this semester I learned that there is not one universal recipe for implementing supervision for social justice. Any initial feelings of disappointment transitioned into motivation to refine my efforts and continue future investigation to consider the most practical expectations and efficient strategies for promoting a framework for social justice in my supervision practice. I gained deeper understanding through this self-study: time, patience, and open space to investigate identity and equity are critical to promoting advocacy with teacher candidates.

Increasing Time with Teacher Candidates. Based on a review of my work with teacher candidates from previous semesters, my pilot study, and the data from this self-study, I recognized that staying for only one class period was not providing an adequate inside view of the classroom environment and work with the classroom students. In recent semesters prior to

this self-study, I had already started observing two or more class periods at a time instead of just the requisite one. I had found that I gained additional access to observation-based data. Admittedly, I had already sensed that a single class visit per cycle was perhaps not enough time to provide enough meaningful data. Therefore, prior to the beginning of this study time period, I decided to implement a standard procedure of longer visits over multiple class periods with each teacher candidate. This was the first semester that I implemented this practice for all three observation cycles.

Beginning with the first cycle, I scheduled to observe two or more classes and stayed during a lunch or planning period for each teacher candidate. As a result, all of the teacher candidates revealed a more relaxed and confident disposition when I stayed for a second class. This also permitted me access to a greater number of the classroom students. This provided me the chance to get to know some of the classroom students. I also noticed that my relationship with the teacher candidates became more collegial. The shift was visible for each teacher candidate.

I used the lunch or planning period as a time to debrief face-to-face (as opposed to virtual). I detected that our post-conferences and reflections were deeper and more insightful. In the following excerpt from my journal, I recorded my cycle one observations for two of Seth's classes with a lunch observation in between. Looking back, I could detect how I was able to gather increased data from multiple classes.

> Observing his classes, I witnessed high-levels of interaction and deep thinking through whole-class discussions. Seth is consistent and frequent with his use of inquiry mindset. He prodded the students to think deeper and rarely answered their questions directly; rather he answered questions with additional questions. A group of Seth' students eat in

his classroom. This gave me a chance to observe how Seth interacted with his students beyond the classroom. (Researcher Journal, September 17, 2020)

When the students had the opportunity to talk to me during lunch, I realized that this was another segue into increasing the comfort level of my presence in the classroom for Seth and his students. I learned that by staying beyond one class period, I could collect additional meaningful data. Thus, I was able to incorporate this information into supervision efforts that were more impactful based on a closer connection to the context of Seth's multiple classes.

By the third observations, I had been in classes with almost all of the teacher candidates' students. Many students recognized me and increased their interaction with me. I was even told by my teacher candidates that their classroom students asked if I would be coming back to visit. As challenges emerged, having met the classroom students provided greater understanding of the situation. I became more adept at interpreting the challenge based on the characteristics and details of the student(s). This allowed me to facilitate deeper conversations about awareness of each student's cultural and socioeconomic situation and how that factored into the situation. By knowing more about the teacher candidates' students, I was more connected in a way that I could probe the teacher candidate to investigate any issues of systemic barriers and inequities that may have been underlying the situation. The following is an excerpt from a recorded and transcribed cycle two post-conference with Lucy.

Me: There was a young man in the back row, sweatshirt, Black student. He was kind of in and out, very quiet. And you checked in with him quite a bit. And when you did check in with him, he looked up and said he was okay. And I saw him work with the female student next to him just a couple of times. She seems like she is a strong student.

Lucy: She really is. She was helping him. She is kind of a leader and he will respond to

her. Sometimes he's passively on task. But I know he has a lot going on at home I am not sure what, but I can just tell.

Me: And what is happening with Jacob in the front, who had his head down the whole class. I think he was sleeping. You handled it well. You checked in with him and I heard you ask him if he needed you to call someone.

Lucy: Yeah. You just have to let him sleep. Today was the worst he's been. So, I'm going to talk to someone about it because I don't know all of the details about his life. Usually when I'm like, all right, get your stuff out. He does it. And then he'll stay and do things for a little bit. And then he goes back to sleep. But today he wasn't having it. He was definitely gone. (Lucy, Cycle Two post-conference, October 19, 2020)

This interchange was based on a second class that I had observed that day. This was not Lucy's preferred class for me to visit, which was the class the period before. The first class that she intended for me to observe was her "best" class. However, the challenges that emerged over the semester came from the second class that I observed. Had I not stayed for the additional classes, I would not have collected data from and garnered insight into the context of those classes, thus hindering my ability to effectively provide support.

A key learning for me has been that teacher candidates usually schedule for me to observe their highest performing, and/or most well-behaved classes. This is understandable; they do this because they are nervous and want their lesson to go well and there is the evaluation component for the university internship requirements. However, I also know that most of my impactful supervision in the past has been with challenging situations in the more difficult classes. If I do not see those classes, meet those students, observe the lessons in those challenging classes, I realized that I could not be as effective with my supervision. Furthermore,

it will be more difficult making any connections to social justice concepts if I have no contextual knowledge or experience with the students that the teacher candidates manage.

Another benefit of spending additional time during school visits was the opportunity to meet administration and other faculty. This included meetings with principals and staying during lunch to meet other teachers. One of the ways I was able to do this was through an initial email introduction and offer to meet. This semester, I had to email each of my teacher candidates' administration to introduce myself and confirm approval to be present in-person on campus (following COVID-19 guidelines). This ended up being a useful segue for setting up the meetings. I learned that by getting to know more about some of the administration and staff, I gained greater insight into the school climate and to what extent I could encourage my teacher candidates' emergence into science teachers as advocates for and activists of social justice in their schools. Leadership and prevailing frameworks vary between schools with regard to addressing equity and social justice for students of color and students from low-income households. In two of the teacher candidates' schools, I met other teachers including faculty leaders who were supportive of the work for implementing a framework for social justice with the teacher candidates. I did not meet any like-minded proponents of a social justice agenda and support for the teacher candidate at a third school. In the fourth school, the teacher candidate revealed some pushback from other faculty when he addressed equity issues. He detected inequity regarding his students of color, therefore he indicated that implementing some of the strategies for social justice in the science classroom was not supported.

How Much? Helicopter Supervisor. Like the colloquial term 'helicopter parent' I believe I had embodied similar characteristics and may have become a 'helicopter supervisor' at times. With each teacher candidate, I grapple with how much supervision is just the right

amount. Devoting more time to the on-site observations permitted more rigorous in-person data collection and reflection. I attempted to predict the right balance of time to dedicate to interacting with each teacher candidate outside of their classrooms. In my prior work as a university supervisor, I had wondered how much communication was too much or not enough. I reviewed my notes and feedback from a prior teacher candidate. She had stated that she wished I had reached out to her more because she was uncertain about how often was appropriate for her to contact me. My prior assumption that I needed to be careful about bothering the busy full-time paid teacher candidates too much ended up being incorrect.

At the beginning of this semester, I set calendar alerts so that I would communicate with each teacher candidate at least once a week (oftentimes more depending on the situation). I recognized within the first few weeks of the internship that each time I sent a message to the teacher candidates to check in, they responded immediately. For any questions, comments, concerns they had, we met through Zoom meetings and those lasted for sometimes over an hour. I learned to intentionally adjust the mode of communication and timing to best meet the needs and time frame for each teacher candidate. I had realized that maintaining a consistent presence was a pathway for me to incorporate my agenda that centered on social justice in science teaching.

While virtual meetings (Zoom), text, emails, and phone calls served as valid and effective modes of communication, I found that meeting in person provided a deeper sense of connection. COVID-19 presented challenges for supervision, but I was able to set up in-person meetings such as meeting for pizza at an outdoor restaurant, meeting for coffee, and just taking a walk outside. I was more concerned than in prior semesters about the additional factors involved while teaching during the COVID-19 pandemic. The teacher candidates' work schedules as they

navigated planning, teaching, managing online and in-person learners simultaneously, and losing planning periods to cover for other absent teachers was worrisome. I was cognizant of the necessary time to support my objectives of implementing resources and ideas to support their development of equitable and culturally responsive science lessons and activities.

By the second half of the semester there was a noticeable drop in responses to my concerted efforts to incorporate some of the resources. Instead, there was an increase in the teacher candidates wanting to primarily address the many challenges they faced. I learned to pivot frequently and quickly in order to facilitate problem-solving discussions that seamlessly and effectively embedded my agenda for social justice as we unpacked issues that had emerged in their classrooms. As discussed in the section above about teacher candidate commitment to social justice, I also realized that I needed to reconsider how much content I was sending to each teacher candidate. Just because there were resources that I found to be impactful and potentially transformative, did not mean that my teacher candidates were in the space and frame of mind at that point in time to read another article, watch another video, and engage in another problematizing scenario about an isolated equity challenge.

I learned that instead of inundating the teacher candidates with all of the resources that I found to be useful, I needed to fine tune my selection of the resources in order to best meet the needs of the challenge for each teacher candidate. I learned that by reducing the number of overall resources in order to individualize my practice for each teacher candidate, I established deeper rigor and efficacy in each situation. Instead of hovering as a 'helicopter supervisor' over each teacher candidate with an arsenal of resources and ideas, I realized the necessary shift to flexible receptivity for each teacher candidate's needs with their specific classrooms.

Increase in my Confidence and Perseverance

This self-study instilled a more profound commitment to supervision for social justice. I found that confidence in my stance as a university supervisor working to infuse an agenda for awareness, advocacy, and activism for social justice with science teacher candidates into my practices had increased over the course of this study. I also noticed my perseverance increase. I realized that I started and ended most conversations with a mindset prepared to discuss culturally responsive science lessons and address classroom aspects within a lens focused on equity and social justice.

The core theme of each of my supervision practices was centered on a combination of awareness, advocacy, and activism for social justice in science teaching. While I still referred to my notes to remind myself to discuss areas for seeking how to make the classroom experience more equitable for all students, I found my stance for socially just science teaching occurred more frequently and naturally within my supervision practices compared to previous semesters. This excerpt from my journal reveals when my confidence had begun to emerge by the midpoint of the semester.

> So far, my TCs who have been implementing culturally responsive activities are finding this to be a turning point for their classes. From what the teacher candidates are reporting to me, the classroom students enjoyed the tasks but also appreciated that their teachers gave them an opportunity to do assignments that connect to their background cultures. The students took these assignments seriously and the work was high level, representing learning and understanding. The good feeling that came along with students producing and performing their own creations of learning along with the high scores was a

significant confidence booster - for the classroom students, for my teacher candidates, and for me as the supervisor. (Researcher Journal, October 5, 2020)

Upon reflection, I realized that my own awareness of and experience with the local secondary schools has increased over multiple semesters of supervision. Gaining access to and familiarity with the district high school's administration and faculty has increased my powers for networking as well as knowledge of the various structures in place in the schools. This aspect has also contributed to my increased confidence in my supervisory practices for social justice in science.

Summary

Research Question Three addressed my own learning and understanding as a result of this self-study: What have I learned about my supervision for awareness, advocacy, and activism for social justice based on my experiences with secondary science teacher candidates? This final research question provided a framework for me to identify new knowledge and understanding that informed my practices for science teacher supervision that ties to a social justice framework for awareness, advocacy, and activism. I entered this self-study prepared to gain new insights while also recognizing a need to reassess my assumptions, improve my practice, and seek areas for continued research. My background knowledge about supervision for social justice in science education was based on the literature, collaborations with peers and critical friends, and my prior experiences. Through this exercise in self-study, each new discovery and learning shaped the way that I supervised my science teacher candidates.

I learned that an abundant amount of open-mindedness, flexibility, and willingness to shift is required to be effective at supervising science teacher candidates within a framework for social justice. After reviewing the supervision practices that provided the most critical support

and guidance during the process, I gained a deeper understanding that will shape my ongoing

supervision, promote continued research for this work, and possibly provide insight and guidance

for others in the field.

Chapter 5: Discussion and Implications

Introduction

The purpose of this self-study was to learn more about my university supervisory practices and their impact on implementing an agenda for social justice awareness, advocacy, and activism (AAA) with secondary science teacher candidates. My goal was to expand my understanding and improve my practices for enhancing supervision for social justice with science teacher candidates. The focus was on the learning that as the researcher and supervisor, I might gain on a personal and professional level through this process. Self-study allowed me to obtain a deeper understanding of the meanings that I constructed from my perspective in relation to how I made sense of my situated experiences working with teacher candidates (Berry & Kitchen, 2020; Merriam, 1998).

To review, the following research questions guided this self-study of my supervision practices for social justice with secondary science teacher candidates:

1) What practices can I, as a university supervisor, implement to promote awareness, advocacy, and activism (AAA) for social justice with secondary science teacher candidates?

2) In what ways do these practices promote AAA?

3) What have I learned about my supervision for AAA for social justice based on my experiences with secondary science teacher candidates?

Self-study provided me with an opportunity to intentionally reflect about my growth as a university supervisor while uncovering and aligning my platform with practice (Bullough &

Pinnegar, 2011). My platform aligned with my objectives for centering my supervision of science teaching based on an equity and social justice framework. I wanted to learn more about my supervision practices as well as the efficacy for promoting AAA with the science teacher candidates. I had reached a point in my journey as a university supervisor where I recognized the need to seek better understanding of my specific practices in order to demonstrate how theory from studies connected with my practical inquiry (Hamilton & Pinnegar, 1998). I wanted to know what the effects of my practices as a supervisor were for fostering a sense of awareness, and stance for advocacy and activism with the science teacher candidates.

Prior to conducting this self-study, I had not given sufficient thought about what I had learned through the process of supervision. In fact, I placed emphasis on ensuring that the teacher candidates were learning, developing, and progressing. In other words, my work centered predominantly on the learning and development of the teacher candidates as it impacted their classroom students. I had not taken sufficient time to consider the benefits of a purposeful exploration of *my own* learning. I wondered which aspects of my supervision practices have been productive in affecting genuine promotion of social justice in science teaching. I questioned whether I had previously continued supervision without proper reflection about the efficacy of what I was doing.

In chapter four, I presented the findings of this self-study based on my analysis. By reporting the findings through a composite narrative, I presented the specific practices that emerged based on my work supervising for social justice with four science teacher candidates. Furthermore, I explored the effects of my supervision agenda of social justice in science teaching through AAA, which revealed a range of outcomes and challenges. Lastly, I revealed key findings for my own new learning and insights based on this self-study.

In this chapter, I discuss the two main sets of findings that emerged from this research. I begin by discussing the impact of the five practices that guided my supervision of secondary science that centers on social justice. Then I discuss the new learning I gained based on my supervisory work for social justice with the science teacher candidates. A list of the limitations of the self-study follows. This is followed up with implications and recommendations for other practitioners (supervisors) and for others in the field of teacher education. Next, I include suggestions for continued investigation based on what I learned in this study, Lastly, I share concluding remarks.

Discussion of the Findings

Table 6. displays five overarching conclusions based on my analysis of the data presented in Chapter 4. They are categorized into two sets: 1) practices that support supervision for social justice with science teacher candidates and 2) transformations in my supervision practices as a result of self-study. In the sections following the table, I discuss each in further detail.

Table 6. Supervision Practices Impact on AAA with Science Teacher Candidates

1) Supervision Practices: Impact on Science Teacher Candidates' Social Justice AAA
a) Meet Earlier and More Often
b) Explicitly Address Identity, Implicit Bias, and Inequity
c) Art as Segue to Social Justice in Science Teaching
2) Transformations in My Supervision Practices as a Result of Self-Study
a) Reflection Increases Supervisor Awareness, Advocacy, and Activism
b) Prioritize Awareness and Advocacy

Supervision Practices: Impact on Science Teacher Candidates' Social Justice AAA

In this study, I adapted and cultivated a variety of approaches, resources, and strategies to support pedagogical growth and learning with the teacher candidates while simultaneously fostering AAA for science teaching that is immersed in a social justice framework. My

interpretation and use of various practices included the methods or strategies that I implemented to encourage science planning and teaching with teacher candidates to support students of color and students from low-income households. I perceived and utilized a combination of practices as a scaffolding process between my supervision efforts and the teacher candidates' development for social justice in their own planning and teaching.

To review, five primary supervision practices for social justice served to undergird my work with the science teacher candidates: 1) establishing and maintaining an open and trusting relationship, 2) incorporating targeted focus on social justice (through AAA), 3) problem-solving for challenges that emerged within the internship, 4) networking with others to expand ideas and resources, and 5) reflecting as a catalyst for shift. I integrated these practices throughout the final clinical internship period with the science teacher candidates. This is to say that at any given point during my supervision work, I simultaneously interweaved variations of these supervision practices in order to achieve my objectives for enhancing awareness, advocacy, and activism for social justice in science teaching.

Although to the best of my ability I implemented these five practices in a consistent and active manner, the results varied among the teacher candidates in their increase in awareness, advocacy, and activism for socially just science teaching. As presented in the previous chapter, a range of findings surfaced. It was important to consider that each teacher candidate entered the final clinical internship with an individual identity, background, and experience. All of the teacher candidates taught in classrooms with students representing a diverse range of demographics. From these findings, I have drawn conclusions about the impact of my practices for social justice supervision that I employed with the teacher candidates' growth in AAA for teaching science equitably. They are discussed in the sections that follow.

Meet Earlier and More Often. Meeting individually and face-to-face with teacher candidates before the beginning of the clinical internship period established opportunity to develop an open and trusting relationship that became a receptive space for the work of social justice. Establishing an open and trusting relationship with the teacher candidates was an early foundational goal. Maintaining an ongoing culture of safe space centered on trust was paramount for the work throughout the entire internship. This connects to the 2016 review of the literature on supervision of teacher candidates in which Burns, et al. emphasize that "trust and time continue to be essential features of a supervisory environment conducive to relationships and relationship building" (p. 66) listing specific practices of "creating a culture of trust and collegiality" and "modeling caring and fidelity" for strong relationships (p. 67). Costa and Garmston (2012) explicitly encourage building relationships with teacher candidates that are authentic, honest, respectful, confidential, and non-judgmental.

By meeting with the teacher candidates prior to the beginning of the final clinical internship period, this practice provided opportunities for the development of an open and trusting relationship earlier than would otherwise have occurred with a typical timeline. Typically, university supervisors meet briefly with their teacher candidates in a group setting during an orientation period when the academic school year has already begun. This is a brief meeting with all of the candidates together; there is not an opportunity for a one-on-one meeting. I intentionally met with each teacher candidate well before the orientation and internship. As a result of meeting with the teacher candidates earlier, I was able to establish time to get to know one another, which then led to discussion of identity. I found it essential to take this time to co-examine demographics and characteristics of the local school community to ensure that teacher candidates began to recognize cultural diversity in their classrooms. This early meeting provided

a low-pressure time together allowing for a relaxed atmosphere to begin investigating topics of identity and cultural diversity.

In addition to an early one-on-one introductory meeting, I found that increasing my access to the specific aspects of the classroom environment and students by observing more of the teacher candidates' lessons proved to be critical for building trust and rapport. I had to balance this with being cognizant of the teacher candidates' concern for the impact of the evaluation component of the supervisor's classroom observation. I am mindful that evaluation must be done in a way that it is a result of sincere mentoring and persistent effort to maintain a trusting relationship with the teacher candidate (Nolan & Hoover, 2005). Oftentimes, teacher candidates will invite the university supervisor to come in only for what they perceive to be the most 'well-behaved' class. I found that as a supervisor, for me to collect enough data to support the teacher candidates, I needed to observe the other classes as well, and that included the classes where teacher candidates experienced the most challenges. I have frequently found that because of the inequities in the educational system, many of the challenges encountered by the teacher candidates are where the work of supervision for social justice needs to be implemented. This extra time observing also afforded me increased connections with the classroom students. As challenges arose, since I had observed the students and interacted with them, I possessed a deeper understanding of the situation. Consequently, I was able to provide more effective support based on the actual students and circumstances while facilitating the conversation to address any areas of inequity when problem-solving and planning.

Another significant finding is that the teacher candidates were often nervous during a classroom observation. By remaining for additional class observations, the teacher candidates each seemed to relax. This presented opportunities to observe more natural interactions with the

classroom students as the teacher candidates became adjusted to my presence. This also included a larger collection of and interpretation of data from observations (as opposed to inferences and judgements from just one instant) thus providing feedback that was used to reflect upon, actively plan, and make decisions for future steps (Cogan, 1973; Goldhammer, 1969; Nolan & Hoover, 2004).

Many supervision frameworks emphasize time for pre-conferencing, observations, and post-conference reflections. The literature indeed points out the complexity of the work to extend beyond just observation and feedback to include building relationships, considering innovative approaches, and commitment to research (Jacobs, et al., 2017). Sweeney (2013) specifically emphasizes the critical work that occurs during the early period of the internship for building mutual trust, establishing respect, creating a safe space for the teacher candidate to have freedom of expression while ensuring that the mentoring and supervision serves the primary goal of increasing the classroom students' achievement. However, there is little mentioned in the literature within the established research on supervision frameworks about the potential for early meetings prior to the internship period and/or increased observations throughout. I found that the teacher candidates benefited from the increased time with me as their university supervisor. The quality of support that I provided for pedagogical development and implementing an agenda for social justice was enhanced through the increased confidence and rapport that emerged from the additional time to establish and maintain the open and trusting relationship.

I anticipate that increasing the amount of time with teacher candidates may not be perceived as a reasonable expectation of university supervisors given the existing requirements. Funding for supervisors may be inadequate to justify adding additional time for observations of teacher candidates. However, I have found that I had to spend less time unpacking details of the

teacher candidates' classroom situation and students when challenges emerged throughout the semester by having already familiarized myself within the classes through observation. I also noticed that teacher candidates' level of anxiety seemed to subside when I stayed for a second class, giving them the chance to refine their teaching in a second chance scenario. This built their confidence. I observed them to be more forthcoming in approaching me to discuss issues sooner, rather than waiting until larger problems developed over time. Overall, spending more intentional time in the classroom observing additional classes actually saved time later as challenges emerged.

I have discovered that spending more time with each teacher candidate in order to build the relationship and collect additional data from more classroom observations can actually save time in the long run. Oftentimes (in my experience as well as in discussion with other supervisors), the entire first cycle is used to build the relationship with the teacher candidate, establishing trust and a sense of support. This is a lost opportunity to establish early pedagogical development that is centered within a social justice framework within the first cycle. Furthermore, I found that when the teacher candidates face challenges, it takes extra time to unpack the surrounding context of the challenge. By spending more time with the classroom students on the front end, I had a deeper understanding of the classroom structure, school environment, and the students themselves. Therefore, the teacher candidates and I could dig into the factors that caused the problem sooner, working to directly address any issues of inequity. In other words, the time that is necessary to describe the scenario was saved since I already had a deeper understanding of the backdrop of the classroom and students. The time I spent with the teacher candidates was more efficient for problematizing the situation and co-constructing strategies to arrive at solutions.

Address Identity, Implicit Bias, and Inequity. I found that examining the concept of identity (teacher candidates and classroom students) as well as implicit bias with the teacher candidates increased their receptivity to inspection of school demographics and areas of inequity. I facilitated ongoing investigation and discussion of these concepts and observed an increase in the teacher candidates' awareness of identity, implicit bias, and equity with their science classrooms and students. This finding is consistent with the literature. Howard (2016) argues that teachers need to consider their past individual experiences with regard to culturally and ethnically diverse communities, recognize privilege, and take on more of a transformational approach to understanding racial identities and becoming active proponents for that change. Moore (2008) emphasizes reflection on intersectionality through dialogue that leads to a deeper understanding for how power and language influence science teaching. According to Mensah (2009), science teacher candidates need to be aware of and account for how their personal backgrounds affect their ideological beliefs, biases, and assumptions as science teachers working to meet the needs of students of diverse racial/ethnic backgrounds.

My effort to promote the co-examination of identity as it relates to equity for students led to the greater confidence and intentionality for social justice with the with teacher candidates. Colón-Muñiz (2010) points out the increased confidence for teacher candidates becoming active participants and advocates within the schools for positive results for their students as well as their lives as teachers. My supervision practice for incorporating targeted focus on social justice, particularly through awareness of identity increased the teacher candidates' recognition of areas of inequity such as confidence gaps in science, skepticism of scientific research, and access to science-based resources (Plutzer, 2013).

I also introduced resources that encouraged co-analysis with the teacher candidates of the research about inequities in science education. Through this effort, they made connections to their schools and classrooms. My supervision practice for incorporating targeted focus on social justice, particularly with regard to advocacy, encouraged the teacher candidates to recognize where there were cases of inequity in their classroom and/or school. Many students of color and students from low-income households may not have connections with teachers who are known advocates or activists in their schools. I found that as the university supervisor, I can purposefully mentor the teacher candidates in ways to ensure the uncovering of pathways to enact a culturally sustaining foundation to their pedagogical development and thus meet the objectives for an influential social justice agenda.

I promoted the use of culturally responsive teaching to assist teacher candidates to conceptualize students' backgrounds in such a way that values and embeds their needs into the science classroom (Atwater, 2010; Gay, 2010; Ladson-Billings, 1995; Lee & Buxton, 2011). Furthermore, the teacher candidates who engaged in culturally responsive teaching practices were able to uncover and disrupt their beliefs and assumptions about their students of color and students from low-income households. Ladson-Billings (2001) asserts that teacher candidates extend their understanding of the diverse cultures of their students by embedding those cultures within the content as a basis for learning. This is why it is critical that novice teachers learn to recognize personal deficits that may lurk in their own background experience within school settings.

Research has been conducted about what teachers need to know and be prepared to do in order to provide a high-quality education equitably to students of all cultural backgrounds (Gay, 2002; Kincheloe, 2004; Villegas & Lucas, 2002). However, the research is limited about the

efficacy of changing teacher beliefs about racial, ethnic, and economic diversity of students for teacher preparation and training (Civitillo, et al., 2018). When the challenges and pressures of performance and managing multiple tasks emerge in the classroom, many teacher candidates revert to a traditional framework of classroom management, thus foregoing the type of teaching that would lead to more equitable access and results for classroom students.

As the teacher candidates each worked in their classrooms, I consistently and persistently promoted awareness and advocacy for a science classroom that is socially just. This entailed an examination of the social and economic barriers within the system that have a negative impact on students of color and students from low-income households. This included an investigation of discipline data as well as the disciplinary frameworks that reinforce inequity. An explicit focus on student behavior management and disciplinary data revealed how the cycle of discipline keeps students from joining class, thus the perpetuation of a negative cycle of falling grades and increasing behavioral problems. It is widely acknowledged there is an association between exclusionary school discipline and harmful outcomes for students of color (Noltemeyer, et al., 2015), specifically with regard to lower achievement (Anderson, et al., 2019; Rausch & Skiba, 2004; Terriquez, et al., 2013). In a 2018 review of school discipline reform, Ritter emphasizes that "Students are missing thousands of hours of class time . . . [which] is especially problematic because the students who are most likely to find themselves academically unprepared are the ones missing class time due to suspension" (p. 137).

My effort to encourage the examination of the discipline data for the school with regard to students of color and students from low-income households provided the teacher candidates with additional insight into implicit bias and inequity that seeps into the education system. In a 2019 study of federal data from almost 96,000 schools with 32 million students, Riddle and

Sinclair reveal the racial disparity in disciplinary actions against Black students in the United States as it is associated with local racial bias statistics. Losen, et al. (2015) demonstrate the differential treatment by the system; students of color are more likely to be reprimanded for smaller subjective insubordinations such as disrespect, defiance, or noise and also teachers are quicker to send them to the office and/or to detention and suspension. Additionally, students from low-income households represent higher percentages in lower-performing schools with higher teacher rates of turnover (Guarino, et al., 2006). Problems related to poverty and unsafe neighborhood conditions can also contribute to student behavior that leads to higher rates of suspension (Cameron, 2006). By conducting a targeted focus on this research data with the teacher candidates, I was able to promote their awareness of inequities in their own classrooms and schools that correlated with these studies.

Through simultaneous consideration of implicit bias and discipline data students of color and students from low-income households, the teacher candidates had opportunities to apply this information to better understand why traditional forms of disciplinary actions can impede their students' learning. As a supervisor, I supported a shift in the teacher candidate's perspective of discipline and encouraged them to advocate an alternative method of classroom management that engages and connects with students as opposed to marginalizing them. Purposeful probing and discussion of implicit bias in conjunction with adjusting the way students are disciplined through a more positive and supportive approach encouraged the teacher candidates to address the disparity in discipline for students (Ford, 2016).

Art as a Segue to Social Justice in Science Teaching. By providing the book and encouraging the reality pedagogical framework of Emdin (2016), I observed an increase in the teacher candidates' interest and receptivity to incorporating art-based representations of student

learning. I was more intentional than ever before with the integration of art-based activities for teacher candidates to try. Thus, I observed how culturally responsive science teaching was supported and enhanced in the teacher candidates' classrooms. When the classroom students had a greater range of choice for representing their learning, they produced artifacts that included the science concepts using language and presentation style that connects to their cultural backgrounds. Forms of art such as music, drawing, literature, and video offered classroom students additional and alternative methods to make sense of and apply the science concepts they learned.

There is literature that exists that supports implementation of the arts. As far back as 1934, Dewey espoused authentic aesthetic experiences for students to make meaningful connections with content through the production of art and subsequent reflection. Milner (2018) emphasizes the connection with students' activities outside of school including music, dance, acting, and art to the classroom curriculum. Finding out what is important to students, what they value in their own communities, is an important element for teacher candidates to understand (Nazer, 2018).

Emdin and Lee (2012) endorse the inclusion of hip hop as a pedagogical approach to creating pathways for students to identify as science learners that recognizes, appreciates, and understands their backgrounds and even promotes their continuation into the field of science at higher levels. Emdin (2013) argues that science (STEM) instruction should be "rooted in the art and culture of marginalized groups. . . . students must see themselves as inherently scientific, . . . They must see diversity in STEM, and how it is expressed to the world" ("In teaching STEM use hip-hop as a bridge"). Kraehe and Brown (2011) point out that aesthetic learning experiences through art can transcend specific subject matter thereby awakening teachers' capacities for

social justice. Emdin's work connects with the concept of understanding how education debt (Ladson-Billings, 2006) is steeped in the historic systemic practices and policies that have been centered on the education of White students. The science teacher candidates promoted their students' connection with science by implementing lessons and activities that provided them with a voice for reflecting their learning, thereby promoting their capability for achievement. Furthermore, this affirmative approach to alternative platforms of learning and representing science through art offered students deeper recognition of how they can use science to impact and improve their own communities.

Transformations in my Supervision Practices as a Result of Self-Study

The self-study process guided my objective to conduct research that centered on my work as a university supervisor implementing an agenda for social justice with science teacher candidates. My objective was to conduct this investigation for critical self-awareness, (Butler, et al., 2014) through self-reflection and to gain a deeper understanding of how my work has been "self-healing, supportive of social justice, or promoting of other positive changes in identity and practice" (Grant & Butler, 2018, p.329).

I gained insight into which supervisory practices were most effective in supporting my objectives, and those that were not. The feedback I received from my teacher candidates in relation to my practice for social justice supervision allowed me to gain deeper understanding for what was and was not effective, and why. As I facilitated the unpacking, addressing, and reflecting on the challenges that arose within the teacher candidates' classrooms, this provided in-depth learning for all of us about critical areas in the secondary science classrooms where the work of social justice is necessary. I found the work for awareness of identity (including the intersection of self-identity and of classroom students), along with the awareness of the historical

and present-day systemic sociocultural inequities in classrooms and schools is a sizeable concept for teacher candidates to embrace.

Reflection Increases Supervisor Awareness, Advocacy, and Activism. My use of a reflection journal occurred frequently and reflexively throughout the supervision period of investigation. The continuous cyclical nature of my reflections provided feedback that guided my subsequent actions at various points during the supervision process. Reflections ranged in quantity and insight depending on the teacher candidate and situation; but all of the reflective processes revealed insight that guided my next steps in supervision. Frequent, brief reflection provided additional data that might otherwise have been overlooked. At the end of the self-study period, a broad overarching reflection including a complete review and analysis of the data proved to be even more insightful.

Reflection explicitly provided me with identification of missed opportunities to implement targeted strategies to address areas of inequity with teacher candidates. Even when a situation with any of the teacher candidates had already passed, reviewing and reflecting the data alerted me to the potential for digging deeper into a particular issue with a social justice lens. As a result of the reflection process, my vigilance expanded for identifying signs of situations where social justice supervision could be effectively implemented. Therefore, I recognized the greater potential to acknowledge such opportunities to center social justice within the supervision process going forward.

Through my reflection, I noticed my awareness of and commitment to supporting the emotional health of the science teacher candidates. The final clinical internship, especially for those in full time paid positions, is a busy and stressful time. My review of the conversations and notes after each cycle presented opportunities for me to detect the emotional status aspect of the

teacher candidates (e.g., expressions of feeling overwhelmed, frustrated, and distressed). Typically, when supervisors leave a classroom or end a conference, the teacher candidates' feelings continue and may in fact, worsen. My heightened empathy for the emotional experience led me to intentionally follow up sooner and more frequently. By setting a consistent plan for reaching out frequently, I connected with the teacher candidates to foster communication and support (resources, ideas, discussion, etc.). In addition, impromptu side conversations presented additional opportunities to discuss ways to increase culturally responsive approaches for teaching the science and addressing inequities that some students face. My continuous process of reflection proved to be an integral method for maintaining cognizance of the teacher candidates even when they were out of sight (and somewhat out of mind).

Prioritize Awareness and Advocacy. I detected growth in the teacher candidates' awareness of identity and issues of equity as I encouraged their development of advocacy for their students of color and students from low-income households. While I originally felt compelled to support their enactment of activism, I came to an understanding that the final clinical internship may not be the time when teacher candidates feel confident enough to become activists. I found that I needed to set realistic expectations when implementing a framework of social justice in science teaching.

As defined in Chapter 1 and further described in Chapter 2, awareness is a concept that is an ongoing state of recognition and consciousness, a constantly evolving and deepening mindfulness. According to the Cambridge Dictionary, awareness is the "knowledge that something exists, or understanding of a situation or subject at the present time based on information or experience" (2020). I implemented efforts to enhance awareness of identity, implicit bias, and inequity as a baseline of my supervision within a social justice framework.

Through the use of a variety of tools and resources, I strategically incorporated these areas of focus within the supervision cycles and ongoing dialogue. Investigating cultural identity is commonly discussed in the literature. Aligning with the work of Zeichner (1993), I prompted the teacher candidates to seek areas of inequity and to dig deeper to get to know their students' cultural identities throughout all aspects of the supervision process. In particular, I found that the White teacher candidates who I worked with needed this opportunity to understand how identity influences assumptions and practice for working with students of color (Emdin, 2016).

The teacher candidates who I have worked with have been predominantly White and middle class, including those I supervised during this self-study. They have reported attending K-12 schools located in middle class neighborhoods where the majority of students are White. My assumption was that they may have had limited exposure to racism and classism that would present situations of marginalization and/or oppression, which is supported in the literature (Achinstein & Athanases, 2005). Most of my prior teacher candidates have revealed that they were initially uncomfortable exploring topics tied to bias and inequity in schools. As with prior experiences with teacher candidates, I utilized dialogue and reflection with them to unearth deficit-mindsets about groups of students who have been traditionally marginalized and/or underserved (Sleeter, 2008).

It was important that I, as a university supervisor, facilitate a safe and receptive environment to encourage teacher candidates to examine their perceptions of students of color and students from low-income households. Through continuous and intentional dialogue to illuminate and interrogate the destructive practices of deficit thinking for students of color and/or lower SES, it was necessary to scaffold the teacher candidates' perspective for classroom students' achievement (Bauml, et al., 2013). Additionally, by co-planning with the teacher

candidates, I was able to facilitate more of a collaborative inquiry that connected to the research literature and cycles of reflection (Jacobs, 2006). Establishing the concept of awareness as the status quo for all interactions with the teacher candidates served as a catalyst for a shift into advocacy for them.

Increased awareness triggered a shift into a mindset for advocacy. Briefly, as defined in Chapter 1 and further described in Chapter 2, advocacy is a stance that one takes to seek and uphold sociocultural consciousness and works to reverse the harmful effects on students once they are aware of a critical situation (Brand, 2014). The teacher candidates' heightened awareness of students' identities in relation to inequity encouraged to them to advocate for their students' needs by connecting the science content to their personal cultures and backgrounds. Thus, the teacher candidates empowered their students to make sense of the science that enhanced their learning by providing a platform for them to express their voice and promoted enactment in their personal lives.

My supervision work for social justice suggests that the teacher candidates quietly became advocates for their students within their individual science classrooms. This is to say that they showed evidence of their heightened awareness of inequities in science education and advocated for their students by making changes to the way they taught and managed each of their own students within their own classrooms. They advocated for equitable access to the science lessons and activities by incorporating culturally responsive content into lesson planning, implementation, and interactions with their classroom students. My hope was to encourage the teacher candidates' confidence as their stance for advocacy increased and thus develop a sense of empowerment to work for larger change within the school or community. My objectives

included supporting their potential shift into more of an activist stance based upon their awareness of and advocacy for equity and social justice in their science classrooms.

While the teacher candidates all developed a strong stance of advocacy for teaching science that is socially just, receptivity and transition into activism within the schools occurred at lower levels. Similar to experiences in prior semesters with other teacher candidates, an activist stance was not adopted by most. I discovered that a rigorous foundation of awareness and advocacy served as a critical driving force for the teacher candidates to adjust their assumptions and perceptions about teaching science in culturally diverse classrooms. However, working to enact larger changes that might impact other classrooms or the school at large did not occur. Many factors could account for this including time, low confidence, being new amongst veteran faculty, juggling internship requirements, not wanting to create more work, a perception of creating trouble, fear of pushback, concern for not being liked by colleagues, and worry about being rehired. In the work of social justice supervision, I found that it is an attainable goal to focus on enhancing teacher candidates' awareness of identity and inequity while encouraging them to embrace a stance as advocate for their students of color and students from low-income households. However, the final clinical internship may not be the most favorable time in their developmental journey as novice teachers to persuade them to enact an activist platform in their schools for many reasons including those listed above.

Implications

Self-study presented an "improvement-aimed" investigation of my own professional practices that provided an opportunity to evaluate evidence that revealed a reframing of perspective and transformation of my practice (LaBoskey, 2004, p. 859). In this section, I present implications for how the finding from this self-study might guide future practice for not just

myself, but others in the field. Additionally, I share recommendations for continued research in the field of social justice clinical supervision in teacher education.

Implications for Practitioners

Self-study methodology is such that researchers can inform and transform their own practice (LaBoskey, 2004). However, self-study should not only focus on one's own transformation of practice, but it can be extended to also inform others in the field that may resonate with them (Loughran, 2005). While my self-study is based on a very small number of science teacher candidates, I suggest that other practitioners in the field may be able to extrapolate the findings in ways that bring additional perspective and new understanding. Furthermore, this study adds value to the impetus for other supervisors to investigate and share their own work through self-study.

Supervision Practices. Firstly, establishing an open and trusting relationship with teacher candidates should begin as early as possible. It is critical to build mutual trust, establish respect in both directions, and establish a safe space for the teacher candidate to freely express their viewpoints with the ultimate goal of ensuring classroom student's learning (Nolan & Hoover, 2004; Sweeney, 2013). The sooner that university supervisors can establish the constructs of trust and rapport within the relationship, the sooner the collaboration for the work to teach science within a social justice framework can begin. Additionally, increasing the time spent together in the classroom environment can enhance supervisor knowledge of the classroom students and climate. This leads to more efficient and impactful cycles of reflection and communication between the supervisor and teacher candidates.

Second, tailoring and incorporating specific strategies and resources that address concepts of identity, implicit bias, and equity within discussions provides a pathway for teacher

candidates to connect themes of social justice with their own classroom and students. Teacher

candidates need to develop their skillset for understanding and recognizing their students'

potential (Russell, et al., 2014). Furthermore, they need to be supported in developing

pedagogical practices that view and incorporate the various assets that students of diverse

backgrounds bring to the classroom (Neri, et al., 2019). By centering conferences within a social

justice perspective, supervisors can encourage teacher candidates' recognition of the culturally

diverse identities of students as well as any obstacles within their pedagogy, their classroom, and

the school that may be the source of inequitable practices that serve to marginalize students.

 Supervision for Social Justice. Supervisors should devote time and targeted strategies

and resources to support teacher candidates' awareness for how identity and implicit bias factor

into their assumptions for how students learn. With a continuous investigation of inequity as it

relates to students' identities, supervisors can encourage teacher candidates to shift their

increasing awareness into an advocacy stance. By developing and teaching culturally responsive

science lessons, supervisors should include cycles of reflection within conferences, encouraging

teacher candidates' transition into becoming more rigorous advocates for students of color and

students from low-income households. Furthermore, supervisors should assist teacher candidates

as they problematize areas of inequity that pertain to students with regard to challenges (e.g.,

discipline, low-income households, attendance).

 The practice for supervision that promotes awareness, advocacy, and activism with

science teacher candidates, can be clarified in a model that I propose in Figure 3. This model

represents an interconnected function of the three aspects within a nested, forward-moving,

continuum. The status of awareness, advocacy, and activism are not static nor isolated at any

given point in time. This aligns with the findings of Jacobs & Burns (2021) who state "…those

who are equity-minded have an equity lens, we do not conceptualize this lens as a tangible or

fixed object . . . [it] is organic and grows and expands as we learn and become more conscious"
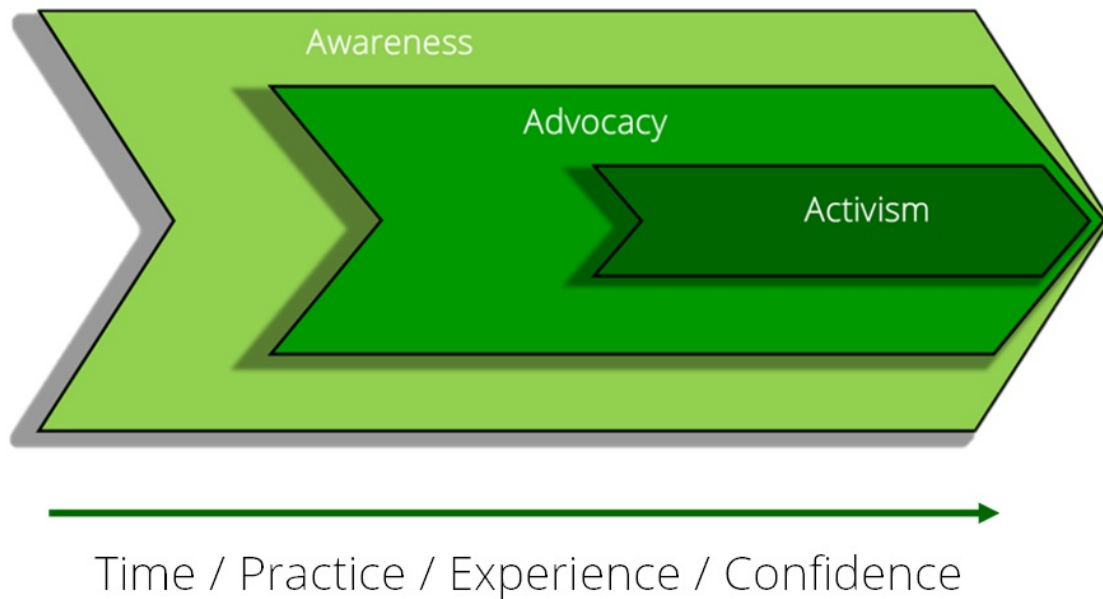
(p. 182).

Figure 3. Conceptual Model of AAA Continuum

Awareness forms the foundation of the continuum and is an ongoing construct that

permeates the entire ongoing work of social justice. Awareness continuously plays a role in how

advocacy is shaped and enacted. As each teacher candidate becomes more enlightened about

how their own identity intersects with the identities of their students, they can better recognize

the aspects that contribute to social justice barriers. Furthermore, they may become primed to

seek out areas for additional inspection and shift their pedagogical approaches in order to

connect the science curriculum in more culturally responsive and meaningful ways as they dig

deeper to understand their students' identities and the cultural capital that they bring with them

(Bourdieu, 1986; Darling-Hammond 2000; Louque & Latunde, 2014).

This conceptual model for understanding and incorporating a framework for awareness, advocacy, and activism for social justice with science teacher candidates presents a general guide for the supervision process. The constructs of AAA are a complex system in which awareness informs advocacy, and advocacy motivates a shift to activism. While the general direction of the model is forward moving towards greater presence of social justice in science teaching, activism can also provide opportunities for deeper awareness and advocacy. Expecting teacher candidates to become activists within their schools may not be a reasonable expectation within the brief time period of the final clinical internship. However, through intentional supervision for awareness of inequity and advocacy for social justice, supervisors can support science teacher candidates to connect science concepts in ways that empower their students to take ownership of and apply the information they learn in their own lives. As teacher candidates' advocacy stance strengthens with practice, they may develop agency to take on more of an activist role beyond their classrooms within the school at large and possibly the community.

Advocacy does not happen without awareness. And activism cannot occur without being an advocate for that cause. To briefly review, activism as defined in Chapter 1 and described in Chapter 2 is an active attempt to bring awareness and concern to the forefront by taking actions to raise awareness of and draw attention to an issue that promotes concern and action for change (Parsons, 2016). An activist works to enact change through sociotransformative approaches to create a more socially just situation or environment (Rodriguez & Morrison, 2019).

Recommendations

As a result of conducting this self-study, I recommend areas for future research. It is important to continue the investigation into effective supervision practices to support supervisors to implement an agenda for social justice with science teacher candidates. There is potential for

continued investigation of the specific supervisory practices that effectively engage science teacher candidates to teach science that is culturally responsive and ensures equity in their classrooms.

Furthermore, it may prove insightful to continue a longer-term study that follows teacher candidates beyond the final clinical internship time period. Research should be conducted to discern how the focus on social justice teaching that focuses on awareness and advocacy for students of ethnically, racially, and/or economically diverse backgrounds can lead to science teachers working as activists for change in their future classrooms and schools.

This self-study was based on my own supervision work with teacher candidates. It would be insightful to conduct action research with a larger quantity of supervisors, each examining their practice used with teacher candidates. Furthermore, I suggest that a collaborative self-study approach amongst a group of supervisors may magnify deeper findings and present richer implications.

In acknowledging the limitations of this study (discussed in the next section), it is my hope and recommendation for others in the field to conduct self-study of supervision of science teacher candidates within a framework for social justice. Perhaps through continued study, access to well-established knowledge about culturally responsive teaching can be distributed and implemented on a wider basis. It is possible that increased efforts for university supervisors to adopt a stance for social justice through the intentional work of awareness, advocacy, and activism may emerge.

Limitations

Even though I conducted a self-study in which I focused on my own learning, I believe that the positionality of my being both the researcher and university supervisor should be

mentioned. The teacher candidates may have felt compelled to integrate the resources and strategies for socially just science based on the power differential of our relationship. They are aware of the evaluation component of the final clinical internship and my role in that (albeit small).

There is possibility that they felt obligated to perform well by integrating the resources and ideas about equity and culturally responsive science we discussed in our conferences because they were aware that this is my area of focus. While I attempted to maintain open and honest relationships based on trust and dedication on my part, I acknowledge the influence that my research purpose may have had on their planning and teaching (Lee, 2011).

Concluding Remarks

In this self-study, I investigated my practices as a university supervisor working to embed a framework for social justice through awareness of identity and equity, advocacy for culturally responsive teaching, and activism for change with science teacher candidates. Self-study has provided the impetus for self-introspection of my own understanding and practice as a university supervisor working with science teacher candidates. I have a greater appreciation for the impact of reflection in my supervisory practices, especially with regard to an agenda for social justice. Prior to this research investigation, I had not devoted sufficient time to self-study. Unfortunately, I had not prioritized self-reflection as high as the logistical work of supervision.

Reflection also prompted me to return to the data, therefore promoting further synthesis for improvement in my practices. I gained deeper understanding for the importance of reviewing and reframing the challenges that emerged within the supervision relationship. As it turns out, reflection revealed areas of missed opportunities within my prior interactions with teacher candidates. Thus, I realized the lost potential to supervise for social justice in science teaching.

By reflecting on past problems based on the data from the authentic groundwork, my own personal development of awareness of inequities increased. I also increased my own preparation and confidence for early detection of opportunities to seek solutions in which teacher candidates can advocate for their students of color and students from low-income households.

I will continue to promote an agenda for enhancing the teacher candidates' awareness of identity and inequities as well as encourage and support their stance for advocacy by implementing culturally responsive approaches to teaching science. However, I will not continue with the third 'A' of AAA, activism. I realize that my work as a university supervisor can contribute to the field of supervision of science teacher candidates that emphasizes a social justice framework by establishing practices that support the growth of awareness and encourage work to shift science planning and teaching to advocate for students from diverse racial, ethnic, and/or economic backgrounds.

Based on the implications above for other supervisors, I will use collaborative self-study as a practice with teacher candidates that I work with. Going forward, I will implement a targeted strategy to co-analyze data from the internship in order to seek areas of inequity in the classroom and school / community together. Self-study can be even more impactful by involving others in the process so that the learning that results is more than just the one individual's experience (Loughran, 2005).

As a result of conducting self-study about my supervision practices for social justice with science teacher candidates, I have raised my level of expectations for my own work as a supervisor. Additionally, through the analysis and refinement of my insights based on continued review of the research connected with the experiences of supervision, I realize the advancement of knowledge for my own practice and potentially for my peers in supervision.

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Appendix A: Teacher Candidate Questionnaire Number One

Focus on Identity, Intersectionality, and Equity

Definitions
- *Identity* is the various characteristics (both visible and invisible) we use to categorize and define ourselves and the various characteristics that are constructed by those around us. Sometimes people only think of identity as those visible characteristics of a person, but sometimes our identity characteristics are invisible which can include all or some of the following: Gender, Ethnicity, Race, Religion, Socioeconomic status, Language, Marital/relationship status, Parent or childless, Family size and composition, Sexual orientation, Education, Career (Teaching Tolerance, 2019).
- *Intersectionality* is the multiple identities that each person has and by being members of more than one "group," they can simultaneously experience oppression and privilege; the unique experiences that are produced when various forms of discrimination intersect with these converging identities can help to recognize areas of discrimination (e.g., race, gender, class, sexual identity, etc.) to historical, social, economic, political, and legal contexts and norms that intertwine to create structures of oppression and privilege (Center for Intersectionality and Social Policy Studies at Columbia Law School, 2009).
- *Equity* is the enactment of specific policies and practices that ensure equitable access and opportunities for success for everyone. It is important to differentiate equity from equality…in order to be equitable, we cannot treat everyone the same. To be equitable, we must treat individuals according to their needs and provide multiple opportunities for success (Rodriguez, 2019).

Prior to Cycle One, please consider what you know about identity, intersectionality, and equity and take some time to provide your thoughts about the following prompts:

1. Identity: Consider how you would you describe your identity based on your background (e.g. ethnicity, race, socioeconomic, cultural, gender, ability, any other areas that comprise your identity). *Do not write this down*. Instead, describe how your background experiences are similar to and different from your students who may be from other ethnic/gender/cultural/SES backgrounds.

2. Beliefs: How can race / ethnic / cultural / socioeconomic backgrounds influence beliefs about what and how students learn?

3. Intersectionality: How might your personal intersectionality influence your perspective about your students' ability and achievement?

4. Equity: What are some factors that you detect that create an imbalance of power within your school community?

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Appendix B: Teacher Candidate Questionnaire Number Two

Social Justice - Advocacy and Action

Definitions

- *Social justice* education is based on an awareness and an examination of the impact of power, privilege, and oppression for students from marginalized groups. It provides a classroom where all groups of students have complete and equal access and opportunities for participation in an environment that is molded to mee the needs of all students (Adams, Bell, & Griffin (1997).
- *Advocacy* often entails the effort to promote social justice in the classroom. The purposeful attempts to engage with other colleagues who may not have historically participated within a social justice agenda can help to encourage goals for socially just teaching. The practice of voicing a consistent goal of equity can be powerful transformative stimulus for other educators and stakeholders (Howard, 2006).
- *Activism* occurs when teachers develop their own sense of agency to intentionally work as agents for change to create a more equitable environment in their classrooms. Teachers who can identify and understand areas of oppression and enact their capacity to change oppressive patterns in schools are social justice activists (Hoyle, 2018).
- *Culturally responsive teaching* includes the approaches that includes the diverse aspects and characteristics of all children within an inclusive classroom environment and ensures that all learners are exposed to knowledge, skills, and attitudes that empower their intellectual, social, emotional development (Ladson-Billings, 2009).

Prior to Cycle Two, please consider the following prompts and share your thoughts and ideas:

1. *Advocacy*: How do fixed mindsets about ethnicity, culture, and socioeconomic status affect students' achievement?

2. *Advocacy*: Where do you detect potential gaps of social equity in your classroom? What are some ways that you might mediate those gaps?

3. *Activism*: What are some strategies you use to embed culturally responsive teaching that supports diversity and socially just approaches in your classroom?

4. *Social Justice education*: How has your experience in the Noyce Scholarship program helped to increase your awareness of and understanding for social justice teaching?

Resources:

Adams, M., Bell, L. A., & Griffin, P. (Eds.) (1997). Teaching for diversity and social justice: A sourcebook. New York: Routledge.

Howard, T. C., & Aleman, G. R. (2008) Teacher capacity for diverse learners: What do teachers need to know? In M. Cochran-Smith, S. Feiman-Nemser, J. McIntyre, & K. Demers (Eds.), *Handbook of research on teacher education: Enduring questions in changing contexts* (3rd ed). Mahwah, NJ: Lawrence Erlbaum.

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

Appendix C: Teacher Candidate Questionnaire Number Three

Reflection and Transformations

As we each reflect on our own theories of teaching and learning, please share your thoughts about your personal beliefs, philosophies, and assumptions about teaching diverse students from all backgrounds.

1. Clarify your beliefs and philosophy about teaching science to all students from all backgrounds.

2. How has your awareness of your personal intersectionality impacted your work as a science educator?

3. Describe how you might plan to continue your advocacy for social justice in science education.

4. What challenges have you experienced enacting socially just approaches to teaching?

5. As a Noyce Scholar, you will be teaching science in a 'high-needs' district. What areas will you continue to work on to enhance your skills for embedding a culturally responsive approach to teaching?

Appendix D: Classroom Observation Instrument

University Supervisor (and Researcher): _____

Teacher candidate observed: _____

Date: _____ Start Time: _____ End Time: _____

School: _____ Grade: _____ Subject: _____

    Data collected during classroom lesson observation:

Strengths:

Areas for continued focus:

General Comments:

Appendix E: Participant Consent Form

Teacher candidate consent forms were obtained by each of the teacher candidates I supervised during this self-study.

8/11/20

Dear _____,

Thank you again for the opportunity to work with you this semester as you complete your final clinical internship as a USF Master of Arts in Teaching Science Robert Noyce Scholar. It is my honor and privilege to continue in the work of supervision and mentoring with such an esteemed group of students, scholars, and teachers. I am eager to continue the work that I have cultivated over the past years with numerous cohorts of final clinical teacher candidates.

Each semester has provided me with additional experiences and reflective opportunities to fine-tune my approaches for coaching and mentoring. My involvement with USF as a doctoral student while concurrently working as a university supervisor has been one of the most fulfilling commitments that I have ever undertaken. I am devoted to the work of supporting developing teacher candidates and continuing that support for those that I work with.

As we work in the 7th largest school district in the United States, we have a rich opportunity to teach students of a vast spectrum of ethnic, racial, cultural, economic, and social backgrounds. As I have gained increasing access to our schools, classrooms, and faculty across the district, I have simultaneously enhanced my supervising strategies that center on issues of equity and social justice, particularly in the secondary science classrooms. Through this work I came to realize that by completing a self-study, I might be able to share with others in the field. There are possible implications for not only me, but for others working in the clinical teacher preparation realm.
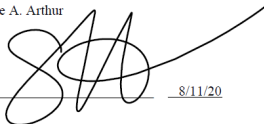
Therefore, I have decided to devote my dissertation research to a self-study that will allow me to deeply analyze the coaching, mentoring, and supervising that I conduct within our relationship. I want to share with you the primary details of this type of study. First of all, there will be complete anonymity at all times throughout my study. While I will certainly rely on my personal notes and reflections based on our work, as well as your valuable feedback, the nature of the study will always center on my analysis of data that will be completely anonymized.

While it was not deemed by the Institutional Review Board (IRB) committee that I would need any review nor approval because of this being a self-study, I did want to share with you the fact that I will be conducting my dissertation in an effort to improve the work that I do as a university supervisor seeking strategies that are effective in coaching and mentoring for culturally responsive (Gay, 2000; Ladson-Billings, 1995) and sustaining (Paris, 2012) pedagogical practices within the science classroom that will promote an atmosphere of socially just teaching and learning for all. If you would like to review the letter from the IRB, please let me know as I am happy to share that. If you would like to know more about my self-study, I am happy to share that with you as well.

My request is that you read and sign this letter indicating that you are aware that I am conducting this self-study during this semester as we work together during your final clinical

internship. If at any point, you would like to review my work, I would be very happy to share with you, and even get your feedback if you are interested in learning more about self-study.

Thank you for all that you have committed to the field of teaching science. I am eager to share in your experience this semester and support your efforts in any way that I can.

Stephanie A. Arthur

_____   8/11/20

I have read the information in this letter and am aware that Stephanie A. Arthur will be conducting a self-study of her work as a university supervisor during the Fall 2020 semester. I understand that my personal information will be kept confidential at all times and my name will not be included in any form in the self-study.

_____ _____ _____
(printed name)   (signature)   (date)

Appendix F: Pilot Study

Prior work with science teacher candidates and a pilot study with a similar research focus served as the catalyst for this dissertation self-study. The findings from my pilot study, conducted in Spring 2019 and Fall 2019 with two cohorts of secondary science final clinical internship Master of Arts in Teaching (MAT) science teacher candidates provided the groundwork as well as incentive for continued interest and investigation (Arthur, Martinez, & Feldman, 2018; Arthur & Feldman, 2020).

By espousing a stance for embedding culturally relevant and responsive teaching (Ladson-Billings, 1995; Gay, 2000) and culturally sustaining pedagogy (Paris, 2012), specific points of focus guided this work. First, I confirmed perceptions and recognized areas for increasing cultural diversity awareness by engaging in pre-semester individual, face-to-face meetings. Through collaborative approaches with the teacher candidates, I worked to develop an awareness of and determination for a constructive learning environment that embeds critical thinking and problem solving. Based on the work of Moore (2008), I also found that through numerous discussions that encourage teacher candidates' reflection on their own intersectionality, there can be a better understanding for how their power and language influence their science teaching.

I modeled and co-planned inclusive culturally diverse science lessons designed to embed the lived experiences of all students. Within that context, I encouraged the continued development of meaningful and intentional science lessons that were appropriate for students of all backgrounds. The ultimate goal was to empower the teacher candidates to develop their own agency for bringing affective change into the classroom, thus presenting a space for genuine social transformation.

A number of methods served as the guiding structure during this pilot study. I espoused and encouraged inquiry as mindset within all of the mentoring relationships during each internship period. This aligns with the core theme of investigation and inquiry in the nature of science. I found that reviewing some of the key findings from research literature helped to guide my discussions with the teacher candidates. For example, I would start a conference by sharing a brief summary of a study with informative results and implications. Time was spent conducting purposeful examination of students in order to unpack their lived experiences outside of the classroom, better understand their identities, and how that corresponded to academic achievement.

Co-planning lesson plans for scientific concepts while simultaneously considering students of color and/or those from lower economic backgrounds served as a way to identify and mediate potential social barriers to equitable learning. By collaborating about the lessons, teacher candidates considered how the structure of the lesson and method for teaching could potentially serve as a barrier to their students' understanding, and thus achievement. Through cycles of ongoing review of my observation notes from the field and simultaneous reflection, teacher candidates had a chance to pause, analyze, and revisit any missed opportunities and seek clarity for how they might adjust their lessons and approaches. At times, efforts to redress areas of

inequity within the science classroom included finding out about prior science content knowledge and experiences, illumination for gaps in understanding, access to resources, and providing additional help. An intentional and constant reminder for the importance of promoting a socially just science experience for all students served as a motivator which helped to build confidence and agency for social justice activism.

Within the two cohorts (two semesters) some themes emerged. All of the teacher candidates expressed a deeper understanding of identity awareness and intersectionality through expanded open-mindedness. There was a range of levels of transformation in regard to the increase of agency for social justice advocacy. Overall, connections and implications for growth and increase of social equity awareness and advocacy were evident in the teacher candidates at the end of their clinical field internship. However, it was a noticeable challenge for teacher candidates to enact an activist stance based on many factors. Limited time in the classroom, the slow process for building rapport, the hierarchal power structure in relation to the classroom teacher, low confidence, restructuring of belief systems, and uncertainty all served as hindering factors. One of the interesting results was my own increased confidence to espouse and enact the work for equity and social justice within the relationship between each preservice teacher. In some cases, this even extended to the collaborating teachers. This motivated my own continued efforts for this kind of work.

The figure presented here, 'Concept Venn Diagram for Secondary Science Social Justice Awareness, Advocacy, and Activism,' represents the framework that emerged based on the pilot study. This concept design maps out the relationship between the university supervisor and teacher candidates. This is how I came to recognize three primary themes of awareness, advocacy, and activism for socially just science teaching. This framework positioned my work as the university supervisor at the conjoined center of the three main themes. Within the overlapping areas of each circle are the methods, approaches, and instruments that aided my efforts. The findings are listed in each of the circles as they relate to any growth in awareness, advocacy, and activism for socially just pedagogical practices for teaching science.

While there is recognition of the need for activism within the science classroom setting, there were some limitations. One semester did not provide enough time for the teacher candidates to gain the stature and rapport necessary to make structural changes within the classroom/school. Although this was my first time studying these concepts and my novice level as researcher and developing supervisor may have prohibited greater transition for activism. Additionally, there was a small number of secondary science teacher candidates. Time was also a major constricting factor. This preliminary work revealed a potential for increased teacher candidate's agency in devoting efforts to incorporate socially just approaches in their science classes. This served as a significant catalyst and motivation to continue to push forward with this work.
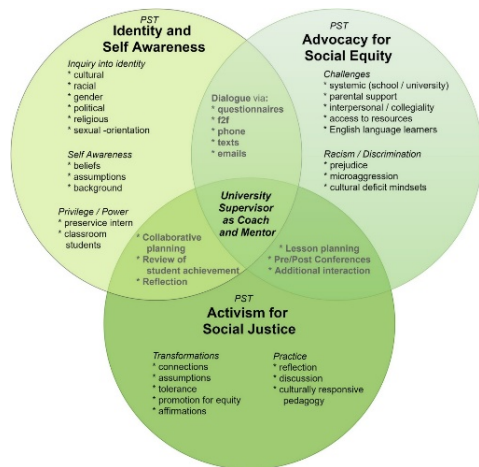
Table 7A. Coded Segments from First Round of Inductive Descriptive Open Coding

Round One Codes	Coded segments	Percentage % Coded segments	Number # Documents code appears in
Inequities in school/classroom	42	2.71	10
US coaching	140	9.04	14
US Learning / Beliefs / Assumptions / Shifts in Mindset	76	4.91	6
US transparency sharing experiences	23	1.48	7
TC confidence	14	0.90	3
SES	31	2.00	5
Black students	10	0.65	2
positive outcome for TC	4	0.26	4
Routines of Practice for Social Justice	104	6.71	1
US / TC relationship	37	2.39	1
NOS Nature of Science	2	0.13	2
Voice	5	0.32	1
SSI	26	1.68	6
gap in theory to practice	2	0.13	1
Safe space	8	0.52	5
Noyce	20	1.29	5
Challenges in internship	22	1.42	4
demographics of school/classroom	48	3.10	8
structural barriers	41	2.65	8
Challenges for teaching	96	6.20	12
IEPs and 504s	1	0.06	1
Mental Emotional Health	21	1.36	1
inquiry	4	0.26	1
shift in mindset based on US resources / practices	30	1.94	10
Beliefs / assumptions negative	28	1.81	10
Students of color and behavior issues	8	0.52	4
COVID-19	21	1.36	6
Privilege / Power	18	1.16	6

Table 7A. (Continued)

|			
Connection of content with students' lives CRP	94	6.07	12
Students performing poorly	8	0.52	5
Marginalization / oppression	6	0.39	3
TC identity	26	1.68	9
TC identity / experiences different from classroom students	30	1.94	10
ELL / ESOL students	55	3.55	9
TC identity - how they connect to their classroom students	37	2.39	12
ELL / ESOL students	6	0.39	2
Equity for teaching students	46	2.97	12
TC teaching science and resistance	22	1.42	6
Implicit bias and unearthing it	15	0.97	4
US identity	1	0.06	1
activism for social justice change	36	2.32	10
advocacy for CRP and social justice in the science classroom	101	6.52	12
Testing (issues with)	3	0.19	1
Fixed Mindset	16	1.03	4
Beliefs / assumptions - Positive	29	1.87	10
Trust and rapport with students of color and/or low SES	19	1.23	8
Challenges classroom students experience	26	1.68	11
TC learning and adjusting to students' needs	91	5.87	14
TOTAL	1549	100.00	

Appendix H: Bar Graph of Coded Segments
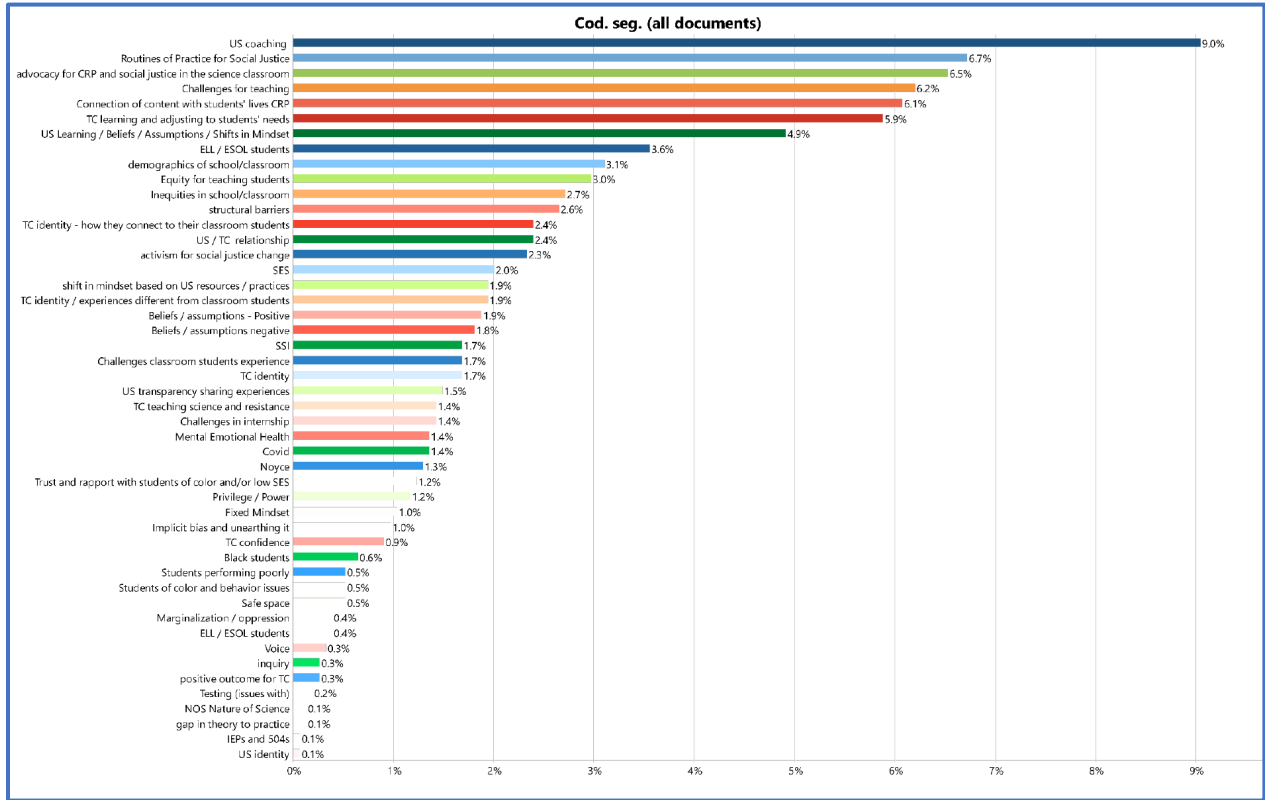
Figure 4A: Coded Segments from First Round of Inductive Descriptive Open Coding

Appendix I: Institutional Review Board (IRB)

UNIVERSITY of SOUTH FLORIDA

NOT HUMAN SUBJECTS RESEARCH DETERMINATION

August 11, 2020

Stephanie Arthur
777 North Ashley Drive
Unit 2713
Tampa, FL 33602

Dear Stephanie Arthur:

On 8/11/2020, the IRB reviewed the following protocol:

IRB ID:	STUDY001346
Title:	Awareness, Advocacy, and Activism: A Self-Study of Social Justice Supervision of Secondary Science Teacher Candidates

The IRB determined that the proposed activity does not constitute research involving human subjects as defined by DHHS and FDA regulations.

IRB review and approval is not required. This determination applies only to the activities described in the IRB submission. If changes are made and there are questions about whether these activities constitute human subjects research, please submit a new application to the IRB for a determination.

While not requiring IRB approval and oversight, your project activities should be conducted in a manner that is consistent with the ethical principles of your profession. If this project is program evaluation or quality improvement, do not refer to the project as research and do not include the assigned IRB ID or IRB contact information in the consent document or any resulting publications or presentations.

Sincerely,

Katrina Johnson
IRB Research Compliance Administrator

Institutional Review Boards / Research Integrity & Compliance
FWA No. 00001669
University of South Florida / 3702 Spectrum Blvd., Suite 165 / Tampa, FL 33612 / 813-974-5638

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