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WHEN WE THRIVE: EXPLORING THE IDENTITIES OF BLACK STEM TEACHERS DURING THEIR TEACHER PREPARATION EXPERIENCE

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by

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Dedication Page

I am dedicating this work to my grandmother and all the other Black students who dream of being in STEM.

To my grandmother, Mattie, I now realize why you were so proud of the academic accomplishments that I often took for granted. As I wrote about the cotton-picking era and the structures that were put in place to prevent you from having access to STEM education, I was able to realize why you pushed me so much through this program. Although Mattie is no longer here, your subtle pushes gave me the inspiration to frame this work. I now know what it means to be the "dream and hope of the slave" (Angelou, 1978).

To other Black students who aspire to have a career in STEM. This work is for you. You can do it!

ABSTRACT

Systemic structures designed to make pursuing a career in science, technology, engineering, and math (STEM) exclusive to dominant culture, typically employ practices of exclusion or isolation of Black people. As such, the demand for more Black people, particularly Black teachers, in STEM has increased the demand for teacher preparation programs (TPP) to recruit and graduate more Black STEM teachers. This research aims to explore the critical reflections of Black STEM teachers during their TPP to understand better how they perceive the role of social identity and how they engage in critical reflection of social identity during their TPP experience. Having a better understanding of how Black STEM teachers use critical reflections about their identities is necessary to improve the Black STEM teacher pipeline. Using Tajfel's Social Identity Theory from the lens of Freire's Critical Reflection, this study embraces tenants of Dumas' anti-Blackness to explore the research participants' critical reflections about identity, belonging, and agency. The researcher collected data for this qualitative study from focus groups, social identity maps, and interviews with six research participants. Three themes were derived from a thematic analysis of the data: altruism, illusions of hierarchy, identity aligned communities, ownership of agency, and multidimensional cultural identity. These findings highlight the significance of cultural identity during the Black STEM teacher's TPP experience. Cultural identity influences community and perception of agency. Understanding how cultural identity impacts agency is essential when planning learning outcomes and clinical experiences for Black STEM teacher candidates. The findings support the study's conceptual framework while demonstrating how community, or sense of belonging, acts as a mediator and influences the Black STEM teacher pipeline. Future research about the critical

reflections of Black STEM can use this research as a foundation to take a closer look at cultural

identities.

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CHAPTER ONE: INTRODUCTION

Most opportunities to pursue a career in teaching science, technology, engineering, and mathematics (STEM) take place in homogeneous environments that are generally not welcoming to Black people. Data from data consortiums such as The Pew Research Center[1] and the National Science Foundation[2] have shared reports demonstrating the underrepresentation of Black people in STEM fields and academic settings. According to a report published by the Pew Research Center (Funk & Parker, 2018), the Black population, which is underrepresented in the STEM field, accounts for 9% of people working in STEM careers. Although the demand for STEM is increasing, the representation of Black people in STEM fields and academia is decreasing. While 19% of Black undergraduate students declare STEM majors, Black students only account for 7% of all STEM bachelor's degrees (Funk & Parker, 2018; Newsome, 2021). Furthermore, the National Science Foundation (2019) has also noticed stagnation to little growth of Black students earning degrees in STEM across 15 years. While the percentage of Black students earning a science degree remained steady at 9%, the percentage of Black students earning an engineering degree decreased from 5% to 4%, and the percentage of Black students earning a mathematics degree decreased from 7% to 4% (National Science Foundation, 2019).

Consequently, Black teacher candidates in teacher preparation programs focused on science, technology, engineering, or mathematics are typically isolated because of their race, gender, and/or socioeconomic status. Several research projects, including research commissioned by The National Science Foundation, have studied the experiences of Black STEM teacher candidates. In each instance, Black STEM teachers reported implicit bias, discrimination, microaggressions, and stereotypes as contributing factors impacting their experience in their

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[1] a nonpartisan, non-profit, and non-advocacy fact consortium
[2] a United States federal agency tasked with using research to keep the United States as a global leader in sciences

teacher preparation program and careers as a teacher (Frank et al., 2019; Justin-Johnson, 2004; Sparks, 2018). Specifically, Dr. Toya Jones Frank's work, funded by the National Science Foundation, explored the experiences of Black mathematics teachers that contribute to Black math teacher retention. In this study, Black math teachers consistently reported experiences of microaggressions, with 60.4% reporting being made to feel intellectually inferior to others because of their race at least once a month, and 58.2% reported their contributions were minimized because of their race (Frank et al., 2019). These factors make Black STEM teacher candidates a prime target for efforts to increase the representation of Black professionals in STEM careers, including teacher preparation programs (Frank et al., 2019). As such, this qualitative exploration into the experiences of Black preservice teachers in STEM in teacher preparation programs may provide insights that will positively contribute to this field of research by illuminating how these underrepresented teacher candidates negotiate their unique identities in a Historically White Institution (HWI)[3].

The literature on social identity has indicated that in-group and out-group differences are powerful indicators of identity, belonging, and agency through which information is filtered and digested. Individuals (e.g., Black preservice teachers in STEM teacher preparation programs) derive their social identity from the social groups to which they belong (Schuchart et al., 2021; Tajfel et al., 1979) and thus are motivated to view their in-group as a way of creating a contrast between self and other. However, limited studies have considered the importance of critical

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[3] Historically White Institution (HWI) is used to emphasize higher education institution that were created prior to 1964 for the purpose of segregation to advance the knowledge of White students. HWIs perpetuated oppressive systemic structures by creating an illusion of hierarchy that privileged White students with access to their institutions while excluding and eliminating marginalized groups based on their racial identity (Cooper & Jackson, 2019; Givens 2016).

reflection to understand better the facets of social identity, which are most salient at the time and place of Black STEM teacher identity reflections.

The Historical Context

Three hundred nineteen years of public education passed before America acknowledged Black students as equal to White students (Coston, 2020). During these 319 years of educational injustice against Black students, many whites perceived most Black people as lacking cognitive abilities and incapable of personal decision-making. As a result, many Black people were treated as sub-human, received minimal education, and a Black person's worth was confined to completing laborious tasks due to their racialized social identity (Berry & McClain, 2014; Martin, 2019; Moses & Cobb, 2002; Schoenfeld, 2004; Stinson & Bullock, 2012).

Public education historians mark May 17, 1954, as a significant turning point in the history of the American public education system for Black students. On this day, the Supreme Court of the United States unanimously held *Brown v. Board of Education of Topeka, Kansas,* that segregation in public schools violates the Fourteenth Amendment of the United States Constitution (Lynn & Dixson, 2021). While the ruling was unanimous, critical theorists and historians continue to debate the authentic actualization of this ruling (Crooks, 2013; Ladson-Billings, 2004, 2005; Mustaffa, 2017).

It is worth noting that prior to *Brown* v. *Board of Education of Topeka, Kansas*, Black students overcame legal rulings that upheld laws and practices designed to minimize Black students' access to equal education. Starting with the Black Codes of 1865 that legalized segregation and continuing with Jim Crow practices in 1887, federal and state laws simultaneously isolated Black people in all public spaces, including schools. Following that, in 1896, *Plessy* v. *Ferguson* established that "separate but equal" public facilities did not violate the

Equal Protection Clause of the 14th Amendment. In response, the 1909 founding of the National Association for the Advancement of Colored People, NAACP, became a vehicle for organizing and challenging segregation in secondary and graduate school spaces. After forty-five years of strategy, the NAACP successfully ended the "separate but equal" doctrine (National Archives, 2021).

Though "separate but equal" was no longer valid, school districts began formalizing policies and using language that disadvantaged Black students and depicted them in a negative image (K. D. Brown & Brown, 2020; Lynn & Dixson, 2021). To illustrate this, the *Brown* v. *Board of Education at Topeka, Kansas* ruling came at a time when the United States experienced advances in technology, with the introduction of the mechanical cotton picker, which eliminated the need for manual labor while increasing the demand for those with knowledge of math, science, and technology courses. In response, schools reserved access to advanced mathematics, science, and technology courses for White students. This practice excluded Black people from having access to the increased economic opportunities that came with the acquisition of knowledge of math, science, and technology (Moses & Cobb, 2002). Since white dominant culture continued to view Black students as only beneficial for manual, repetitive, and laborious tasks that did not require high cognitive demand, school leaders used access to mathematics, science, and technology courses to eliminate Black students while simultaneously creating an illusion of hierarchy and power that privileged those with access to those courses (Berry & McClain, 2014; Kilpatrick & Stanic, 2003; Martin, 2019; Schoenfeld, 2004; Stinson & Bullock, 2012; Tate & Rousseau, 2002).

The Emergence of the Problem

Although the ruling of *Brown v. Board of Education of Topeka, Kansas,* set a legal precedent, the United States Constitution did not guarantee public education as a fundamental right for any student. To codify into law the *Brown v. Board of Education of Topeka, Kansas* decision, President Lyndon B. Johnson signed the Civil Rights Act of 1964, making discrimination and the segregation of schools illegal. However, true accountability did not occur until the Elementary and Secondary Education Act (ESEA) of 1965. This was monumental, especially for Black people in Southern states where segregation was more prevalent. ESEA brought federal funding to local public schools, which, in turn, forced schools to desegregate to access ESEA funds (Smith, 2020).

Even though ESEA was a huge win, Black students continue to face the challenge of having a 319-year delay in accessing equal schooling. What this means is that the residual effect of hundreds of years of cognitive oppression and low expectations continue to make it too challenging to reimagine a Black person's cognitive worth and abilities. Consequently, systemic structures of inequities in education, such as teacher preparation programs, continue to persist and lack culturally responsive structures so that Black pre-service teachers can be viewed as holders of knowledge who can add valuable contributions to STEM academia. As a result, Black teachers still only represent about 7% of all teachers and even lower for STEM teachers (Ingersoll & Merrill, 2017; National Center for Education Statistics, 2022).

The Need for Black Teacher Representation in STEM

Black teachers make up 6.7% of all public school teachers and 7% of all science and math teachers. Even though the Black teacher representation is low, there has been a steady decrease in the percentage of Black teachers in the United States of America. In 2011, 9% of all

math and science teachers were Black. By 2019, the Black teacher representation in science and math declined to 7.8% (National Center for Education Statistics, 2022). Reports have found that some Black teachers are choosing to exit the field of education to take employment offers that offer more competitive salaries. In contrast, others are unable to remain in the field of education due to state credentialing requirements (Everett, 2016). A subset of Black teachers also chooses to leave the field due to microaggressions and mistreatment. Despite the declining numbers, some Black teachers decide to stay in the field of education. When Black teachers remain in the field of education, they provide a valuable legacy filled with academic and leadership contributions (Frank, 2019).

There is an added value to having Black teachers in the classroom. Black teachers approach teaching with diverse experiences, hopes, and teaching practices that illuminate the Black students' opportunity for success in school (McCray et al., 2002). When Black students have access to Black teachers in the classroom, they perform better and are more likely to attend and graduate from college (Lindsay, 2020). Black college students reported having a sense of belonging and connectedness to their colleges and universities when they had a Black teacher (Leggett, 2020). Black students viewed their Black teachers as role models and reported having someone they could easily relate to.

Currently, there is a racial mismatch between students and teachers in the United States of America. Almost half of the students in public schools are minority students, whereas less than ten percent of the teachers are teachers of color (Lindsay, 2020). Due to the tremendous benefits that Black students gain from having a Black teacher, there is a need to increase the percentage of Black teachers. To increase the rate of Black teachers, teacher preparation programs must make a conscious effort to be culturally responsive by enacting inclusive

curricula, embracing diversity, and engaging in social justice and race-conscious conversations that support identity, belonging, and agency (Howard, 2019). Not only are teachers needed, in general, but there is a need to increase the percentage of Black STEM teachers considering Black STEM teachers only make up 7% of the teaching population (National Center for Education Statistics, 2022). Not only do Black STEM teachers encourage Black students to take STEM courses, but Black STEM teachers also provide enhanced learning opportunities and experiences for Black students, which ultimately increases the percentage of Black STEM teachers in the American education system (Funk, 2022).

Conceptual Framework

Social Identity Theory

To understand Black STEM teachers' thinking about their identities, this study is situated within Tajfel's social identity theory, which emphasizes individual and social elements of identity construction (Tajfel et al., 1979; Tajfel & Turner, 2004). This study defines social identity as the relationship between members in socially constructed in-groups and out-groups that influence the perception of one's capacity, assets, and position (Tajfel et al., 1979). When aligning this definition of social identity theory to this study, it can be used to explore the social identities of Black STEM teachers. Tajfel (1979) purported that identity includes three core elements that will be explained later in this section: social categorization, social identification, and social comparison. This approach recognizes both human agency in constructing identities and the influence of group membership in constraining and facilitating that identity construction.

Although social identity theory provides an essential structure for understanding the social construction of and beliefs about identities, several researchers have called for a more critical perspective on social identity to understand better the experiences of Black students in

the American education system (Burson & Godfrey, 2020; DiAngelo, 2018; Freire, 2014; Kendi, 2019; Solomona et al., 2005; Vavrus, 2002; Watts et al., 2011). Thus, while focusing on social identity, this study explores the integration of critical reflection, an essential dimension of critical consciousness, when exploring Black STEM teachers' identities.

The Lens of Critical Reflection

Given that Black people are a part of a historically marginalized group, this research uses social identity from the lens of critical reflection, a dimension of critical consciousness, to reason about how Black STEM teachers overcome oppressive systems despite the inequalities that have persisted in the Black academic landscape. Paulo Freire's (2014) findings about critical consciousness indicated three dimensions: critical reflection, political agency, and critical action. Critical reflection is essential in the field because it allows educators and students to focus on what Watts et al. (2011) explain as the most neglected critical consciousness dimension, critical reflection. Therefore, this research will focus on critical reflection. Throughout this research, the researcher makes mention of critical reflection to denote a dimension of critical consciousness.

Critical reflection of Black STEM preservice teachers involves critically examining one's intersectional identities and structural and historical thinking about the STEM teacher preparation program's status quo to identify growth areas, shared values, and perceptions of common fate (Collins, 2000; Schauer, 2021). Scholars (Crenshaw, 2017; DiAngelo, 2018; Watts & Hipolito-Delgado, 2015) argued that critical reflection might provide a source of identity, belonging, and agency to critique deficit-framing projections by documenting how traditionally marginalized people reflect on the conditions that shape their lives and actively works with themselves and/or others to 'resist' problematic conditions. Therefore, critical consciousness'

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focus on reflection expands our understanding of collective and individual identities among racial minorities. This study purposely aligns the dimension of critical reflection within the three vital cognitive components of social identity: social categorization (identity), social identification (belonging), and social comparison (agency). This is done to make the connection between the experiences of Black preservice teachers within the American education system, such as teacher preparation programs, and one's racialized social identity. During this study, there are elements of anti-Blackness mentioned; however, the researcher's epistemological stance from the lens of critical reflection will be used to guide this research. From this lens, one can examine how perceived social identity groups perpetuate the mistreatment of out-group members.

Figure 1

Conceptual Framework: Black STEM Teacher Pipeline
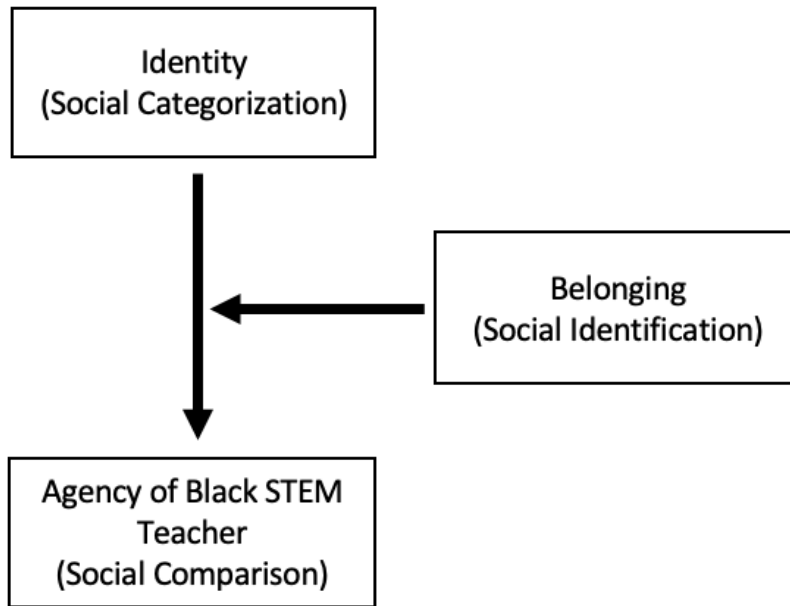
Note. This figure represents the conceptual framework for the Black STEM teacher pipeline in alignment with the social identity theory from the lens of critical reflection.

Figure 1 represents the conceptual framework of this study, while Table 1 aligns the themes within the conceptual framework. Figure 1 shows how the pathway to becoming a Black STEM teacher is rooted in the social identity theory from the critical consciousness dimension of critical reflection. The pathway begins with social categorization, which is acknowledging one's identity. Next, the sense of belonging informed by one's identity represents Tajfel's social comparison component. Finally, agency demonstrates Tajfel's social comparison component.

Table 1

Themes Investigated from Deductive or a Priori Codes Derived from Conceptual Framework

Social Identity Theory Framework	Social Categorization	Social Identification	Social Comparison
Researcher's Conceptual Framework	Identity	Belonging	Agency
Researcher's Themes	Identity creates the capacity to educate and learn from others.	Identity offers assets that create a sense of belonging.	Identity as a Black STEM Teacher produces a position in the community that liberates.
Alignment of themes in the Teacher Preparation Program	Identity offers a capacity to educate and learn from others	Belonging within a community produces assets to offer others	Position as a Black STEM teacher in the community ensures academic equity for all.

Note. This is a map that aligns critical reflection with the three components of social identity: social categorization, social identification, and social comparison. The researcher will review two focus group transcripts and five social identity maps to investigate themes within deductive or a priori codes derived from the conceptual framework in Figure 1.

Together, social identity and critical reflection underscore the Black STEM teachers' marginalized identities and explore how they exhibit awareness of oppressive realities that shape their lives and their 'capacity' to transform that reality (Crenshaw, 2017; Watts & Hipolito-

Delgado, 2015). This study aims not to examine how Black STEM teachers can enhance their critical political efficacy and critical action, but rather to explore the critical reflections of Black STEM teachers about their social identities.

Aligning Social Identity and Critical Reflection: Black STEM Teacher Pipeline

Using the social identity theory as a foundation, this research uses critical reflection to present a pathway to becoming a Black STEM teacher. The essence of the Black STEM teacher pathway begins with the social categorization, or identity, process, where the social identities about oneself within STEM are revealed. Those identities are rooted in one's Blackness and whether one perceives they are a part of the in-group or the out-group. From acknowledging one's identities, the Black STEM teacher candidate perceives they are a part of the in-group or the out-group. Through the revelation of identity, the Black STEM teacher candidate acknowledges their capacity to embrace what it means to be a Black STEM teacher (Cedillo, 2018; Dumas, 2016; Dumas & Ross, 2016; McGee, 2016, 2020). When extending social categorization within the lens of critical reflection, there is evidence of identity awareness that affirms how one's identities or the intersectionality of one's identities supports the capacity to learn from and educate others (Burson & Godfrey, 2020; Gay & Kirkland, 2003; Gutiérrez, 1995; Jemal, 2017; McDonough, 2009; Robinson, 2017).

Next, the sense of belonging informed by one's identity represents Tajfel's social comparison. One's sense of belonging within their community reveals the assets the Black STEM teacher candidate's identities provide to the community. Although Black STEM teacher candidates must first believe in themselves by having a positive perception of their assets, it is equally necessary for others to perceive a strong identity in the Black STEM teacher candidate (Jemal, 2017; Kozan et al., 2017; Madden et al., 2017). In this phase, Black STEM teachers

begin creating "opportunities" to develop a sense of belonging by engaging in honest and precise feedback and conversations about one's Blackness in the realm of STEM education (Dumas, 2016).

The final pathway to becoming a Black STEM teacher is social comparison. Social comparison from the lens of critical reflection involves agency. The Black STEM teacher candidate understands that they have the agency to use their position, created by their identity as a Black STEM teacher, to disrupt historical legacies of discrimination to ensure educational equity for everyone. A positive identity from an asset-based lens promotes a vital Black STEM teacher pathway. When this occurs, Black STEM teacher candidates are equipped to solicit ideas and practices to promote the longevity of teachers of color. On the other hand, deficit thinking about identity has the opposite effect on the Black STEM teacher pathway. Deficit thinking about identity impedes progress and disrupts the Black STEM teacher pathway (McGee, 2016). An extension of social comparison within the lens of critical reflection is taking ownership to recognize one's position within the dominant culture and privilege (Cohen, 2011; El-Amin et al., 2017; Godfrey & Wolf, 2016; Goodkind et al., 2020; Jemal, 2017; McDonough, 2009; Vezzali et al., 2015; Windsor et al., 2018).

Purpose of the Study

Much of the prior research on Black STEM teachers' identities is taken from a deficit lens rooted in dominant classism and racist ideologies (Bruton & Robles-Piña, 2009; Solórzano & Yosso, 2002), which seeks to understand assumptions about a lack of agency, motivation, and preparation that keep Black teacher candidates from fitting into the dominant cultural norms of STEM. In addition to having roots in classist and racist ideologies, deficit thinking is anchored in colorblindness. Deficit thinking intersects with colorblind ideologies, which misleadingly

implies that the legacies of racist oppression and other intersectional issues of oppression do not shape the experiences and outcomes of social groups in STEM education and STEM Teacher Preparation Programs. It is important to note that, since the 1980s, deficit thinking has converged with colorblindness to facilitate the negative portrayal of Black people in the U.S. STEM workforce and teacher preparation programs, which intensify early research on the effects of in-group and out-group categorizations. This study investigates the critical reflections of Black STEM candidates about their social identity. This examination deserves a critical eye, particularly as it relates to facilitating positive experiences for Black STEM teacher candidates who have historically been marginalized in STEM fields.

Research Questions

This study answered the following questions:

1. How do Black STEM teachers perceive the role of social identity in their teacher preparation experience?

2. How do Black STEM teacher candidates engage in critical reflection of social identity in their teacher preparation experience?

The first research question is being asked to determine how Black STEM teacher candidates collectively perceive the role of their social identities as they matriculate through their teacher preparation program. This question will provide information about salient themes of social identity theory from the lens of critical reflection that influences the collective perceptions that Black STEM teacher candidates have about the role of group membership. The question will support the researcher's understanding of the experiences of Black STEM teachers at different points in the teacher preparation pipeline.

The second research question is being asked to understand better how Black STEM teacher candidates independently engage in critical reflection about their social identities while in their teacher preparation program. This question will provide the researcher with information on whether critical reflection happens, the impact that individualized critical reflection has on the Black STEM teacher candidate's thinking about their identity, and which theme of social identity has the most impact during the period of critical reflection. The information gained from this research question will be helpful for teacher preparation programs as they design participant program experiences to recruit and retain Black STEM teacher candidates.

Research Design

Using a qualitative research design, the study explores the individual and collective views, motives, and meanings of Black STEM teachers. Understood through critical consciousness' dimension of critical reflection, this study's methodology is dialogical, allowing the opportunity to discover generative themes and stimulate both individual and collective critical reflection of these themes. Given that the research will explore collective and individual reflections of research participants, this research will follow Maxwell's (2013) interactive design to lead two different focus groups about one week apart to collect collective responses and independent reflection data from an identity map. The social identity map will serve to visually represent the critical reflections of Black STEM teachers (Crenshaw, 2017).

Significance of the Study

Currently, teacher preparation programs in the United States are undergoing continuous changes to improve the Black STEM teacher candidate experience to enhance the Black STEM teacher pipeline (Frank et al., 2021; McGee, 2020). Teacher preparation programs must support the identity development of Black STEM teacher candidates. Furthermore, it is necessary to

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ensure that Black STEM teacher candidates can identify their capacity to educate and learn from others and perceive they have assets to offer others while recognizing their position as a Black STEM teacher creates educational equity for all students. Thus, exploring the critical reflections of Black STEM teachers is necessary for improving the Black STEM teacher pipeline. This is needed to dismantle the systemic and oppressive attacks resulting from deficit thinking about the identities of Black STEM teachers. This study explores the critical reflections of Black STEM teachers' social identity to provide more insight into the collective and individualized identities among Black preservice teachers.

This study will also be beneficial to teacher preparation programs at HWIs and minority-serving institutions (MSIs)[4] to assist them with recruiting, retaining, and improving the experiences of Black STEM teacher candidates that will empower teacher candidates to engage in critical reflection to affirm their identities, perceptions, and positions within their school communities. Since research has shown that the experiences of Black students at HWIs often become overlooked, ignored, silenced, and disregarded, this study is intentionally designed to benefit the higher education leaders in HWIs (Howard, 2019; Irizarry & Donaldson, 2012). Although this study can support higher education leaders at MSIs, one should be careful not to limit this research to MSIs merely because this study focuses on the experiences of Black preservice teachers. There is a more substantial implication for the use of this study at HWIs to dismantle the oppressive practices that silence the voices and experiences of Black preservice teachers. Finally, this research study can assist district-level administrators in planning professional development activities for early-career Black STEM teachers. Additionally, school

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[4] According to the U.S. Department of the Interior, Minority Serving Institutions (MSIs) are higher education institutions where more than fifty percent of their population is made up of minority students (2021).

leaders should use this study's conceptual framework and findings to improve the Black STEM teacher experience at their school while improving their relationship with their staff.

Assumptions

This study assumes that all research participants will continue in their teacher preparation throughout this study. There was an assumption that research participants engage in critical reflection about their social identity. Furthermore, it was assumed that each research participant is truthful about their social identity, especially their racial identity, to be eligible for the study. Finally, there is an assumption that research participants will authentically engage in collective and individual critical reflection activities by providing honest and truthful responses.

Delimitations

The researcher established boundaries in this study to allow for a focus on the experiences of Black STEM preservice teacher candidates. The researcher limited the research participants to Black teacher candidates, recent graduates, and alums attending an alternative teacher certification program at an HWI in the northeastern United States. The research participants were limited to Black teacher candidates, recent graduates, and alums seeking teacher certification in Elementary Education or Secondary Mathematics while teaching mathematics, science, or STEM. Finally, although this study focuses on critical consciousness, the researcher has limited this study to only focus on the critical reflection dimension of critical consciousness.

Limitations

The design of the research has created some limitations. This study uses focus groups which may cause some participants not to share as much information as they would during individual interviews. Furthermore, this study requires that some research participants recall

experiences from several years ago. There is the possibility that their perspectives about the experience have shifted due to current news events. Another limitation of this study is that it cannot be generalized. Last, the study is limited to the themes that the researcher selected based on the literature.

Definitions of Terms

- *Black* – Taken from the Black Power movement in the 1960s and 1970s, this term is used to describe any nonwhite person of Black descent, regardless of national origin. (https://www.missouristate.edu/Equity/definitions.htm)

- *Historically White Institution, or HWI* – a higher education institution whose historical structure privileged Whiteness and intentionally excluded and/or limited Black students from enrollment prior to 1964; has a current student population of at least 50% White (Cooper & Jackson, 2019; Givens 2016).

- *Minority Serving Institutions, or MSIs* – higher education institutions where more than fifty percent of their population is made up of minority students (U.S. Department of the Interior, 2021).

- *Preservice Teacher* – A person currently enrolled in a teacher preparation program and is working towards an initial teaching credential (IGI Global, 2018)

- *Program Specific Alumni* – An in-service teacher who completed their teacher preparation program (Ragland, 2017)

- *Program Specific Inservice Teacher* – A teacher who is currently teaching full-time as a teacher of record in a school district while also working towards completing their teacher preparation program (IGI Global, 2018)

- *Science, Technology, Engineering, and Mathematics, or STEM* – the integration of four closely connected areas of study for the purpose of learning and development: science, technology, engineering, and/or math (Gustavsen, 2022)

- *Teacher Candidate* – "A student who is participating in a [accredited] teacher preparation program and preparing to become a certified teacher, but is not yet graduated" (IGI Global, 2018).

- *Teacher Preparation Program* – "A state-approved course of study, the completion of which signifies that an enrollee has met all the state's educational and/or training requirements for an initial credential to teach in a K-12 school" (Congressional Research Service, 2018)

Summary

Chapter 1 consisted of the introduction, the purpose of the study, the research questions, and the organization of the study. Chapter 2 consists of a review of related literature. Chapter 3 consists of the conceptual framework. Chapter 4 consists of the findings. Chapter 5 consists of a discussion of the findings. Chapter 6 consists of the study's conclusions and implications for further research.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

This study explores the critical reflections of Black STEM teachers' social identity during their teacher preparation experience at a Historically White Institution (HWI). Often the experiences of Black students at HWIs become overlooked, ignored, silenced, and disregarded. Therefore, understanding how Black STEM pre-service teachers engage in critical reflection about their social identities will provide more insight into the collective and individualized experiences that Black pre-service STEM teachers encounter while in their teacher preparation program. This study will be framed by Henri Tajfel's Social Identity Theory (1979) from the lens of Paulo Freire's (2014) first and often overlooked dimension of critical consciousness, critical reflection.

Deficit Discourses, Colorblind Lenses, and Black STEM Teachers

The historical practice of deficit thinking about Black teachers has contributed to the stifled progress and racially stained educational experiences of Black students in STEM (Williams et al., 2020). Due to several years of deficit discourse about Black students in higher education, continuous misconceptions about the cognitive abilities of Black pre-service teachers have resulted in culturally misaligned STEM and higher education coursework. Consequently, generations of deficit thinking about a Black person's identity stunts progress and diminishes opportunities for Black pre-service teachers (Coles & Powell, 2020; Dumas, 2014; Ladson-Billings, 2006; Williams et al., 2020). In fact, research demonstrates how dominant in-group members maintain a Eurocentric culture in STEM that supports eliminating Black pre-service teachers (Russo-Tait, 2022). Moreover, research in education has done little to refute the deficit thinking about the intellectual abilities of Black pre-service teachers, such as illuminating the assets of Black pre-service teachers. Instead, education researchers approach inquiries about

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Black pre-service teachers from a deficit-centered perspective by magnifying the academic under-achievements and challenges of Black pre-service teachers (Harper, 2009). Thus, the dominant lens about Black pre-service teachers negatively impacts the experiences of Black pre-service teachers in higher education settings, which decreases the likelihood of Black in-service teachers breaking into higher education spaces as holders of knowledge (Ladson-Billings, 2006; Williams et al., 2020).

To illustrate, Fries-Britt and Turner (2002) alleged Black pre-service teachers engage in self-doubt about their cognitive abilities due to narratives from the perspectives of those with privileged identities coupled with assumptions about underserved populations. Narratives from the lens of privilege often align with White, heterosexual, male, or upper-class culture, which society perceives as the dominant and socially constructed in-group. At the same time, these narratives highlight the lack of success among Black pre-service teachers without considering the systemic structures that minimize a Black pre-service teacher's opportunity for success (Harper, 2009; Williams et al., 2020).

At the same time, Black pre-service teachers often experience inequities in STEM education due to a lack of identity and access to such curricula. One main factor is that the STEM curriculum is heavily influenced by privileged and colonizing narratives that are culturally inappropriate for Black pre-service teachers. In response, there is an increase in literature publications that offer counter-narratives about the academic achievements and trajectories of Black pre-service teachers in STEM and higher education. Through this body of work, writers are re-creating the narratives about the experiences of Black pre-service teachers in STEM and higher education from an asset-based perspective (Coles, 2020; Everett, 2016; Fries-Britt & Griffin, 2007; Harper, 2009; Sealey-Ruiz & Greene, 2011; Williams et al., 2020).

Within higher education structures lies endemic racial biases with historic roots tracing back to slavery. Such history creates racial divides for Black STEM pre-service teachers who carry the burden of deflecting the deficit and biased narratives about their intellectual abilities. When Black pre-service teachers attend HWIs, they become members of the out-group and experience microaggressions and biases. Dominant in-group members who hold Eurocentric views and values challenge the racial identities of the traditionally marginalized out-group members, making colonizing views and values the perceived norm (Williams et al., 2020).

In the same way, systemic structures within STEM create an illusion of hierarchy through policies and practices that privilege those with access to STEM knowledge. With this privilege comes the perception that normalizes White, Western, and middle-class values, while rejecting the humanity of and contributions from Black pre-service teachers, in-service teachers, and researchers (Bang & Marin, 2015; Carlton Parsons et al., 2011; Ladson-Billings, 1994; Malcom & Feder, 2016; McGee, 2020; Russo-Tait, 2022; Vakil & Ayers, 2019). Colorblindness, a leading value within STEM, aligns with the aforementioned White-dominant culture and serves as the gatekeeper to denying Black pre-service teachers access to STEM education. Through the lens of colorblindness, race, culture, ethnicity, and the history of racial trauma are ignored in an attempt to end racism. Colorblindness asserts that everyone has an equal opportunity regardless of their racial, cultural, or ethnic identity. Given these points, STEM fields are easily associated with a colorblind mindset because of a belief that anyone, regardless of race, ethnicity, culture, or status, can achieve success in STEM as long as they work hard (Adams & Salter, 2019; Carlton Parsons et al., 2011; McGee, 2014, 2020; Russo-Tait, 2022; Williams, 2011).

On the other hand, supporters of colorblind ideology claim this philosophy is race-neutral and emphasizes fairness. However, research suggests such stances silence the unjust experiences

of racially minoritized people resulting in oppressive systems that lack understanding about race and how to eradicate racial inequalities in areas like STEM education that already lacks racial diversity. In the same way, a colorblind mindset diminishes one's sense of having a critical racial consciousness. When colorblindness is allowed to persist within STEM, the racial disparities, violence, and trauma against Black students and teachers in STEM are silenced, which fosters a continuous cycle of racism. As a result, those with a colorblind mindset can easily ignore racism, disengage in conversations about race, and justify its non-existence based on their privileged experiences. When operating without a critical racial consciousness, one cannot reflect critically on racialized experiences in a way that eliminates racial injustices (Asare, 2017; Dowd & Bensimon, 2015; Freire, 2014; Joseph et al., 2016; Powell et al., 2021; Williams, 2011). For these reasons, a colorblind stance is especially harmful in STEM education, where Black pre-service teachers are already disproportionately represented.

Adding to racial disparities in STEM education is Charles Murray's Bell Curve. The Bell Curve is a graph that represents the normal distribution for a set of data. The graphical representation of the data set resembles the shape of a bell. Although the bell curve helps analyze economic and financial data, it is harmful when used to describe the cognitive abilities of racial and ethnic groups (Herrnstein & Murray, 2010; Muntaner et al., 1996). It is even more harmful when used as a basis to validate who belongs in STEM. Conversely, the Bell Curve has unfairly produced outcomes where White people are the majority and consistently perform higher on IQ tests than Black people without addressing the why behind this data. Therefore, the use of this model creates racial prejudice, biases, and disparities when used to represent cognitive abilities by worshiping the data, which aligns to a tenant within White supremacy culture (Muntaner et al., 1996).

The Significance of Social Identity Theory in Black STEM Teacher Research

From a Historical Perspective

Henri Tajfel, a researcher who founded the social identity theory, used his life experiences to drive his work on the social identity theory. Since Tajfel and his family were Jewish, the Nazis held them as prisoners of war in a concentration camp during the Holocaust. As an outcome of their Jewish affiliation, Tajfel and his family suffered extreme conditions, which led to the death of every member of Tajfel's family. This experience caused Tajfel to investigate group membership relationships (R. Brown, 2019).

As Tajfel began looking into group membership relationships, he wanted to know how group membership impacted the treatment of group and non-members. More specifically, he wanted to identify the root cause of the mistreatment of members of the Jewish community by Nazis during the Holocaust. He questioned whether group membership was the cause of their harsh treatment and death. After studying realistic group conflict theory, he found that conflict between groups happened when there was conflict for resources. However, realistic conflict theory does not explain what happens within groups without competition for resources. Thus, Tajfel discovered social identity theory in response to realistic group conflict theory (R. Brown, 2019).

In the 1970s, Tajfel began looking at the social identity theory by studying group relationships during a series of minimal group studies. Tajfel and his research team assessed the role of perception in prejudice and stereotypes of others. During the studies, research participants were anonymously placed into two groups and allowed to give rewards to pre-determined in-group and out-group non-members. The findings from the minimal group studies demonstrated the favoritism one tends to have towards members of their perceived group,

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regardless of their relationship and the prejudice one has towards non-members of their group. In some instances, group members did not know one another and still received favoritism because they were group members. Ultimately, the data from Tajfel's minimal group studies demonstrated the impact of ethnocentrism when in-group members consistently provide bias toward members of their group. (Tajfel et al., 1979).

Dr. Robert Cialdini, another researcher during the 1970s who studied basking in reflected glory, or BIRGing, aided in developing the social identity theory. In 1976, Dr. Cialdini led a research team investigating behaviors of in-group and out-group memberships. According to BIRGing, in-group membership can be flexible (Hirshon, 2020). For example, a person can become a member of the in-group by associating themselves with the winning team or the person being celebrated. In this situation, one uses "we" to demonstrate association and affiliation with the winning person or team. The research noted that persons also wear team attire and colors to signify their association. Being associated with a winning team or person fulfills the need and desire to boost self-esteem (Cialdini et al., 1976; Jensen et al., 2018).

By contrast, people can easily disassociate themselves from an unsuccessful team or person. When this happens, one uses "them" to signify that the unsuccessful team is part of the out-group. One will also wear non-team colors and attire to confirm their disassociation from the team (Hirshon, 2020).

Together with John Turner, Tajfel used the findings from research such as the minimal group studies and BIRGing in 1979 to introduce the social identity theory as three components: social categorization, social identification, and social comparison (Hirshon, 2020; Stryker & Burke, 2000). Their work, along with the contributions of other social theorists such as Dr. Cialdini et al. (1976), demonstrated how social group membership influenced the treatment of

others. Overall, early social theorists' work focused on paradigms of a person's prejudices and discrimination within in-group and out-group engagement (R. Brown, 2019; Tajfel et al., 1979; Tajfel & Turner, 2004).

In-Group/Out-Group Dynamics

The social identity theory looks at the relationship between in-group and out-group members by explaining how they view themselves based on their social group membership. In-group members are group members to which one belongs, while out-group members are the opposing group. In-group members exhibit a uniformity of perception and behaviors of other in-group members (Stets & Burke, 2000). The in-group out-group dynamic fuels judgment by in-group members that their thinking and behaviors are better than the opposing out-group members (Fries-Britt & Turner, 2002; Tajfel et al., 1979; Tajfel & Turner, 2004).

According to this theory, the conflict occurs from one's desire to create a positive social identity by connecting it to group membership. Under those circumstances, a person will take on the social identity of their group in the form of similar behaviors and seeing things from the group perspective. These behaviors occur because one tends to view themselves concerning the social groups one belongs to (Stets & Burke, 2000; Stryker & Burke, 2000). For this reason, social identity theory can explain inter-group conflict, prejudice, discrimination, and the formation of stereotypes.

Social identity theorists recognize a group as a collective of related people who identify with one another, envision themselves and each other similarly, and hold similar views that contrast with out-group members (Stets & Burke, 2000). The group's similarities eliminate non-group members' acceptance, resulting in tension, conflict, and competition. Additionally, tension, conflict, and competition are magnified when one works to make their group better than

the other group. By doing so, the tension, conflict, and competition can lead to prejudice, discrimination, and stereotypes solely rooted in group membership (Tajfel et al., 1979; Tajfel & Turner, 2004).

While the social identity theory can explain the inter-group conflict that constructs structures for the development of prejudice, discrimination, and stereotypes, there are limitations when seeking to rationalize the inter-group conflict in the context of what it means to be Black and Blackness. In particular, the social identity theory generalizes the explanation for inter-group conflict. While doing so, the theory lacks the opportunity for critical reflection, which is needed to address the "specificity of anti-Blackness in explaining how Black bodies become marginalized, disregarded, and disdained in schools and other spaces of education" (Dumas & Ross, 2016).

Furthermore, social identity theory is race agnostic. In other words, it does not consider how the afterlife of oppression or slavery (Cedillo, 2018) influenced the cultural values and aspects of Blackness (Dumas, 2016; Dumas & Ross, 2016; Wynter, 1989). The social identity theory asserts that any out-group member can experience prejudice, discrimination, or stereotype due to being a member of a socially constructed out-group. Given these points, the social identity theory disregards the experiences specific to the identities of Black STEM teachers by omitting opportunities for critical reflection and generalizing prejudice, discrimination, and stereotypes from a non-specific racial lens.

Despite its limitations, social identity theory has still made valuable contributions that researchers can use when investigating the role of identity of Black STEM pre-service teachers in teacher preparation programs. The three-step process of the social identity theory addresses the dilemmas that arise as one navigates the intersectionality of their identities to create a

positive social identity within a teacher preparation program. Considering social identity theory explains group conflict between social groups, this theory can also be used in this context to justify why conflict occurs.

Critical Theories in Black STEM Teacher Education

The structure of social identity theory limits scholars to using this theory to explain the chosen behaviors of people based on their social group affiliation (Hogg & Reid, 2006). More specifically, social identity theory places limits when studying topics specific to racialized identities. The fact that social identity theory lacks an opportunity for critical reflection has caused researchers to call for a more critical perspective on social identity (Burson & Godfrey, 2020; DiAngelo, 2018; Freire, 2014; Kendi, 2019; McDonough, 2009; Solomona et al., 2005; Vavrus, 2002; Watts et al., 2011). The sections that follow explore critical theories that inform research in education.

Critical Race Theory in Education

Following the Critical Race Theory work of Derrick Bell, the father of critical race theory, Dr. Gloria Ladson-Billings and Dr. William Tate ushered Critical Race Theory into the field of education (Ladson-Billings, 1998; Ross, 2019). From the start, Ladson-Billings and Tate (1995) drew on Critical Race Theory to show how Whites used institutionalized racism to eliminate Black children from receiving an equal public education. For example, public education became a system where whites used their privilege to ensure their "absolute right" to exclude Black students (Ladson-Billings & Tate, 1995) and control the narratives about Black people (Dumas & Ross, 2016).

Meanwhile, in 2006, Ladson-Billings used critical race theory to reject previous deficit thinking about the achievement of Black students in her presidential address to the American

Educational Research Association, *From the Achievement Gap to the Education Debt:*
Understanding Achievement in U.S. Schools (Fultz, 1995; Milner, 2013). The phrase "the achievement gap" (Ladson-Billings, 2006) evolved into deficit thinking about the academic acquisition of Black students (Lee, 2002; Milner, 2013). Ladson-Billings challenged education researchers to critique the ideology of a presumed achievement gap and consider the demonstrated performance of Black students to be the result of an education debt that America has failed to pay to Black students (Ladson-Billings, 2006; Milner, 2013). An education debt, as Ladson-Billings asserted, is a more appropriate comparison due to the years of unequal education Black students received despite *Brown v. Board of Education Topeka, Kansas* (Ladson-Billings, 2006). Ultimately, Critical Race Theory in education became a theory of race used to evaluate White supremacy and the confines of the hegemonic liberal multiculturalism (Dumas & Ross, 2016; Jett, 2012; P. McLaren, 1995; Melamed, 2011).

Black Critical Theory, BlackCrit

Further expansion in the study of Critical Race Theory in education would evolve into a Black Critical Theory, or BlackCrit, centered on anti-Black racism (Dumas, 2016; Dumas & Ross, 2016). BlackCrit, a theory of Blackness, rationalizes how dominant in-group members perpetuate anti-Black experiences where Black people have perceived advances in race and diversity (Dumas & Ross, 2016). Because Blackness matters, one can rely on BlackCrit to synthesize how anti-Blackness shapes our schools by eliciting violence against Black people through social and education policy (Dumas, 2014, 2016; Dumas & Ross, 2016).

Adding to BlackCrit, Leon Walls (2016) suggests, "race has been, and continues to be, a uniquely thorny aspect of American society; [therefore], how it is positioned, represented, and discussed within research agendas is vitally important" (2016, p. 1547). When considering the

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social identity theory from the lens of BlackCrit, researchers must consider humanity from the lens of Black people and Blackness. Whereas Black people and Blackness are associated with being sub-human antagonists, humanity becomes anti-Black and rejects Blackness and Black people (Cedillo, 2018; Dumas, 2016; McGee, 2020). Hence, non-Black people automatically create groups through social categorization that identifies Black people as out-group members.

Anti-Blackness

From a lens of BlackCrit in STEM education, anti-Blackness seeks to explain the quest to eliminate Black people from accessing opportunities in STEM. In most cases, anti-Blackness is the root cause of the deficit thinking about Black people in STEM academic content. As for the research, it suggests Black students' limited instruction comes at the mercy and hands of Whites, who are the holders of knowledge because some Whites automatically perceive Black people as deficient in STEM-related content (Bullock, 2017; Harris, 1993; Hottinger, 2017; Joseph et al., 2021; Mensah & Jackson, 2018). At the same time, anti-Blackness also explains why Whites often portray Black people from a deficit perspective, an antagonist who is a societal problem, unworthy of high-level STEM coursework (Dumas, 2016; McGee, 2020). This negative portrayal means that deficit thinking about Black people impacts what happens within the school building and influences policies and dialogue that ultimately affect students' STEM identities (Frank, 2019; McGee, 2016).

Given these points, Black people experience violence that is not limited to prejudice, discrimination, and stereotypes from social comparison. The violence persists in the form of racialized microaggressions and can frame the perceptions that one has about their identity. In-group members victimize the essence of Blackness through the out-group homogeneity effect. Consequently, the mistreatment creates an illusion of hierarchy and power for those privileged to

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be in-group members (Berry & McClain, 2014; Martin, 2019; Stinson & Bullock, 2012; Tate & Rousseau, 2002).

Critical Consciousness

While working with a marginalized group, Paulo Freire theorized critical consciousness (El-Amin et al., 2017). Through his research, he noted reasons inequalities persisted within the marginalized group of adults, which led to three dimensions of critical consciousness. This research's focus emphasizes one dimension of critical consciousness, critical reflection. With critical consciousness in mind, critical reflection is what motivates marginalized students to achieve academic success. Because Black teachers are aware of the injustices against them, using frameworks of critical reflection will help them understand how to accomplish their desires to become STEM educators by overcoming the barriers of injustice acts (El-Amin et al., 2017).

According to Paulo Freire (2014), critical analysis, sense of urgency, and commitment to action support the development of critical reflection (Whitaker, 2020). This cycle created an awareness of the injustices amongst marginalized people to prevent further unjust actions by resisting oppressive forces (P. L. Carter & Welner, 2013; El-Amin et al., 2017). With this in mind, critical reflection promotes awareness of engagement in a larger shared struggle for social justice by removing one's feelings of isolation and self-blame for the challenges one faces (Diemer et al., 2017; El-Amin et al., 2017; Ginwright, 2010).

Within critical reflection, intraminority solidarity looks at group dynamics within marginalized groups. When marginalized groups experience widespread "social, political, and/or economic marginalization due to an aspect of [their] social identity shared among group members" (Burson & Godfrey, 2020, p. 1362), there is a need to understand how the group members arrive at a state of solidarity. Although there are barriers, such as competition and

threats to one's social identity, there are also opportunities for intraminority solidarity to exist (Burson & Godfrey, 2020).

In response, critical reflection theorists proposed transformative potential because of the limitations of critical reflection. Transformative potential goes beyond reflecting the problem or need for change. It explains the intervention that is needed for the transition to occur. Based on transformation potential, reflecting on realities, coupled with intervention, leads to change (Jemal, 2017). Therefore, critical reflection affords transformative potential within the social identity theory.

Since critical reflection is situated in the theory of critical consciousness, the researcher has chosen to ground this study in the social identity theory from the lens of critical reflection to explore Black STEM teachers' collective identities. Critical reflection involves a critical examination of one's intersectional identities and structural and historical thinking about the status quo of STEM teacher preparation programs to identify areas of growth then and shared values and perceptions of common fate (Collins, 2000; Schauer, 2021). That being the case, scholars (Crenshaw, 2017; DiAngelo, 2018; Watts & Hipolito-Delgado, 2015) argued that critical reflection might provide a source of agency to critique deficit-framing projections by documenting how people of color reflect on the conditions that shape their lives and actively works with themselves and others to 'resist' problematic conditions.

Introduction to Research Aligning the Conceptual Framework

Figure 1

Conceptual Framework: Black STEM Teacher Pipeline
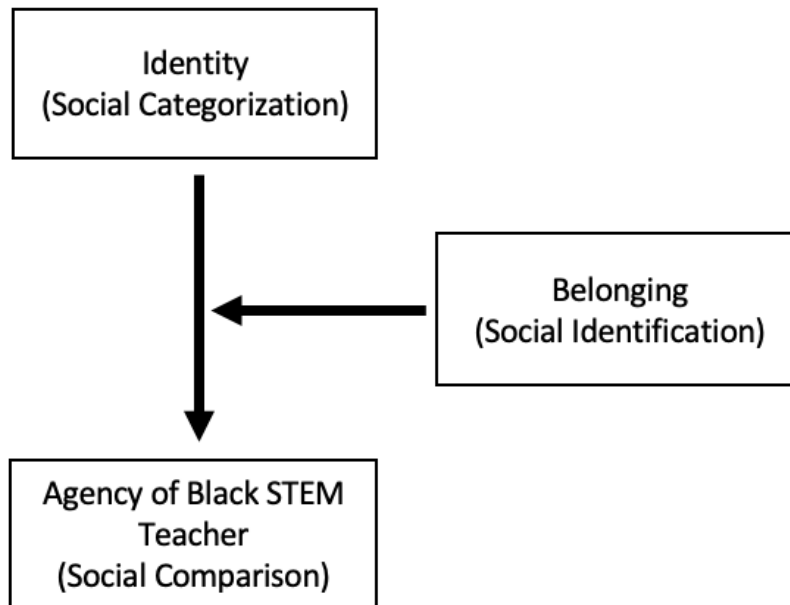
Note. This figure represents the conceptual framework for the Black STEM teacher pipeline in alignment with the social identity theory from the lens of critical reflection. This figure is a duplicate of Figure 1 in Chapter 1.

Social identity theory has three main processes that create a pathway to the conflict between the in-group and out-group as outlined in Figure 1 and Table 1. First, there is social categorization followed by social identification. Lastly, there is social comparison. Research in critical consciousness allows one to view the social identity theory from the lens of critical reflection. The following sections extend social identity theory into the lens of critical reflection. Critical reflection is used throughout this research to reference a dimension within critical consciousness for brevity.

Table 1

Themes Investigated from Deductive or a Priori Codes Derived from Conceptual Framework

Social Identity Theory Framework	Social Categorization	Social Identification	Social Comparison
Researcher's Conceptual Framework	Identity	Belonging	Agency
Researcher's Themes	Identity creates the capacity to educate and learn from others.	Identity offers assets that create a sense of belonging.	Identity as a Black STEM Teacher produces a position in the community that liberates.
Alignment of themes in the Teacher Preparation Program	Identity offers a capacity to educate and learn from others	Belonging within a community produces assets to offer others	Position as a Black STEM teacher in the community ensures academic equity for all.

Note. This is a map that aligns critical reflection with the three components of social identity: social categorization, social identification, and social comparison. The researcher will review two focus group transcripts and five social identity maps to investigate themes within deductive or a priori codes derived from the conceptual framework in Figure 1. This table is a duplicate of Table 1 in Chapter 1.

Social Categorization - Identity

Social categorization, or identity, is the first process of the social identity theory. During social categorization, one recognizes self-identities and begins to form social groups. When one creates social groups, people, in general, are defined based on social groups as opposed to characteristics. Social groups are formed based on one's identity. For this reason, one adopts an "us" versus "them" mindset (Tajfel & Turner, 2004). Social categorization from the lens of critical reflection highlights how one can educate and learn from others based on their identity.

Critical reflection research extends the social identity theory's component of social categorization by creating a structural-historical thinking style that causes reflection on injustices and oppression among the members of marginalized groups (Burson & Godfrey, 2020; Cortland et al., 2017). Instead of competing with one another, Cortland et al. (2017) used research to suggest group members realize the similarities within their identities and their capacities to educate and learn from others based on similar experiences. There is an increased perception of resemblance (Cortland et al., 2017). As a result of these perceptions, evidence suggests an increased chance of having a shared outcome, or fate, to collectively resist the injustices and acts of oppression to eliminate the oppressors (Burson & Godfrey, 2020).

According to research about identity, individuals possess multiple identities that align and, at times, compete to shape attributes needed within one's community. It should be noted that the intersectionality of one's multiple identities within critical reflection can be used to fill in the gap in the social identity theory that fails to address privilege and the oppressor. According to Crenshaw (2017), intersectionality is the construction of the total person through their identities, such as race, gender, and sexual orientation. In a similar way, Collins (2000) based the intersectionality of identity on the belief that cultural groups such as gender, race, social class, ability, sexual orientation, geographic location, and religion relate or *intersect* among groups and support one another instead of functioning independently. Adding to these findings is research that proposes that within each social category lies a socially constructed system of hierarchy that intersects, resulting in oppression, domination, and discrimination (Nash, 2008; Robinson, 2017). Moreover, Robinson's (2017) research suggests that within each category, one's social identity can offer them a status of being privileged or marginalized, which impacts opportunities.

Adding to the research on the intersectionality of identity, Jemal (2017) suggests intersectionality affirms multiple identities of individuals and how they intersect with privilege and the oppressor-oppressee dichotomy. Jemal (2017) proposes that one's experience with privilege and oppression is individualized. Therefore, findings suggest one cannot stigmatize social groups based on in-group identity because group members might unknowingly oppress members of their own in-group (Jemal, 2017).

Studies on the teacher-student relationship suggest an alignment of social identity theory and critical reflection. There is evidence from studies on the teacher-student relationship that indicate students are more likely to have better self-awareness when the teacher functions as a facilitator of knowledge instead of a strict and authoritative figure (Diemer et al., 2016; Smith-Maddox & Solórzano, 2002). To illustrate these research findings, Smith-Maddox and Solórz (2002) looked at the outcomes of a teacher-student relationship from a non-hierarchical lens. In their study, the teacher is the facilitator of knowledge co-constructed with the student (Smith-Maddox & Solórzano, 2002). Their study proposes that although the facilitator is needed to model challenging concepts, there is an opportunity to produce more favorable outcomes with student identities. There can be more favorable outcomes with student identities if the facilitator's primary role is to empower the student rather than impose authoritative and inflexible teaching that rejects opportunities for autonomy, ownership, and critical thinking (C. Campbell & MacPhail, 2002; Diemer et al., 2016; Smith-Maddox & Solórzano, 2002).

Similarly, researchers recommend the first step in developing critical reflection is having the aptitude to see one's identity as society positions it within social and structural systems of power (Freire, 2014; Kendi, 2019; Schauer, 2021; Watts et al., 2011). When considering the Black-White racial relationship, critical race theorists suggest White people constructed racial

identity to distinguish themselves from Black people (DiAngelo, 2018; Dumas, 2016; Kendi, 2019). Therefore, minimal research on Whites as a racial identity adds to the systemic and structural oppression against Black people and minority groups. As a result, researchers have explored White teacher identity at a lower rate than Black teacher identity. The lack of research contributes to the lack of critical reflection development among White teachers (DiAngelo, 2018; Freire, 2014).

Perceptions and actual membership in groups form our social identities. One example of this is the findings of studies on White pre-service teachers. Research suggests White pre-service teachers first develop their consciousness during their teacher preparation program by reflecting on their multiple identities (Nieto et al., 2008). This reflection triggers an understanding of their privilege in their social context (McDonough, 2009). Thus, the development of a White pre-service teacher's antiracist stance evolves out of opportunities to engage in critical reflection and an awareness of one's social context about existing acts of oppression. As a result, studies suggest it is essential for pre-service teachers to engage with the principles of racial identity formation through exploration and practice (McDonough, 2009; Solomona et al., 2005; Vavrus, 2002).

Schauer's (2021) research on collective identification contributed to critical reflection research that extends the social identity theory pathway of social categorization. According to Schauer (2021), collective identity denotes having a positive view of membership in a specific social group, such as race, ethnicity, or sexual orientation. Additional findings suggest having a collective identity allows teachers to connect with their students beyond race (Watts & Hipolito-Delgado, 2015).

On the other hand, Diemer et al. (2016) view individualism as necessary for increased critical reflection. According to researchers of individualism, findings suggest more positive outcomes when one has time for individual critical reflection. Studies suggest individuals have ideal optimal mental health and greater academic engagement and achievement outcomes while also being more likely to enroll in higher education and obtain more successful careers with jobs where the pay is higher (Cabrera et al., 2014; Diemer et al., 2010, 2016; Luginbuhl et al., 2015; McWhirter & McWhirter, 2016; Olle & Fouad, 2015; Ramos-Zayas, 2003; Zimmerman et al., 1999). Either way, research supports the need for critical reflection to keep one's identity development within social categorization.

Investigations suggest teachers adopt a colorblind stance when they disregard the salience of race and reject its effect on matters that involve equity (Amatea et al., 2012; Chubbuck, 2004; Darling-Hammond, 2006; Robinson, 2017). As previously mentioned, a colorblind stance is a race-neutral mindset that chooses not to see race, racial disparities, inequities, or historical and current trauma within a racist society. Because a colorblind stance focuses on treating everyone as equally as possible, it uses the lived experiences of privileged White people to validate disengaging in conversations about race and disregarding the racial disparities, inequities, and trauma that Black teachers and students experience as a result of their racial identities (Asare, 2020; Williams, 2011). To this finding, teachers often demonstrate their colorblind stance when they are uncomfortable talking about race. Studies reveal their lack of comfort about race leads to total disregard for racial differences. While doing so, findings show two direct correlations: students of color rarely receive affirmation and the creation of hierarchical divisions along racial lines (Chubbuck, 2004; Schauer, 2021). These results suggest the colorblind stances of teachers do little to promote a positive self-identity among students of color.

To resist injustices, El-Amin et al. (2017) used research to recommend one must be able to recognize the unfairness and oppressive acts against marginalized groups. According to El-Amin's study, this is especially true if you are a marginalized group member. The research found that when society teaches one the language of inequity, one can identify injustices and have the language to explain the injustices at a deeper level (El-Amin et al., 2017). One finding suggested introducing a framework for analyzing equity as a strategy that academic institutions can use to demonstrate the language of inequity. When students knew and understood that interpersonal racism, institutional racism, and internalized racism transmitted racism, they were more aware of their own identities. As a result, they could make racism visible and describe it (El-Amin et al., 2017).

Studies imply a strong correlation between critical appraisal of one's ethnic identity and increased ethnic consciousness. Raising one's ethnic consciousness is supported by findings that suggest doing more than acknowledging one's ethnic identity. Accordingly, there must be an opportunity for critical reflection that elicits an evaluation of one's social situation with options for relevant problem-solving (Aldana et al., 2012; Gutiérrez, 1995; Mathews et al., 2019; Yee, 2005).

Social Identification - Belonging

During social identification, one identifies as a member of a particular group which involves developing a sense of belonging. Being a group member also informs the behaviors one believes one should exhibit. Thus, they think they should exhibit similar behaviors that are perceived characteristics. When one socially identifies with a group, they boost their self-esteem (Tajfel & Turner, 2004). Research that aligns the social identification component of social

identity theory to critical reflection highlights one's perceptions about the assets they have to offer others (Watts et al., 2011; Watts & Hipolito-Delgado, 2015).

According to McDonough (2009), our cognizant and unconscious group membership influences our worldview and how the world perceives us. Therefore, McDonough's research implies that critical reflection allows teachers to engage in culturally relevant teaching due to an awareness of inequitable structures. Furthermore, evidence suggests this results in a clear cognizance of one's identity and the cultural understanding that exposes contradictory practices of individual teachers or institutional systems (McDonough, 2009).

When looking at access to social support, studies reveal it elevates one's critical reflection (Diemer, 2009; Jemal, 2017). When one has social support, one perceives one is more equipped to address inequities (Diemer, 2009). Moreover, there is evidence to suggest that when in-group members have access to fellow in-group members with higher levels of critical reflection support one's critical reflection development. Research implied this was especially true when being around others, especially those in roles of authority (Jemal, 2017).

Likewise, studies recommend giving group members access to resources in general (Robinson, 2017). Since access describes the opportunity to engage with specific resources, granting access to resources not traditionally shared with one's group membership has supported the development of one's critical reflection. According to the research, when one has access to specific resources, group members create an illusion that they are more valuable or privileged than those without access to particular resources (Robinson, 2017; Scott, 1994). Teachers will avoid conversations about race by shifting the attention away from race to other social group identities such as class, gender, and individuality (Chou, 2007; Robinson, 2017). Research has shown the resulting action minimizes race by making it synonymous with other socially

constructed groups (Gay & Kirkland, 2003; Haberman & Post, 1992; Kelly, 2003; McKoy, 2013; Robinson, 2017). When this happens, teachers avoid critical self-reflection.

Researchers Burson and Godfrey (2020) identified that in-group members must perceive that their similarities and shared experiences are the same to achieve solidarity. If this perception does not exist, competition and threats pose a risk to accomplishing solidarity amongst in-group members (Burson & Godfrey, 2020). Based on these findings, group members can obtain solidarity by appreciating and understanding others (Willey & Magee, 2016). In another study conducted by Willey and Magee (2016), findings imply that social interactions are often normed around tenets of Whiteness and frames of reference (Sensoy & DiAngelo, 2017). The results suggest white perspectives and frames of reference reduce the opportunity to see others from a non-biased lens. These findings further indicate a rationale for the limited relationships non-Black teachers have with their students and families of color (Willey & Magee, 2016). Within solidarity, there is an appreciation for and understanding of others (Burson & Godfrey, 2020; Sensoy & DiAngelo, 2017; Willey & Magee, 2016).

Equally important is the theme of White privilege. Based on the research, White privilege manifests out of an attempt of in-group members to influence structural protections of White self-images and accountability for individual and systemic racism (DiAngelo, 2018). Exercising one's White privilege is demonstrated through acts that create illusions of hierarchy for in-group members (Chubbuck, 2010; Robinson, 2017). Furthermore, findings suggest that in-group members preserve White through silence and colorblind stances in classrooms (Chubbuck, 2010; McDonough, 2009; Solomona et al., 2005).

Studies have revealed a correlation between one's acknowledgment of their racial identity and increased ethnic consciousness. In one study, a harmonious relationship among

members of one ethnic group occurred when there was a more positive awareness of their collective racial identity (Yee, 2005). In another study, it was revealed that intergroup dialogue that supported a sense of racial belonging promoted the ethnic consciousness of adolescents (Aldana et al., 2012). In a similar way, another study (Chavous et al., 2003) among adolescents demonstrated the impact of an awareness of one's ethnic consciousness on their ethnic consciousness. The study revealed how an increased ethnic consciousness resulted in an adolescent's ability to promote positive images, attitudes, and beliefs about their group's abilities.

Critical reflection research also suggests a relationship between social and ecological systems in marginalized youths (Kozan et al., 2017). Numerous studies indicate that providing opportunities for critical reflection among marginalized youth is more impactful than critical action (Diemer & Blustein, 2006; Kozan et al., 2017; Watts & Hipolito-Delgado, 2015). When researchers exposed marginalized youth to environmental and food justice topics, they began to discover the collective assets they have to offer others through their critical reflections (Kozan et al., 2017).

Social Comparison - Agency

When social comparison occurs, one compares their in-group to the out-group in a way that boosts and maintains their self-esteem. In-group members begin recognizing how their identity and group membership have created agency. Moreover, one can use the agency that comes with their identity as a position of power to elicit and evoke liberation (Tajfel & Turner, 2004).

Because there is an emphasis on maintaining high self-esteem, one tends to exaggerate the comparisons between the in-group and out-group. The comparisons are from a biased

perspective. Accordingly, social comparison produces prejudice, discrimination, and stereotypes. Research aligning social comparison to critical reflection demonstrates how one's position as a Black STEM teacher in the community ensures educational equity (McGee, 2020).

When positive distinctiveness occurs, in-group members are inspired to maintain their in-group bias. The negative judgments against members of the out-group make in-group members feel better about themselves. In-group members tend to see themselves as individuals while making unworthy generalizations against all out-group members. Consequently, this out-group homogeneity effect brings about negative judgments and unfavorable treatment of out-group members (Dumas, 2016; Tajfel & Turner, 2004). These prejudices and acts of discrimination breed negative stereotypes about out-group members.

McDonough (2009) used research to assert that our knowledge, cognizance, and how we present our identities are culturally positioned and influenced by experiences and group membership. Findings suggest one uses identities, whether perceived or visible, to guide actions and decisions and lead the exploration of power and privilege (Lea, 2004; McDonough, 2009). The resulting influence manifests in expectations, dialogue, learning to teach, and curriculum production. Thus, studies suggest opposition to analyzing power dynamics and interrogating the status quo can appear in silence, rejection, or guilt (Gay & Kirkland, 2003; McDonough, 2009).

On the other hand, research findings recommend asking reflective questions to focus on the positionality of those engaged in making change (Jemal, 2017). When focus group facilitators pose reflective questions, it allows one to investigate how knowledge is created and preserved by more significant sociopolitical influences (Garcia et al., 2009; Jemal, 2017). Furthermore, reflective questions create opportunities to ideate how one can use their position to "improve the situation or take action to promote social justice" (Watts et al., 2002).

Group process involves creating a space for small group discussions with opportunities for open-minded listening (Cohen, 2011). Research on group process suggests it creates a culture for group members to develop a group identity that shifts silenced individualized thinking towards liberatory agency to make a change collectively (Cohen, 2011). Data also suggests these discussions lead to recognizing problematic practices that disproportionality impact students of color (Willey & Magee, 2016). There was a positive correlation between having increased opportunities to engage in reflective practice and one's ability to recognize, discuss, and eliminate problematic practices that negatively impacted students of color (Willey & Magee, 2016).

Definitions of critical reflection omit the oppressor. Jemal's (2017) research suggested the removal of the oppressor may unintentionally support the notion that oppression is a problem for the oppressed to figure out and solve. On the other hand, another researcher used findings to infer that those privileged can better understand their role to use their position to operate as allies to achieve true liberation (Jemal, 2017; Thomas et al., 2014).

Similarly, research suggests critical reflection omits the concept of privilege (Jemal, 2017). According to one researcher, the development of critical reflection encompasses assessing how one's privilege hinders the ability to empower and provide for those with less power and privilege. This idea exists while counteracting the empathy and inter-group alliance needed to dismantle socially constructed hierarchies (Carolan et al., 2010; Jemal, 2017). Studies suggest discussing privilege is a difficult conversation that many choose to avoid. As a result, the absence of challenging discussions about privilege prevents the development of critical reflection and true liberation (Chou, 2007).

Research suggests providing opportunities for pre-service teachers to engage in critical reflection. Based on findings from Robinson (2017), there are myths, misconceptions, and misdirections about a teacher who can teach ethnically and culturally diverse students. Therefore, pre-service teachers need to engage in reflection, deconstruction, and critical thinking to evaluate how diverse learners can use their position as a teacher (Cochran-Smith & Lytle, 1993; Robinson, 2017).

Although some pre-service teachers express guilt over past actions of oppression and inequities, findings propose that some pre-service teachers view their role as necessary to prepare Black students to live in the real world by softening the tone so that White students will not feel discrimination. Gay and Kirkland (2003) found that teachers will sanitize messages to make them more palatable for non-students of color. Additionally, findings mention teachers will validate their actions by stating claims of maintaining high standards not to minimize expectations when this suggests a negative image of Black students.

Adding to their research, other research has cited incidents where teachers avoid critical self-reflection by being silent and refusing to participate in conversations about race (Cochran-Smith & Lytle, 1993; Gay, 2000). Based on the findings, teachers will reject being co-collaborators and refuse to use their position to move the needle about racism. Hence, they will either remain silent or plead ignorance. As a result, findings suggest dialogues become monologues, and one's critical reflection development does not occur. Rather than staying physically silent about race-related topics, researchers recommend that others will use their position to silence the subject. For example, teachers can undermine the importance of the questions about race or encourage their students and colleagues to change their stance about

using race-related theories to minimize the need for critical self-reflection and action to elevate critical reflection. When this happens, true liberation cannot occur (Vavrus, 2002).

Critical reflection requires understanding their position as power within a hierarchy in their in-group dynamic and rejecting that existence as prejudiced (Burson & Godfrey, 2020). According to the work of Burson and Godfrey (2020), Critical reflection does not focus on identity, but instead focuses on the critical examination of structures of disparity and systems of oppression. Findings suggest critical reflection does not require particular levels of in-group identification. Therefore, it offers a format to assist individuals with multiple in-group connections (Burson & Godfrey, 2020).

Taking the time to reflect on injustices against marginalized groups provides meaningful critical reflection. According to research, this window of critical reflection allows for one's ability to reflect critically. As a result, a dominant in-group member can begin to see oneself and their family as situated in wealth and power. The findings suggest this elevates one's critical reflection to want to make a change to dismantle the injustices (Watts & Hipolito-Delgado, 2015).

Studies propose that truly integrated critical reflection development within schoolwork reflects schools being prepared to incorporate spontaneous critical conversations that involve critical reflection when there is a need in the school community (El-Amin et al., 2017). For example, there were times when conversations about race and oppression were not part of the regular school lesson. Still, the ability to facilitate critical dialogue supported students' critical reflection (El-Amin et al., 2017). As recommended in the research, students can benefit when teachers make space to address injustices that might be occurring against students of color or

members of their in-group identities to elevate their critical reflection (El-Amin et al., 2017; McDonough, 2009).

Research suggests agency occurs along a continuum that begins with practical, ethnic consciousness (Watts & Flanagan, 2007). In one study, adolescents felt a greater sense of agency and felt better equipped to enact change based on a positive relationship with their racial group (Matthews et al., 2019). Additional studies purported that participants with high levels of ethnic consciousness were likelier to engage in critical reflection that supported problem construal (Gutiérrez, 1995; Padilla, 1985; Parsons, 1991). As a result, research suggests participants were more likely to problem-solve for solutions they felt empowered to enact because they were more consciously aware (Longres, 1982).

When researchers looked at the impact of critical reflection on marginalized youth, they found that the marginalized youth were able to reflect on how dominant culture and sociopolitical factors affect the environment and health of others (Kozan et al., 2017). The critical reflection of the research participants was elevated, causing them to develop an understanding of their position within the community to create change. Readers can infer that the student responses implied that in addition to gaining insight about personally relevant issues, they had opportunities to reason about their roles and take ownership in revolutionizing those challenges (Diemer & Blustein, 2006; Kozan et al., 2017; Watts & Hipolito-Delgado, 2015).

Alignment of Themes

Appendix A represents the connection between the researcher's conceptual framework on the social identity theory for the Black STEM teacher pipeline and the deductions of themes aligned with critical reflection. This table highlights the use of literature alignment to demonstrate the association between social identity theory (social categorization, social

identification, and social comparison) and critical reflection (identity, belonging, and agency).

Literature alignment is a way of discovering and exploring connections across scholarly articles.

Table 1 explores the themes that emerged from literature alignment—identity, belonging, and agency.

Table 1 distills three themes from deductive or a priori coding derived from the literature. First, under identity, critical reflection is expected to offer a reworking of experience to fit better with a person's sense of self and personal history. Second, under belonging, critical reflection incorporates both personal and social elements of familiarity, thus reworking the interaction process to create a sense of belonging. Finally, under agency (either individual or collective), critical reflection highlights the 'power within' insofar as it aligns with one's ability to define one's values.

The Benefit of Critical Reflection on Black STEM Teacher Identity

Given the low representation of Black teachers in STEM classrooms, there is a need to increase the Black STEM teacher pipeline (Farinde et al., 2016; Farinde-Wu et al., 2017; National Center for Education Statistics, 2022; Shipp, 2000). Because 7% of all secondary mathematics and science teachers are Black, Black STEM students are unlikely to experience the benefits of added support, mentoring, and motivation from being taught by a Black STEM teacher (Frank et al., 2019; National Center for Education Statistics, 2022; Neil, 2016; U.S. Department of Education, 2019). Furthermore, the lack of Black STEM teacher representation creates an illusion that Black teachers do not have the cognition to be the holder of knowledge in STEM subjects. Given the low percentage of Black STEM teachers, research in this field helps to improve the Black STEM teacher pipeline.

Many existing studies in the broader literature have examined the 'us' versus 'them' dichotomy of the social identity theory without a critical reflection lens. In education, researchers have recognized this relationship between teachers and students. Whitaker (2020) found that many urban teachers hold an 'us' versus 'them' mentality that shapes how they view their urban students.

Black pre-service teachers in teacher preparation programs perform better when they report having positive relationships with faculty members. For example, when there was an opportunity to be mentored by faculty or when they felt like the faculty cared for them, created more opportunities for success (Leggett, 2020), "She (my professor) is always checking in on me." College students in STEM-related courses also reported feelings of isolation, exclusion from study groups, and lack of support (Ireland et al., 2018).

A recent study led by Kisha Jones et al. (2020) used the social identity theory to explain the intersectionality of identity between racial differences and vocation. Specifically, the researchers used literature on the disparities of Black people in careers to examine the Black-White race differences in vocational choice. Previous research on Black-White social group membership and vocational choice suggested that previous employment and social experiences of Black people influence vocational interests (Armstrong et al., 2010; R. T. Carter & Swanson, 1990; Lattimore & Borgen, 1999; Tracey & Robbins, 2005). According to Jones et al. (2020), racial group membership contributed to race gap vocation selection beginning at college entry and impacted interest level and gender.

A series of recent studies led by critical Whiteness scholars suggest that "invisible norms of whiteness" create the division between the groups and impact urban students' expectations (Applebaum, 2016; Glock, 2016; Tyagi & Thompson, 1996; Whitaker, 2020). For instance,

several studies suggest that the stereotypes held by white teachers resulted in lower expectations for hypothetical minority students and higher expectations for hypothetical white students in general education and gifted education classrooms (Gershenson et al., 2015.; Glock, 2016; Grissom et al., n.d.; Whitaker, 2020).

The idea that White pre-service teachers bring colorblind ideology into PreK-12 and college classrooms is not uncommon. Because White teachers enter programs with minimal engagement with non-White races, they often carry negative perceptions about people of color and avoid addressing race altogether (McDonough, 2009; P. L. McLaren, 1995; Terrill & Mark, 2000). In essence, this impacts their experiences, beliefs, and assumptions about people of color. Ultimately, these actions maintain the marginalization of people of color due to viewing everyone as raceless individuals and using patterns of "White talk" (Marx, 2006; McDonough, 2009). Ultimately, there is a need for White pre-service teachers to seek out discourses of possibility through reflection, awareness, and understanding of the challenges to engagement.

Education researchers value the experiences of Black students and teachers (Clark, Badertscher, et al., 2013; Clark, Frank, et al., 2013) to discover opportunities and make recommendations to grow the Black STEM teacher pipeline. As researchers interrogate the Black STEM teacher pipeline, they aim to increase the percentage of Black STEM teachers in public education.

The education debt is systemic educational injustices enacted against students of color (Ladson-Billings, 2006). Teaching STEM from a social justice perspective is one way to remedy the education debt. Exposing students of color to robust STEM programs from a social justice perspective exposes the injustices as relevant, lived, and complex realities that students of color often face. Using a STEM curriculum that includes social justice increases students' critical

reflection while providing them with the content knowledge of STEM concepts. This research focuses on Freire's theory and maximizes the idea of fostering critical literacy to create critical reflection. Bronfenbrenner's ecological model describes the development of one's level of critical reflection using the STEMJ curriculum (Madden et al., 2017).

There is a need for teachers to be held accountable for enacting culturally responsive teaching practices. Being accountable means engaging in learning that challenges the thinking about one's own teaching beliefs and behaviors about multicultural education and educational equity (Danielewicz, 2001; Gay, 2003; Gay & Kirkland, 2003; Ladson-Billings, 2001; Schön, 2017; Valli, 1992). It can become easy for pre-service and in-service teachers who lack an understanding of culturally responsive teaching to avoid and resist race-related topics and lessons. Therefore, pre-service and in-service teachers need ongoing training to develop time for critical self-reflection and opportunities to engage with the knowledge that will strengthen their cultural consciousness.

Summary

With the increased need for Black STEM teachers, teacher preparation programs are under pressure to produce well-qualified teacher candidates (Urban Teachers, 2021). Because data suggests students of color perform better when they have teachers who look like them, many higher education institutions have increased their recruitment of teachers of color for STEM subjects (Egalite & Kisida, 2018). However, the intersection of class and Black critical theory suggests systemic barriers often serve as barriers, preventing people of color from entering the field of education (Howard, 2019). "If the institution does not make the necessary changes to make the campus climate inclusive, the institution will have [difficulty] maintaining diversity" (Hiraldo, 2010, p. 54). Using the social identity theory alone disregards race rooted in anti-

Blackness. With this in mind, there is a need to view the social identity theory from a lens that allows for critical reflection (Dumas & Ross, 2016; McGee, 2016; McGee, 2020). Critical reflection can rationalize how dominant cultures perpetuate the experiences of Black STEM teachers in a society where Black people have perceived advances in STEM (Dumas, 2016). Given that Blackness matters, one can rely on critical reflection to support the social identity theory to synthesize how anti-Blackness shapes inter-group conflict in social categorization, social identification, and social comparison (Dumas, 2014; Dumas, 2016; Dumas & Ross, 2016). Overall, the social identity theory and critical reflection can become a way of reimagining the future of Black STEM teachers while deconstructing the past experiences of Black STEM teachers.

CHAPTER THREE: METHODOLOGY

Research Purpose and Guiding Research Questions

This study aimed to explore the critical reflections of Black STEM teachers' social identity. The researcher sought to ask the following research questions:

1. How do Black STEM teachers perceive the role of social identity in their teacher preparation experience?

2. How do Black STEM teachers engage in critical reflection of social identity in their teacher preparation experience?

When approaching research as a culturally responsive evaluator, studies indicate that it is vital for researchers to develop research questions that reflect the issues and interests of those marginalized (Hood, 2001; Hopson & Hood, 2005). To create these questions, the researcher answered the following questions (Hopson & Hood, 2005; Maxwell, 2013):

1. What were the gaps in, or tensions between, the intersectionality of the social identity theories and critical consciousness for Black STEM teachers?

2. What would addressing my questions tell me that I do not already know?

3. How will answering these specific questions help me achieve my personal, practical, and intellectual goals as defined by Joseph Maxwell?

4. How did these questions form a coherent set that will guide my inquiry?

According to Maxwell (2013), personal goals motivate the researcher, but not necessarily anyone else. As a Black STEM educator, the researcher was personally motivated to understand the intersectionality between identity and experiences during teacher preparation. According to Earnest House (2017) and Karen Kirkhart (2015), failure to deal with your personal goals can

contribute to biased findings. Therefore, the researcher needed to acknowledge and reflect on personal goals in the research questions for this study.

Intellectual goals were based on general investigation and analysis purposes. The researcher's intellectual goal was to emphasize the Black STEM teachers' marginalized identities and explore how they demonstrate awareness of oppressive realities that shape their lives and their 'capacity' to transform that reality. While this study does not focus on critical action, this study illuminated what Roderick Watts (1999) explains as the most neglected critical consciousness dimension, critical reflection. The researcher's practical goals were focused on the needs and concerns of Black STEM teachers.

Assuming the role of a culturally responsive evaluator coupled with the personal and intellectual goals set forth, the researcher developed two research questions. The researcher posed the first research question to determine how Black STEM teacher candidates collectively perceived the role of their social identities as they matriculated through their teacher preparation program. This question provided information about salient themes of social identity theory from the lens of critical reflection that influenced the collective perceptions that Black STEM teacher candidates have about the role of group membership. The question supported the researcher's understanding of the experiences of Black STEM teachers at different points in the teacher preparation pipeline.

The researcher asked the second research question to understand better how Black STEM teacher candidates independently engaged in critical reflection about their social identities while in their teacher preparation program. This question provided the researcher with information on whether critical reflection happens, the impact that individualized critical reflection has on the Black STEM teacher candidate's thinking about their identity, and which theme of social identity

has the most impact during the period of critical reflection. The information gained from this research question will be helpful for teacher preparation programs as they design participant program experiences to recruit and retain Black STEM teacher candidates.

Research Design

If one of the conditions of critical consciousness is the investigation of ways of thinking (i.e., critical reflection of social identity), then dialogue is the method through which research inquiry occurs (Bloomberg & Volpe, 2019; Brown & Strega, 2005; Jacobson & Mustafa, 2019). This study's methodology was dialogical. A dialogical methodology created an environment conducive to two primary outcomes: discovering new themes and stimulating research participants' awareness of these themes. Specifically, critical reflection was about time-limited encounters where the value came from dialogue intended to cultivate ideas and take them somewhere. This kind of inquiry attempted to put something in the middle: an image, or identity map, that somehow represented or invoked the issue in question, that engaged both the collective attention of the participants and reflected on different experiences (Bloomberg & Volpe, 2019; Brown & Strega, 2005; DeCuir-Gunby et al., 2019). The dialogue was not about prescription or rule-giving but about engaging the group's collective attention and explicitly identifying one's social position.

Higgs et al. (2011) noted that critical reflection as a research method is dialogic and integrative. It was dialogic, creating a shared representation of experience through a dynamic interaction between participant and researcher. When research participants shared through conversations in focus groups, it potentially provided insight into overlooked microaggressions that impacted their teacher preparation experiences through dialogue about personal and social views in the interactive process. The researcher used group interactions during focus groups and

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individual reflections during a social identity map activity to understand the core of the

experiences of Black STEM teachers. Collecting data from both methods allowed the researcher

to understand better Black STEM teachers' experiences (Savin-Baden & Major, 2013). These

data collection methods enabled participants to create close connections while elevating

previously silenced messages, thus exploring whether insights and perspectives can be

synergistically merged. Using social identity maps, research participants provided a type of

concentrated microcosm or personalized map of social identity. Research participants reflected

and connected personal experiences in a way that felt satisfying to them that provided more

detail to identify themes that may be tied to the details of their social identity (Jacobson &

Mustafa, 2019).

Focus Groups

Since there were six participants, the researcher used a nominal group technique to ensure

equity of voice among research participants. The researcher also established ground rules to

facilitate two different focus group discussions. The researcher shared ground rules with the

research participants in advance. The ground rules affirmed the confidentiality of the group

members, ensured everyone felt like a valuable member of the community, and encouraged the

participation of each focus group member.

The focus groups allowed the researcher to gather qualitative data from all the research

participants simultaneously. The type of information, or data, that was generated during the

focus groups provides clarity around the way research participants perceived a topic, idea,

experience, or service (Krueger & Casey, 2015). Therefore, the focus groups were carefully

planned around a focused topic so that group participants could share their thoughts.

The focus groups supported culturally responsive evaluation as well as inquiry with marginalized groups (Madriz, 1998; Wilkinson, 1999). Since the focus groups were also a highly-rated method of understanding different cultures, the focus groups allowed the power to shift from the researcher to the research participants. Thus, generating an authentic way for focus group members to interact with one another and share perceptions (Hall, 2020; Hughes & DuMont, 2002; Savin-Baden & Major, 2013). Additionally, the focus groups provided opportunities for the researcher to simultaneously collect a wide range of data on whether group members share a collective or individualized thought. Furthermore, the focus groups were advantageous because they produced data from group interactions that the researcher used to answer both research questions to contribute to the literature and implications for higher education and K-12 school leaders of Black STEM pre-service teachers (Barrett & Kirk, 2000; Hall, 2020; Merton & Kendall, 1953; Morgan, 1996, 2018). Therefore, this study's culturally responsive researcher used focus groups to study the impact of oppressive acts of violence against marginalized groups to disrupt negative stereotypes related to marginalized social identities (Halcomb et al., 2007; Madriz, 1998; Wilkinson, 1999).

On the other hand, there were some disadvantages to using focus groups. For example, the focus groups may not have been the best option when there was the need to discuss highly confidential information. Because the focus groups took place in a group setting, the researcher could not guarantee the confidentiality of information shared during focus group discussions. An attempt to address the challenge of maintaining confidentiality was made when the focus group occurred in a virtual synchronous format where participants only used a pseudonym (Hall, 2020). Another disadvantage of using focus groups is that it may not have been the best option if the focus group topic was highly debatable. Because there were multiple group members, the focus

groups required a skilled moderator to prevent a dominant member from influencing the results. To remedy this, the moderator asked fewer questions to ensure each group member could share their perspectives and views (Hall, 2020; Krueger & Casey, 2015).

This study used a video conferencing platform to conduct two synchronous online focus groups. A video conferencing platform was advantageous because it eliminated transportation-related barriers to attending the focus group and allowed participants to appear from a private location of their choice as long as there was access to the internet (Hall, 2020). There were additional advantages to facilitating synchronous online focus groups. Benefits included options for maintaining a research participant's confidentiality by using a pseudonym and the ease of opting out of questions or removing themselves from the group by turning the camera or audio off (Douglas et al., 2021; Wirtz et al., 2019).

Critics of using synchronous online focus groups cited several disadvantages that the researcher considered when determining whether to use synchronous online focus groups. First, critics noted that participants of synchronous online focus groups must have optimal internet speed, technology, and technical literacy. The focus group moderator must also be skilled and manage turn-taking during discussions. Furthermore, synchronous online focus groups privilege those with access to the technology to access the synchronous online focus group (Hall, 2020; Wirtz et al., 2019).

Given that group dynamics was an influential part of the social identity theory, the researcher determined that the advantages of using focus groups outweighed the disadvantages of synchronous online focus groups because the focus groups "allowed [the] researcher to view the social interactions" of group members" (Savin-Baden & Major, 2013, p. 374). To ensure the maximum benefit from the focus groups was gained, the researcher evaluated whether the

technology would enhance the participant experience in focus groups. Since it enhanced the

experience, the researcher selected technology participants were likely most familiar with

(Krueger & Casey, 2015; Reisner et al., 2018). Using technology supported the researcher's

personal goal to provide culturally responsive evaluation; therefore, the researcher facilitated the

focus groups using the Zoom platform. The researcher determined that participants were likely

familiar with Zoom because their teacher preparation program used Zoom for coursework and

teaching. Also, research participants had presumably used Zoom to facilitate instruction during

the coronavirus global pandemic while schools were closed for in-person learning. In addition to

using Zoom for video conferencing, Zoom was also used to video and audio record both focus

group discussions to capture participant perspectives on the discussion protocol.

The researcher followed Maxwell's (2013) interactive design during both focus

groups. According to Maxwell, qualitative research should follow the nonlinear processes of

inquiry. Given this assertion, the researcher used two focus group protocols to facilitate

discussion questions, probes, and reflective prompts, allowing for opportunities to adjust and

change as needed (Hall, 2020; Maxwell, 2013). An interactive design provided the opportunity

for reflexively constructing and reconstructing the design based on how the focus group

members responded to the in-the-moment experiences.

According to Krieger and Casey (2015), focus groups were informal, socially constructed

opportunities for participants with similar characteristics to interact with one another. The focus

group dialogue among group members provided a deep, reflective understanding of their STEM

identity development. The researcher shared each discussion group question from the focus

group protocol in chat as an ADA accommodation. The researcher developed two focus group

protocols, or questioning routes, that contained questions and probes aligned to both research questions and themes presented in the literature (see Table 1).

The researcher ensured the quality of the discussion by making the following assumptions (Krueger & Casey, 2015, p. 40):

1. The respondent understood the questions.

2. The environment was conducive to an honest answer.

3. The respondent knew the answer.

4. The respondent could articulate an answer.

5. The interviewer understood the answer.

The researcher refrained from using ambiguous words, unfamiliar phrases, and acronyms to elicit conversation. Moreover, the researcher developed straightforward questions that were short, clear, and open-ended (Krueger & Casey, 2015). When focus group leaders use specific strategies, they are more likely to yield conversations of high quality. Therefore, the researcher followed the recommendations of Krueger and Casey (2015) to elicit dialogue and make the research participants feel comfortable. First, the researcher welcomed participants and got participants acquainted with each other. The researcher "nudged" conversations before the focus group discussions began by using prepared colloquial questions as she welcomed research participants into the virtual video conferencing platform.

Social Identity Map Activity

The researcher used a social identity map activity to collect data on individual critical reflections about each research participant's identity to answer both research questions. The social identity map activity involved each research participant independently completing a social identity map followed by an individual interview with the researcher. The social identity map

was a mind map used at the conclusion of the first focus group to evoke engagement among research participants (Krueger & Casey, 2015). Researchers have recently introduced social identity maps in research out of a need to conceptually capture one's thinking about their social identity, the intersectionality of one's multiple social identities, and how one's identities function within the social world (Cruwys et al., 2016). According to research led by Cruwys et al. (2016), social identity maps have helped those who used social identity maps actualize their identity in ways that words do not capture while allowing the researcher to compare the multiple dimensions of one's social world. In other studies, social identity maps created visualizations to support the researcher's understanding of social organizations and space for reflecting on the intersectionalities between facets of one's social identity (M. Campbell & Gregor, 2002; DeVault & McCoy, 2002). Since the researcher was external to the social experiences of research participants, the researcher could not isolate the research participant's identity from the research; thus, the social identity map provided a path for the researcher to connect with the research participant's social experiences and oppressions (M. Campbell & Gregor, 2002; DeVault & McCoy, 2002; Jacobson & Mustafa, 2019).

Serving as a visualization of the process that one goes through to engage in critical reflection on the development of their identities, positionality, and dimensions, the social identity maps served three fundamental purposes (Crenshaw, 2017; Cruwys et al., 2016; Fine et al., 2005; Jacobson & Mustafa, 2019; Krueger & Casey, 2015). First, the social identity map helped individuals identify and make meaning of the psychological importance of their perceived in-group affiliation. Second, the social identity map supported individuals in creating conjectures to describe significant aspects of their in-group and out-group memberships. Third, the social

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identity map aided individuals in representing their comparisons of in-group and out-group members (Cruwys et al., 2016).

Research participants, through independent critical reflection, mapped their identities by "describing the often neglected or unexplored experiences of [STEM teachers] of color who [were] on the margins because they are not at the center of people's minds or political agendas" (Crenshaw, 2017, p. 30). Some researchers have suggested that social identity maps allowed research participants to recognize and compare their position in social groups (Fine et al., 2005). As a result, research participants explained the mapping, comparisons, and reflections in their social identity maps to the researcher during individual interviews.

According to Crenshaw (2017), everyone's identity can be viewed as one dimension of a person. Crenshaw suggested that a person's multiple identities collectively intersect and fit together, like the relationship between edges and faces when constructing a three-dimensional geometric shape. One's multiple identities, or dimensions, served as the different sides of the object, thus creating a visual for how one's multiple identities intersect to form an inseparable geometric object (Crenshaw, 2017). Given this analogy, the researcher used a social identity map as a visual representation to understand how Black STEM teachers independently critically reflect on their multiple identities as they participate in their teacher preparation program.

The researcher chose to use a social identity mapping activity for its alignment with the social identity theory from the lens of critical consciousness. The literature review suggested that critical reflection is integral to the theory of critical consciousness. Using the social identity map as a form of data collection, the researcher facilitated a rich data collection process to elicit responses rooted in deep critical self-reflection from each research participant. As participants created their social identity maps, they made visual connections that represented the evolvement

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of their social identity (Crenshaw, 2017; Cruwys et al., 2016; Fine et al., 2005; Jacobson & Mustafa, 2019; Krueger & Casey, 2015).

Research Site

The researcher carefully selected one site for this research. The researcher chose one teacher preparation program at a highly selective Historically White Institution (HWI) with campuses in three cities. The rationale for using an HWI for the site is that there was a gap in the research on the identities of Black STEM teachers at HWIs. Furthermore, the site allowed the researcher to capture the experiences of research participants in three northeastern cities and one southern city in the United States of America.

The HWI was chosen because it focused on preparing teachers for inner-city schools with an antiracist mission statement. The teacher preparation program was a four-year program. Teacher candidates in the teacher preparation program earn a Master of Art in Teaching (MAT) in two certification areas after the program's second year. The teacher preparation program offers three tracks for initial certification: elementary and special education, secondary mathematics and special education, and secondary literacy and special education. In addition to receiving a MAT degree, program participants received instructional coaching during the entire four years of program participation.

Participant Selection

Early researchers discovered that focus groups yielded more information than traditional one-on-one interviews because the focus group environment was warm and inviting (Krueger & Casey, 2015). Furthermore, the focus group data relied on the research participants' recall of prior experiences and conversations (Krueger & Casey, 2015). For these reasons, the researcher determined the types of people best suited to share the information necessary for the research

topic (Krueger & Casey, 2015; Patton, 2015). The researcher was optimistic that the research participants had experienced the phenomenon, respected divergent experiences, supported evolving viewpoints that changed during the focus group discussion, and had time for memory reactivation to share their reflections (Krueger & Casey, 2015). Because this research considered the reflections of Black STEM teachers during their teacher preparation program, the researcher determined that Black teachers of STEM, mathematics, or science who have attended the teacher preparation program at the selected research site would provide the most insight into the reflections and experiences of Black STEM teachers in a teacher preparation program.

The size of the focus group was significant for several reasons. Generally, the optimal number of research participants in a focus group should be no less than five and no more than eight people (Balch & Mertens, 1999; Hall, 2020; Krueger & Casey, 2015; Patton, 2015). However, since the focus group happened in a synchronous online format, the focus group size recommendation was no less than four participants and no more than six participants to increase visibility and promote engagement (Hall, 2020; Lobe, 2017). In alignment with the literature on focus groups, the researcher considered selecting a smaller focus group participant size because the researcher was working with minorities and historically overlooked groups of people (Hall, 2017; Krueger & Casey, 2015). By keeping the focus groups smaller for these groups of people, Hall (2020) contends that the small group size better positioned focus group members to have their voices heard due to potentially having more time to share their views.

For the above reasons, the researcher invited the same six research participants to participate in both focus groups. One focus group participant did not show up for the second focus group, so the researcher conducted an additional interview with that research participant to ensure their voice was heard. The focus group included one cis-male, one gender

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nonconforming, one lesbian female, and three cis-females to reflect the racial and gender demographics of the research site. To obtain feedback that reflects the diverse perspectives of Black STEM teachers' social identity, the researcher recruited teacher candidates at different intervals of teacher preparation. Table 2 outlines the characteristics of each research participant that the researcher recruited. Criteria 1 research participant recently entered the teacher preparation program, had less than one year of teaching experience, and was in the first year of their Master of Art in Teaching, or MAT, graduate program. A teacher candidate in the middle of their program, in the second and final year of the MAT degree program, and in their second year of teaching was a Criteria 2 research participant.   The third criterion for a research participant was an in-service teacher who was at the end of their teacher preparation program, held a MAT degree, and was in their third year of teaching. A Criteria 4 research participant was an in-service teacher with a MAT degree in their fourth year of teaching. The final criterion, Criteria 5, was an alumnus of the teacher preparation program who held a MAT degree and was in their fifth year of teaching.

Table 2

Research Participants' Profile

Research Participant	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5
Program Status	Teacher Candidate	Teacher Candidate	In-Service Teacher	In-Service Teacher	Alumni/Alumna
Length in Teacher Program	Recently Entered the Teacher Preparation Program	Middle of the Teacher Preparation Program	End of the Teacher Preparation Program	Recently completed the Teacher Preparation Program	Alumni of the Teacher Preparation Program
MAT Degree Status	First year of MAT degree program	Second and final year of the MAT degree program	Holds a MAT degree	Holds a MAT degree	Holds a MAT degree
Teaching Experience	Less than one year of teaching experience	Year two of teaching	Year three of teaching	Year four of teaching	Year five of teaching

The researcher used a snowball, or chain referral, sampling to identify members of the participants' pool. "Snowball or chain referral sampling yielded a study sample through referrals made from two faculty members in the teacher preparation program. The referring faculty members "shared or knew of others who possess some characteristics of research interest" (Biernacki & Waldorf, 1981, p. 141; Patton, 2015). Receiving assistance with recruiting was a crucial advantage of using this recruitment method (Krueger & Casey, 2015). Although this was a key benefit, it was disadvantageous because the researcher had limited control over the recruitment, and the "sample [was] limited to the recruiter's networks" (Hall, 2020, p. 30; Krueger & Casey, 2015). When prospective participants chose to participate in two focus group discussions and the social identity map activity, the researcher shared confirmed dates and locations for the event with the research participants.

Sources of Data

The research data sources were two focus groups that occurred one week apart, one social

identity map for each research participant, and one follow-up interview with the researcher. The

researcher designed focus group questions to discuss themes that emerged from Figure 1 and

Table 1. Prior to conducting the focus groups, the researcher pilot-tested the focus group

question protocols, the social identity map, and the follow-up interview questions to ensure they

are understood. During both focus groups, the researcher used a semi-structured discussion

guide (see Appendix B and Appendix C) to ask participants open-ended questions. The

researcher prepared four open-ended questions and five follow-up questions for the first focus

group and four open-ended questions and four follow-up questions for the second focus group.

The researcher's questions clarified the Black STEM teachers' perceptions of their collective

social identities from the lens of critical reflection. The collective focus group responses from

the research participants answered research question one.

Figure 1

Conceptual Framework: Black STEM Teacher Pipeline
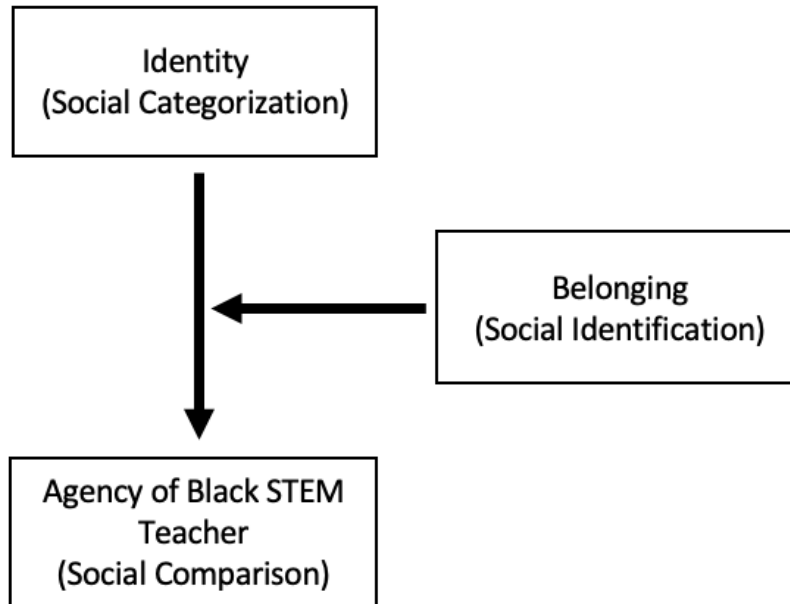
```
        ┌─────────────────────────┐
        │        Identity         │
        │ (Social Categorization) │
        └─────────────────────────┘
                    │
                    │          ┌─────────────────────────┐
                    │ ◄────────│       Belonging         │
                    │          │ (Social Identification) │
                    ▼          └─────────────────────────┘
        ┌─────────────────────────┐
        │   Agency of Black STEM  │
        │         Teacher         │
        │   (Social Comparison)   │
        └─────────────────────────┘
```

Note. This figure represents the conceptual framework for the Black STEM teacher pipeline in alignment with the social identity theory from the lens of critical reflection. This figure is a duplicate of Figure 1 in Chapter 1.

Critical reflection prompts for the social identity map (see Appendix D) were developed to engage research participants in independent critical self-reflection about their social identities. Participants were asked three main identity reflection questions during the individualized critical reflection and social identity mapping activity. The researcher organized the critical reflection questions for the social identity map to align with the themes in Figure 1 and Table 1. The individual critical reflection responses from the research participants answered research question two.

Table 1

Themes Investigated from Deductive or a Priori Codes Derived from Conceptual Framework

Social Identity Theory Framework	Social Categorization	Social Identification	Social Comparison
Researcher's Conceptual Framework	Identity	Belonging	Agency
Researcher's Themes	Identity creates the capacity to educate and learn from others.	Identity offers assets that create a sense of belonging.	Identity as a Black STEM Teacher produces a position in the community that liberates.
Alignment of themes in the Teacher Preparation Program	Identity offers a capacity to educate and learn from others	Belonging within a community produces assets to offer others	Position as a Black STEM teacher in the community ensures academic equity for all.

Note. This is a map that aligns critical reflection with the three components of social identity: social categorization, social identification, and social comparison. The researcher will review two focus group transcripts and five social identity maps to investigate themes within deductive or a priori codes derived from the conceptual framework in Figure 1. This table is a duplicate of Table 1 in Chapter 1.

Data Collection

Qualitative research collects data from recorded participant responses (Saldaña, 2021). The purpose of the inquiry drove the data collection (Krueger & Casey, 2015). The researcher explored the reflections of Black STEM teachers' social identity while in their teacher preparation program. Therefore, the researcher used a dialogical approach to collect the data in a systematic, verifiable, sequential, and continuous way (Krueger & Casey, 2015). Before conducting the two focus groups, social identity mapping activity, and six interviews, the

researcher used deductive coding to identify themes that emerged from the literature, as captured in Figure 1 and Table 1.

Data from participants were audio recorded and transcribed using a verbatim transcription technique. The researcher stored the data in a secure database on a password-protected computer at the University of Memphis. After one year of data storage, the researcher will destroy all collected and analyzed data.

Planning was a meaningful first step because it is often omitted in preparing to facilitate a focus group (Krueger & Casey, 2015). Before beginning each of the two focus groups, the researcher completed CITI training in research ethics. Afterward, the researcher designed the research, shared the procedures, and conducted two focus groups one week apart and one social identity map activity that included six independent interviews with the same six participants following IRB requirements. The procedures include consent to audio and video recordings of the focus groups and interviews. The researcher shared detailed verbal and written descriptions of the study procedures. Consent forms and instructions emphasized that participants could withdraw from the study at any time without penalty or the loss of benefits to which they were entitled. The researcher also informed participants that they could decline to respond to questions without penalty. Each participant gave consent before participating in the focus groups. There was an option to end involvement before initiating the focus groups either because the participant did not meet inclusion criteria, declined consent, or chose to participate no longer. Everyone consented to the research and participated in the study.

Before conducting the study, the researcher identified a practical goal of wanting to learn more about the needs and concerns of Black STEM pre-service teachers and an intellectual goal of emphasizing the Black STEM teachers' marginalized identities through a demonstrated

awareness of oppressive realities that shaped their lives and their capacity to transform that reality. The researcher's previously identified goals aligned with both Reiss's (2004) motives of curiosity and idealism, which support asking questions to pinpoint "emotional hot buttons," and Kreuger and Casey's (2015) findings on asking questions to elicit factual responses. Therefore, the researcher chose to ask both types of questions to find the "emotional hot buttons" and the intellectual knowledge of the research participants.

Data were collected on two different days. On the first day of data collection, the researcher conducted a focus group followed by the administration of the social identity map. Since the researcher was studying the identities of Black teachers, the researcher began the first focus group discussion by capturing the identities of the research participants. Hence, during the first focus group, the researcher delivered a prompt to note everyone's collective identities immediately following a brief period of conversational questions. This type of data collection helped the researcher capture salient themes about the study participant's identities that were discussed during their focus group conversations (Fine et al., 2005).

To engage participants, the researcher asked them to list their identities. Requiring respondents to list things helps with engagement during focus group sessions. Thus, the researcher used this strategy during the focus groups to maintain research participant engagement (Krueger & Casey, 2015). According to researchers, the goal of the question should be a determinant of the types of questions asked of research participants (Feig, 2006; Krueger & Casey, 2015; Reiss, 2004). Feig (2006) suggested asking questions to find the "emotional hot buttons" of research participants, while others feel it necessary to ask questions that produce intellectual and factual responses. Supporters of asking questions to get at a research

participant's "emotional hot buttons" suggest people generally make decisions based on their emotions instead of making rational decisions based on intellectual and factual information.

The "emotional hot buttons" type of questions changed the dynamics of the focus group and produced responses about the ways research participants felt, which was more in line with how research participants, in general, made decisions. While on the other hand, researchers suggested that questions that yielded a more factual and intellectual response made research participants feel more detached from the focus group or the research topic (Krueger & Casey, 2015). When determining which types of questions were best for a focus group, the researcher referenced Reiss' (2004) recommendation for assessing the goal of the focus group. During the first focus group, one "emotional hot button" type of question was asked when the researcher asked focus group participants, "Why are you skipping beyond the becoming part of your journey of becoming a Black STEM teacher?" After sixty minutes of discussion during the focus group, the researcher concluded the first focus group. The researcher was able to use data from the first focus group to answer both research questions.

Although there were various ways to incorporate a social identity map into the focus group, the researcher chose to provide research participants with a pre-drawn social identity map that aligned with the pre-determined themes. At the conclusion of the first focus group discussion, research participants were given a ten-minute break before beginning the social identity map activity. The researcher used Nearpod's Draw It feature to facilitate the social identity map activity. Using Nearpod, the researcher could monitor the research participants' progress toward completing the social identity map and offer help if anyone needed it. The study participants were provided a Nearpod code which led them to a virtual social identity map that captured their reflections about their identity, communities, and agency. The researcher advised

participants that they could work with their cameras off or on and send the researcher a private message in chat once they completed the social identity map. Research participants were dismissed one at a time upon completion of the social identity map. After the social identity map activity, the researcher concluded the first data collection section and saved each virtual social identity map using the research participant's pseudonym. The researcher was able to use data from the social identity map to answer both research questions.

Exactly one week after the first focus group, the researcher conducted the second focus group and follow-up interviews. The researcher used member checking before performing the second focus group to maintain a culturally responsive research design and engage the research participants. Member checking was a technique that involved "returning an interview or analyzed data to a participant" (Birt et al., 2016, p. 1802). At the beginning of the second focus group, the researcher shared the preliminary data interpretations derived from the first focus group in the form of a word cloud (see Figure 2). The researcher chose to share a word cloud because it was an easily digestible format for the focus group members to review. The researcher empowered focus group participants to check whether their voices were represented within the preliminary data by asking them, "Do you feel as though your voice was adequately captured from last week? Is there anything missing that you would like to add to this word cloud from last week? Is there anything you would like to take away?" This approach supported a culturally responsive research design that captured a fuller range of perspectives (Hall, 2020). After seventy-five minutes of discussion, the researcher concluded the second focus group and used the data to answer both research questions.

Figure 2

Member Checking Word Cloud of Focus Group 1

Following the second focus group session, the researcher provided a ten-minute break before beginning the individual follow-up interviews. Participants were placed in a breakout room until their turn to have their follow-up interview. The researcher allowed the participants to describe their social identity map during the follow-up interviews. To begin the dialogue during the independent follow-up interviews, the researcher asked each participant to (a) explain the parts of their identity that supported their sense of belonging in their communities, (b) elaborate on connections made within the map, and (c) share any additional information they felt

was necessary for the researcher to know. The researcher asked these questions to understand better which part of critical reflection is most meaningful for Black STEM teachers. The researcher used the data from the independent interviews to answer both research questions.

One of the six research participants was absent from the second focus group. To ensure their voice was captured, the researcher conducted an extended independent interview with that research participant, asking the same questions that were asked during the second focus group in addition to the questions that were asked during the independent interviews. The researcher felt it was essential to ensure all voices were heard; therefore, this additional interview was held.

Data Analysis

Before conducting the data analysis, the researcher immediately transcribed the two focus group recordings and the six independent interview recordings using a verbatim translation technique. Afterward, the researcher conducted a review of related literature about the phenomenon. The literature review revealed that critical reflection supports the Black STEM teacher identity development. Since having a solid STEM identity was essential, the study used thematic analysis to analyze participant responses during focus groups, interviews, and social identity maps to look for the emergence of the themes identified in Table 1, which align with identity, belonging, and agency. The researcher selected these three themes because they aligned with the conceptual framework that grounds this research in Figure 1.

To obtain the themes presented, the researcher used deductive coding (Fereday & Muir-Cochrane, 2006) to explore the intersectionality of Black teachers' social identity and their identity as STEM teachers. As a qualitative researcher, this study acknowledged the inability to generalize these findings to all Black STEM learners. Still, it offered the discoveries from this

study to begin thinking about what social identity means for these pre-service teachers within this context of STEM learning.

Immediately following the first data collection day, the researcher began to analyze one focus group transcript and six social identity maps using thematic analysis. The researcher used nVivo to help organize the data, verify the codes, and generate themes. The researcher familiarized herself with the data by reading the transcripts, re-reading the transcripts, watching the recorded video multiple times, and notating specific details from the data collected. Next, the researcher used nVivo to create a word cloud of the data. Afterward, the researcher coded the data using the previously identified data themes as parent nodes. After the second cycle of coding the data, the researcher added child nodes as they became evident. The researcher went through three coding cycles by identifying concise categories from the data, noting patterns, and capturing repetitive behaviors relative to both research questions. Through each iteration of coding, the researcher made further refinements to the child nodes, resulting in concise themes.

Next, the researcher began the initial coding of the social identity map. The initial analysis of the social identity maps occurred in two phases. First, the researcher printed the social identity maps created by the research participants. Through careful critique, the researcher studied the social identity maps to look for evidence of independent critical reflection among research participants. Since critical reflection required self-critique of one's past, present, and future, the researcher assessed whether this happened in two phases (Freire, 2014). First, the researcher examined the social identity maps to look for evidence of self-critique about the study participant's past through the use of symbols, their present through connections detailed on the map, and their future through examination of their agency statement.

After this step, the researcher used the following questions and began the analysis of the social identity maps. This was important because the researcher used triangulation of data to establish trustworthiness and credibility.

- What was in the social identity map that supported or reinforced what was learned from the focus groups?

- What was in the social identity map that contradicted what was learned during the focus groups?

- What was the hidden meaning behind contradictions or missing information?

After answering the beforementioned questions, the researcher began creating separate cases in nVivo for the social identity maps and started coding social identity map responses to the previously identified parent nodes for the social identity map and focus group cases. At this step, the researcher developed an initial thematic map of the focus group and social identity map data to begin answering both research questions. Since critical reflection is fluid and an ongoing process, the researcher continued to listen for evidence of critical reflection during the interviews. Therefore, the researcher refined the focus group 2 protocol to ask questions that would clarify the data during the second focus group. Table 3 shows the initial themes that emerged after the first focus group and the social identity map activity.

Table 3

The Emergence of Codes after Focus Group 1 and the Social Identity Map Activity

First Cycle Coding		
• Division within Blackness • Black Pride • Various Identities	• Host Teachers • Family • School • Social Groups • Omissions/Silencing	• Lacking Agency • Classroom Teachers • Only Classroom Agency • Motivation and Representation
Second Cycle Coding		
Identity	**Belonging**	**Agency**
• Blackness is Nuanced • Acceptance	• Illusions of Hierarchy • Acceptance	• Blackness is not Agentic
Third Cycle Coding		
Identity	**Belonging**	**Agency**

• Various Identities
   • Race
   • Gender
   • Sexuality
   • Geographical
   • Religion
   • Cognitive
• Blackness is Altruistic
   • Role model
   • Help Others
• Blackness is Not Monolithic
   • Black Americans
   • Black Internationals
	• Illusions of Hierarchy
	   • Entitlement
	   • Privilege
	• Blackness and Community
	   • Queer
	   • Science
	   • Foster Care
		• Blackness Limited Agency
		   • Classroom Agency
		   • Agency with Students

After the second focus group and follow-up interviews, the researcher followed the same steps to analyze the focus group and follow-up interview data. Afterward, the researcher reorganized all the data in nVivo to create files for focus group data and cases for the social identity map and follow-up interview data. Once all the data was combined, the researcher went through two additional cycles of coding to refine the data and derive at concise themes. The researcher looked deeply at the coded data to identify subthemes. At this step, the researcher developed a refined thematic map of both sets of focus groups, social identity map, and interview

data. The second focus group data included data from member checking. After composing the

thematic map, the researcher made further refinements to the data to interpret the story the data

revealed from the collective reflections of the research participants in the focus groups. Finally,

the themes were named and checked to ensure proper alignment with the conceptual framework

and the research questions.

To conclude analyzing the social identity map and follow-up interview data, the

researcher used the same process to analyze the data from the social identity maps. After going

through one additional coding cycle for the follow-up interview data, the researcher combined

the data from the social identity map and the follow-up interviews with the focus group data to

create a thematic map of the data. The researcher looked for repetitions within individual group

members to review drawings and mark instances where themes occurred. Similar to the focus

group data analysis, the researcher ensured the parent and child node data in nVivo by checking

for alignment to the conceptual framework and whether it answered both research questions by

identifying how the themes were linked. The final step in using thematic analysis for the focus

group discussions, identity maps, and follow-up interviews was to write a report about the

findings. The report showed how each of the data points contributed to answering both research

questions. Table 4 demonstrates the emergence of the themes after the analysis of data collected

from focus group 2 and six independent interviews with the six research participants.

Table 4

The Emergence of Codes after Focus Group21 and Six Independent Interviews

Fourth Cycle Coding		
Identity	**Belonging**	**Agency**

• Blackness is Altruistic
  • Asking for Help
  • Helping Others
• Illusions of Hierarchy
  • Being Black is Not Monolithic
  • Intersectionality
• Various Identities
  • Race
  • Gender
  • Sexuality
  • Geographical
  • Religion
  • Cognitive
	• Blackness and Community
	  • STEM University Classes
	  • Religion
	  • Females in STEM
	  • LGBTQ+ in STEM
	  • Black Males in STEM
	  • Classroom Community
	  • Hometown
	• Practices of Exclusion
	  • Exclusion
	  • Silence
		• Blackness as Agency
		  • Position of Teacher as Power

Fifth Cycle Coding		
Identity	**Belonging**	**Agency**

• Altruism
• Helping others
• Asking for help
• Illusions of Hierarchy
• The intersectionality of being Black with other marginalized groups
• Being Black is not monolithic.
• Intersectionality of Cultural Identities
	• Similar Identities and Thriving Communities
	  • Being Black in STEM University Classrooms
	  • Black LGBTQ+ in STEM
	  • Hometown
	  • Black Females in STEM
	  • Classroom Community
	  • Black and Religion
	  • Black Males in STEM
	  • Silence
	  • Omission
		• Using Position as Power
		  • Lacks Ownership Beyond Classroom
		  • Agency in Classroom

Instrumentation

Focus Group Discussions

The research instruments for data collection included two sets of Focus Group Discussion Questions and member checking data (see Appendix B and Appendix C).

Social Identity Mapping

The research instruments for data collection included the Critical Reflection Prompts for social identity mapping and independent interviews (see Appendix D).

Trustworthiness and Credibility

Researchers need to establish trustworthiness and credibility in their research. Establishing trustworthiness in research is a way to ensure that qualitative research is rigorous (Baxter & Jack, 2008). Credibility referred to the ability to trust the findings provided by the researchers (Anfara et al., 2002; Cho & Trent, 2006). The researcher chose methods to establish trustworthiness and credibility based on the research design.

Member checking was used as a basis to establish the credibility and trustworthiness of the responses from the focus group data. According to scholars, member checking created a structure to confirm the meaning behind research participants' voices and the interpretations made by the researcher, which adds credibility to the study (Candela, 2019; Hall, 2020). The use of member checking elevated the voices of the focus group members while minimizing the opportunity for researcher bias. By reducing researcher bias, the intended voice and meaning of focus group members were preserved (Hall, 2020). The member checking process involved the participants being shown the word cloud in Figure 2 of their responses from the first focus group. Participants were asked if they (a) agreed with the information, (b) whether their voice was

adequately represented, (c) if anything should be added, and (d) if anything was omitted from the analysis.

Triangulation in research was another way to establish trustworthiness and credibility. Triangulation involved "using multiple data points to broaden the researcher's understanding of the subject of their research" (Merriam & Tisdell, 2016). The researcher used triangulation to find coherence and inconsistencies between the collected data. The multiple data points the researcher used were data from two focus groups, feedback from member checking, data from the social identity maps, and data from the six independent follow-up interviews.

The researcher also used methodological coherence. Methodological coherence was a strategy where the researcher creates a study that aligns the research question, methods, data, and analytical processes (Savin-Baden & Major, 2013). Although this approach presented a challenge due to qualitative paths not being linear, the researcher used this approach because the researcher valued ensuring congruence between the research question, methods, data, and analytical process.

The researcher used pilot testing to establish the trustworthiness and credibility of the research questions. Prior to conducting the research, the researcher conducted a pilot test on each of the questions on the interview guides and the social identity mapping activity. The researcher used the feedback from the pilot test to ensure the questions were understandable. Additionally, the input provided during the pilot test allowed the researcher to revise questions to remove ambiguity (Krueger & Casey, 2015).

Positionality

A philosophical stance is a researcher's position that impacts their perception of reality and their decisions about their research. As a result, the researcher's epistemological and

philosophical view can affect the accrual of knowledge, perspectives about truth, and what one has accepted as their perception of reality (Savin-Baden & Major, 2013). It is important in qualitative research because a philosophical stance impacts the researcher's "belief about what counts as knowledge, how the researcher critiques the world, how their beliefs are justified, and what a researcher ethically believes" (Savin-Baden & Major, 2013, p. 54).

The researcher's beliefs align with theories of critical reflection from the lens of social identity theory and have shaped the researcher's epistemological stance. Although a great deal of the researcher's study aligns with the theory of anti-Blackness, the researcher's epistemological stance of critical reflection shapes thinking about this research as the researcher critically reflects on personal identities and how those identities shaped the researcher's experiences. The researcher is a Black female teacher of STEM, Mathematics, and Science courses who attended various schools: public, private, urban, and gifted schools, along with HWIs. The researcher is also a mother of three daughters who attended private and public schools.

Currently, the researcher works in a Graduate School of Education's Teacher Preparation Program. As a full-time faculty member who leads a nationally recognized teacher preparation program, the researcher's university recently appointed them as the Program Director of one of the University's Master of Arts in Teaching programs. Before this appointment, the researcher was a full-time higher education faculty and leader of mathematics and science. Because the researcher has witnessed the increased need for Black educators in STEM, the researcher wants to investigate the role of critical reflection with Black STEM teacher candidates. Interrogating this space will reveal critical factors that Teacher Preparation Programs can use to increase the credentialing of Black teachers of STEM subjects.

When it comes to STEM education, the researcher advocates for educational justice. It reflects the researcher's internal core values and beliefs about STEM education. The researcher can remember being in spaces and experiencing microaggressions based on the content of the subjects they have taught

Because of the researcher's experience as a Black female STEM educator in mathematics, science, and STEM courses, the researcher must be careful not to allow bias to interfere with their research. For example, because the researcher has experienced many negative interactions with white male colleagues at an HWI, it is easy for the researcher to be biased against white male Mathematics Professors. This type of bias can potentially negatively impact the researcher's interpretation and data collection.

Chapter Summary

This chapter discussed the methodology for the researcher's research. Two focus groups comprised the same six group members from an HWI with an urban teacher preparation program. Group members participated in two focus group discussions one week apart, one social identity mapping activity, and one follow-up interview for the researcher to investigate the phenomenon. This study collected data from two focus groups, one social identity mapping activity, and one follow-up interview. Finally, the researcher used thematic analysis to analyze the data to identify themes.

CHAPTER FOUR: FINDINGS

Overview

This study aimed to explore the critical reflections of Black STEM teachers' social identity while enrolled in a teacher preparation program at a Historically White Institution (HWI). This chapter presents key findings from two focus groups, six social identity maps, and six interviews with six research participants. As a result of thematic coding, three major themes emerged from this study:

- Multidimensional Cultural Identity: Research participants perceive their identities as multidimensional and a reflection of their culture.

- Identity Aligned Communities: Research participants cited similar identities as an indicator of a thriving community.

- Ownership of Agency: Research participants cited limitations to their agency as Black STEM Teachers.

The themes that emerged from this qualitative study addressed the research purpose. The themes addressed both research questions #1 and #2, respectively: "How do Black STEM teachers perceive the role of social identity in their teacher preparation experience?" and "How do Black STEM teacher candidates engage in critical reflection of social identity in their teacher preparation experience?"

Following is a description of the research participants and a discussion of the emerged themes, including details supporting and explaining each finding. The following section exemplifies how each theme responds to the study's research questions. Throughout this section, illustrative quotations are taken from the focus groups, interview transcripts, and visual data to portray equity in voice for participant perspectives and capture the diverse and complex

dialogue. The researcher has chosen to represent the findings from the focus groups, social identity maps, and independent interviews separately to preserve the integrity of the data. Although the findings are reported separately, triangulation of the data was used to answer both research questions.

Research Participants

A total of six Black STEM Teachers participated in this study. The study participants were enrolled in the same Teacher Preparation Program (TPP) located in three different cities[5]: City A, USA; City B, USA; and City C, USA. The six participants represent five cohorts from the TPP: less than one year of teaching experience, year two of teaching, year three of teaching, year four of teaching, and year five of teaching. Of the six research participants, three identified as cis-female, one identified as a lesbian female, one identified as cis-male, and one identified as gender nonconforming. There was a total of thirty-five identities collectively reported among the research participants, with fourteen repeated identities, and Black being the most repeated identity. Table 5 provides an overview of the identities derived from each research participant during the entire study.

Participant Descriptions

This section provides descriptions of the participants in this study. The details about each research participant were either named by the participant as part of their identity or emerged during the focus group discussions or interviews. All participants attended the same two-year, or six-semester, Master of Art in Teaching (MAT) Teacher Preparation Program (TPP). All names are pseudonyms and geographic locations have been assigned a fictitious name to prevent deductive disclosure of the research participants.

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[5] The names of the cities have been changed to protect the identities of the research participants. The cities will be referred to as City A, USA, City B, USA, and City C, USA throughout this report.

Nakeia is a Black lesbian female who is a first-year pre-service teacher. Since she just started the program, she has four semesters remaining until she receives her MAT degree. A native of City B, USA, Nakeia is studying to become a teacher in City A, USA. At the time of the focus groups and interview, Nakeia's clinical placement was in middle school math.

Tyrell is a second-year Black cis-male teacher in the middle of his teacher preparation degree program. Tyrell's extensive undergraduate coursework in math and science supports his current teaching assignment as a fourth-grade math and science teacher and his role as sponsor of the school's Robotics Team. Tyrell is currently teaching in City A, USA and has one semester remaining to fulfill the requirements of his MAT degree.

Marvin is a second-year teacher with an undergraduate degree in Earth Science. They are a Black queer elementary math and science teacher currently teaching in City B, USA. Marvin has one semester remaining to fulfill the requirements of his MAT degree.

Denise is a City D, USA[6] native in her third year as a teacher. At the time of this study, Denise was teaching 6th -8th grade STEM in City C, USA. Denise is a Black cis-female who is one-year post-MAT.

Minnie is a Black cis-female who is a fourth-year teacher in City C, USA. As a City E, USA[7] native, she graduated from a Historically Black College and University (HBCU) with an undergraduate degree in science. Minnie fulfilled the requirements of her MAT degree two years ago. At the time of the study, Minnie was an Early Childhood Education (ECE) math and science teacher.

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[6] City D, USA is not one of the TPP's satellite locations. City D, USA is listed because the research participant named it as part of her identity.
[7] City E, USA is not one of the TPP's satellite locations. City E, USA is listed because the research participant named it as part of her identity.

BPRS is in her fifth year of teaching in City A, USA. BPRS has an Associate of Science, Bachelor of Science, and Master of Science degrees in Computer Information Systems with a minor in Cybersecurity, along with her MAT degree, which she completed three years ago. Currently, BPRS the Special Education Department Chair at her school while she provides math and science special education instruction in an elementary school.

Table 5

Research Participant Descriptions and Identities

RESEARCH PARTICIPANT (PSEUDONYM/ PRONOUNS)	RESEARCH CRITERIA ATTRIBUTE	IDENTITY RESPONSES	
		Focus Group	**Social Identity Map**
NAKEIA (SHE/HER)	• Recently entered the Teacher Preparation Program • First year of the MAT degree program • Less than one year of teaching experience	*Black* City B, USA *Mathematician* Lesbian	*Black* Female Funny Educator *Mathematician*
TYRELL (HE/HIM)	• Middle of the Teacher Preparation Program • Second and final year of the MAT degree program • Year two of teaching	*Black* *Gamer* Reader Writer Anything sports Teacher	*Black* Smart Young *Gamer* Passionate
MARVIN (THEY/THEM)	• Middle of the Teacher Preparation Program • Second and final year of the MAT degree program • Year two of teaching	*Black* *Queer* *Philosopher*	*Black* *Queer* *Philosopher* Scientist Teacher
DENISE (SHE/HER)	• End of the Teacher Preparation Program • Year three of teaching	African American *Woman of God* *Author* Teacher City D, USA City C, USA Community University[8]	Black *Woman* *Christian* *Author* Dancer/Passionate about the arts

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[8] Community University is an HBCU that two research participants attended and named it as part of their identity.

Table 5 (Continued)

Research Participant Descriptions and Identities

RESEARCH PARTICIPANT (PSEUDONYM/ PRONOUNS)	RESEARCH CRITERIA ATTRIBUTE	IDENTITY RESPONSES	
		Focus Group	**Social Identity Map**
MINNIE (SHE/HER)	• Recently completed the Teacher Preparation Program • Year four of teaching	*Super competitive* *Creative* Hard Softie Community University[7]	*Competitive* City E, USA[9] Black Woman *Creative*
BPRS (SHE/HER)	• Alumni of the Teacher Preparation Program • Year five of teaching	*Dweeb* Gamer Nerd Anime Manga Teacher *Young* *Educated*	Black *Dweeb* *Young* *Educated* Woman

Note. This table provides all of the identities shared by each research participant during their participation in the two focus groups, social identity map activity, and interview. The researcher used these identities to answer the research questions and derive themes from the collected data.

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[9] City E, USA is not one of the TPP's satellite locations. City E, USA is listed because the research participant named it as part of her identity.

Focus Group Findings

The purpose of the focus groups in this study was to collect qualitative data to answer research questions #1 and #2 respectively, "How do Black STEM teachers perceive the role of social identity in their teacher preparation experience?" and "How do Black STEM teacher candidates engage in critical reflection of social identity in their teacher preparation experience?" A total of six research participants were invited to two focus groups that were held one week apart. Two focus group sessions were conducted with six and five research participants, respectively. To ensure everyone's voice was captured, a separate interview was held with one research participant who missed the second focus group. The focus groups were led using a video conference platform, allowing research participants from three cities to attend the same focus group sessions synchronously. Each of the six focus group participants were consented before participating in the research study.

Data from the collective focus group responses of the research participants answered the first research question. The first research question was asked to determine how Black STEM teacher candidates collectively perceived the role of their social identities as they matriculate through their teacher preparation program. This question provided information about salient themes of social identity theory from the lens of critical reflection that influences the collective perceptions that Black STEM teacher candidates have about the role of group membership. The question supported the researcher's understanding of the experiences of Black STEM teachers at different points in the researcher's conceptual framework, which represents the teacher Black STEM teacher preparation pipeline.

The second research question was asked to understand better how Black STEM teacher candidates independently engage in critical reflection about their social identities while in their

teacher preparation program. This question provided the researcher with information on whether critical reflection happens, the impact that individualized critical reflection has on the Black STEM teacher candidate's thinking about their identity, and which theme of social identity has the most impact during the period of critical reflection. Although this question focused on independent reflection, the focus group questions were designed to capture independent critical reflections from the research participants. To answer research question #1, the researcher listened for reflections about identity and experiences from the perspective of identity within the community. The researcher also listened for shared experiences and similarities and differences in reflections that were shared. To understand whether critical reflection happens and which component of the conceptual framework had the most impact on research participants, research question #2, the researcher listened for evidence of critical self-interrogation and connections between identity and community.

The following three salient themes were derived from the data analysis of the two focus group sessions:

- Multidimensional Cultural Identity: Research participants perceive their identities as multidimensional and a reflection of their culture.

- Identity Aligned Communities: Research participants cited similar identities as an indicator of a thriving community.

- Ownership of Agency: Research participants cited limitations to their agency as Black STEM Teachers.

Table 6 provides codes corresponding to the emergent themes from the two focus groups.

Table 6

Coding and Theme Development for Focus Groups

Theme	Multidimensional Cultural Identity	Similar Identities and Thriving Communities	Agency is Limited
Derived Codes	• Altruism 　• Helping others 　• Asking for help • Illusions of Hierarchy 　• The intersectionality of being Black with other marginalized groups 　• Being Black is not monolithic.	• Being Black in STEM University Classrooms • Black LGBTQ+ in STEM • Hometown • Black Females in STEM • Classroom Community • Black and Religion • Black Males in STEM • Silence • Omission	• Using position as power

Multidimensional Cultural Identity

During the focus groups, research participants often spoke about the intersectionality of their cultural identities: race, gender, sexuality, locality, religion, and social class, as opposed to their social identities. When speaking about the intersectionality of their cultural identities, they led with describing what it meant being Black, how their Blackness intersected with their other cultural identities, and how their Blackness created illusions of hierarchy. Although the researcher's initial focus was on social identities, the emergence of this theme resulted in findings being reported as cultural identities. The use of cultural identity is used to reference the findings from the qualitative data. As a result of the findings for this theme, subthemes of altruism and illusions of hierarchy emerged, which illustrated the research participant's perspectives about their cultural identities.

Altruism. "It's not about me." This section shares the focus group findings of one of the subthemes for Multidimensional Cultural Identity: Research participants perceived the role of their racialized identity in STEM education as altruistic. The findings of this subtheme

demonstrate how the research participants perceive the role of their racialized identity of being Black in STEM. To better understand how research participants perceived the role of their social identity during their Teacher Preparation Program (TPP), it was important for the researcher to interrogate the identities of research participants in the context of learning to teach STEM. Although the first focus group discussion began with participants explicitly naming their identities, there was a need for further interrogation to actualize the role of their identity fully. Therefore, during the second focus group, research participants were asked to describe "what it means being Black and [another identity] in the context of learning to teach a STEM subject." The significant coded responses for this theme are captured in Appendix E. The overall theme for the findings that follow is best summarized in Minnie's quote, "it's not about me" as she explains her benevolence in her role as a Black STEM teacher.

Five of the six research participants revealed that the unselfish spirit was intrinsically present before enrolling in the TPP. Similarly, they expressed the desire to use their racial identity in STEM to help family, friends, and others that "looked like them." Minnie, Nakeia, Denise, Tyrell, and BPRS expressed altruism in the following ways:

For Minnie, learning to teach STEM in the context of being Black took on a personal meaning. It began with a "[desire] to educate my family members and then wanting to educate my friends." By fulfilling her desire to educate family and friends, she could "educate [Black] people because, as Black people, we need to know this information because we're the ones [suffering] the most."

Like Minnie, Nakeia shared a personal meaning about what it means to be a Black STEM teacher. Because Nakeia has "the ability to be good in math," she thought, "why not help the other people that look like me try to be as good as me? Or try to feel like they can surpass me?"

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Her mathematical talents inspired her to want to help her school peers, whom she "saw struggling with math, but I didn't [struggle]. I didn't have the same struggle…I don't want to feel like I'm a genius or anything, but I want to help the people that look like me get to my level."

Given that Denise was in a different career field before she entered her TPP, her perspective took a more holistic approach. She sees herself as a minoritized figure in STEM who can relate to Black students. Denise recognized there were problems in the classroom. She believed she could help. Denise shared that she planned to "go into the classroom to see what the issue is… and find a solution." Denise shared that she continues to maintain this mindset because she "wants what's best for them at the end of the day, and [my] job is to serve them; that's what [I] signed up for."

Tyrell told the group that he always wanted "to share information that I've learned with other people." By doing so, Tyrell leads the Robotics Club at his school. Tyrell suggested that using his presence alone as a Black male in STEM could "increase more Black and brown students in STEM just by me being involved in STEM."

Finally, BPRS shared how her STEM talents were discovered and expressed the desire to recreate that feeling in other children:

> While I was living with my last set of foster parents, who eventually adopted me, there was a desktop computer that was about to go in the trash. I was playing with it one day… and I fixed it. When they found out that I was really good at [fixing] computers, they encouraged me…and from then on, he was like, "Oh, you're good at this!" So to the military base, we went, and he knew some people in the IT department, and he would take me there every single weekend. I would get to stay there for as long as I wanted to see what they were doing, and help with the computers, and learn how to use the

software. And then, when I knew how to do something, I would teach other people how to do it, which is how I first discovered my love for teaching… I wanted to be able to give back to other children who did not have much growing up like I did.

On the other hand, Marvin and Minnie shared moments of altruism during moments of resistance. For example, both shared experiences of not receiving the help they needed but refusing to give up because their students needed them. Marvin shared that despite not receiving support when asking for it, he was "doing that all externally. That's all me. That's because I care." Marvin also spoke about independently creating classroom resources without the help of the TPP so that the students would "have what they need."

Minnie agreed that she "did not [ask for help] in [her TPP] because [she] didn't feel comfortable." Unlike Marvin, Minnie believes "many Black students [do not ask for help]. I think it's because we haven't been taught how to ask for help, and we've been taught that asking for help is weak…Why can't I ask for help? I believe this is why we see so many students falling behind because they don't want to ask for what they need."

Although altruism is a prominent theme that explains what it means to be a Black STEM teacher, it is worth noting that the initial discussion prompt was for research participants to share what it means to be a Black and [a second identity] in the context of learning to teach STEM. All the focus group participants initially provided experiences about what it means to be Black and a second identity in the context of teaching STEM, as opposed to in the context of learning to teach STEM. When the researcher pointed this out, research participants responded with perceptions of being absent in the learning space, which will be discussed in greater detail in this chapter's section on Similar Identities and Thriving Communities.

Illusions of hierarchy. "These identities automatically put up a wall. There's a lot of negotiation and decolonizing, right?" This section provides the focus group findings of the second emerged subtheme of Multidimensional Cultural Identity: Research participants perceived illusions of hierarchy that privileged dominant groups. The findings from this subtheme demonstrate how the intersectionality of multidimensional cultural identities plays out in society. To interrogate the value that the research participants place on their multidimensional cultural identities, it was necessary to explore whether there were any perceived strengths and limitations associated with the named cultural identities. Therefore, the researcher facilitated a conversation during the first focus group by asking the study participants, "Based on your identities, what are your strengths and limitations within the STEM community?" The researcher listened for the continued emergence of this phenomenon during the second focus group. After a review of the data, the findings suggested there was a perception of an illusion of hierarchy that privileged non-Black (Black American) people in academia within the STEM community. According to Marvin, "these identities automatically put up a [imaginary] wall. There's a lot of negotiations and decolonizing…" which take place to deconstruct the illusions of hierarchy that exist. The codes for this subtheme also suggested there was an illusion of hierarchy that privileged dominant and certain African diaspora groups. The following summaries, along with Appendix F, provide data corresponding to the significant findings about illusions of hierarchy within this study.

Nakeia, Minnie, and Denise shared stories that suggest illusions of hierarchy exist within the African diaspora within academia in the Black STEM community. Their stories suggest that having a racialized identity of being Black within STEM is nuanced; it is not monolithic. Similarly, the experiences that were shared occurred during their undergraduate experience while

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all three were majoring in a STEM subject. Although Tyrell did not verbally share a similar

experience, he also believed there is a need to place more of an emphasis on the "role of the

Black diaspora in academia and how we perceive our race based off of our country of origin."

On the other hand, there was disagreement between Minnie and Nakeia as to why the nuance

exists.

Minnie believes that Black international students are perceived as smarter and are the

recipient of privilege that is not afforded to Black American students. To validate her beliefs,

Minnie shared her undergraduate experience at a Historically Black College and University

(HBCU) that she attended while majoring in science. The following is an example Minnie

shared of the type of privilege that was given to Black international students.

> I went to an HBCU, so I was surrounded by nothing but people that looked like me. But
>
> there was still a divide where you knew Black people who weren't from the U.S. It was a
>
> different type of stigma where they were held on a pedestal if they [Black students]
>
> weren't from the U.S…And it's like, you try not to go against people who look like you,
>
> but you're taking away from my access... Students who were not from the U.S. were
>
> given more time and effort.

Minnie then shared two experiences that she had with the faculty at her HBCU. In one

encounter, she was truthful about her country of origin, and in another example, she was not

truthful about her country of origin. She reported being treated differently based on her

communicated country of origin. Denise, who went to the same HBCU as Minnie, but at a

different time, agreed with Minnie, citing, "I graduated from [the same HBCU], and yes, there is

definitely still a divide." The following is what Minnie shared:

I still feel like an outsider. Even the teachers made it seem like that. I had one professor ask me, "Oh, what's your name?" I told him my name, and he was like, "Oh, where are you from?" After telling him [state], he was like, "No, but where are you from? What are you?" And I'm thinking, I know got, skin of a goddess, but I could be from here too. … I often wonder if I did tell him I was Caribbean or from another country, would he have treated me differently? … There was another professor that I would see how he treated other students and me differently until the point I told him that I was Black American because he was under the notion that I was from another country and I was an international student.

Additionally, Minnie shared her experiences with the Black international students. In her reflection, she describes the illusion of hierarchy that exists between Black American students and Black international students. From Minnie's account, there is the perception that Black international students are "more than" Black American students.

It was really a divide between Black people even though we could party together. But if I came to them [Black international students] for help when we were in class, it was like they did not know me. …I am like we [are] all Black; we should all uphold each other and uplift each other. That's why we came to a Black school. But there's still a divide where you're still looking down at me because of what you heard about Black people like me when you were in your country.

Nakeia also noted an illusion of hierarchy among Black American and Black international students at her undergraduate institution. Like Minnie and Denise, Nakeia also went to an HBCU for undergraduate studies. However, Nakeia attended an HBCU different from Minnie and Denise. Nakeia agrees there was the existence of an illusion of hierarchy that

privileged Black international students, but there was disagreement as to why this privilege was given to Black international students.

> The international [students] got treated differently even though we looked the same…but they were treated differently. And I recognize that while my major was math, I…spent a lot of time with them because a lot of the internationals focus on STEM…. I think there was a social divide on my campus [between] Black people from the U.S. and the Black internationals. The Black international [students] would always hook up and I felt they had to be like that. It was the opposite of Minnie. I felt like [we] as Americans treated them badly because they were internationals.

As well as the illusion of hierarchy that emerged within the African diaspora, there was also the emergence of an illusion of hierarchy that surfaced between dominant groups and the intersectionality of having a Black racialized identity in addition to one or more traditionally marginalized identities: Black woman STEM teacher, Black male STEM teacher, and a Black person in STEM from foster care.

The intersectionality of having a Black racialized identity along with other traditionally marginalized identities also emerged within the subtheme of illusions of hierarchy. Within this conversation, Nakeia and Denise discussed the illusion of hierarchy associated with being an aspiring Black STEM teacher. BPRS discussed the illusion of hierarchy associated with being Black and in foster care. Although the intersectionality of identities varied in each case, there were stark similarities in the practices that created the illusions of hierarchy that implied privilege to non-marginalized groups.

The following is an experience Denise encountered in her classroom. Her experience shares the illusion of hierarchy among the students in her classroom.

There is a [white] student in my class that is very smart. One of my Black students was like, "Oh, my goodness, I'm finally in a group with him. That means I'm smart!" I told her that was not the truth and that was not how she should see it. So I sat down with her and then began to have a conversation [with her]. I told her that she was already great. But they always see this white student as the smartest in the class. And I don't know if they think it's because he's white or something else. My main thing is not to let them continue to think, "Oh, if I get in [the group] with him now, I'm great."

Along a similar theme, Nakeia shared an incident she had with one of her white peers while in her TPP.

I had a run in with one of my peers who are in the program with me. My peer whom I had the run in with is white and all my other peers look like me. We broke up into groups for one activity and each group had to come together to present their work. She [my white peer] stood up in front of the class and said, "Well, I feel like I should not represent because I'm the minority." I could not believe she said that because this teacher prep program is geared toward people of color, to help people of color. How could she suggest someone else present because she's white and we're Black? That doesn't give her the right to not present.

Identity Aligned Communities

Identity Aligned Communities was the second theme that emerged during the focus groups. Identity Aligned Communities suggest what occurs when research participants are in communities with those who share a similar identity. Within this theme, research participants shared reflections on a successful and thriving community within their teacher preparation program. Research participants also shared reflections from their communities when there was

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harm and distrust. In the data that follows, the research participants revealed their teacher preparation program experiences when they were in a community with teacher mentors that shared similar identities, as well as when they were in a community with teacher mentors who shared divergent identities.

Identity aligned communities. "I'm so happy we have this space. I am so happy to be in community with ya'll and really engage in these conversations." This section shares the focus group findings for the theme of research participants citing similar identity as an indicator of a thriving community. During the focus group discussions, the researcher wanted to learn more about the phenomenon sense of belonging for Black STEM teachers during their TPP. To this end, the researcher facilitated a discussion during the first focus group by asking the group, "What part of your identity do you believe has the most effect on your interactions with instructors and host teachers?" To gather additional data, the researcher led an additional discussion during the second focus group by asking, "What part of your identity do you believe has the most impact on your interactions with instructors in your TPP?" Throughout both focus groups, the researcher listened for the emergence of this phenomenon and captured data about interactions with the research participants' peers. Coded responses for this theme are captured in Appendix G.

Upon review of the coded data, the emergence of a theme of community was clear, but what was most striking in the data was the emergence of the role of identity within the community. There was an emergence of two subthemes: (a) a thriving community is the result of similarly aligned identities among group members, and (b) when identities are misaligned, exclusion and silencing occur within the community.   In addition to the findings that follow, Marvin's statement, "I'm so happy we have this space. I am so happy to be in community with

ya'll and really engage in these conversations," affirmed a community within the focus groups with a thriving sense of belonging.

Five out of six of the study participants discussed experiencing a sense of community with one individual within their TPP as opposed to feeling a sense of belonging with the TPP as a whole. In each of the pieces of data shared below, there is a theme of similarities in identity that creates community. Of the shared experiences, one experience occurred with faculty, three experiences occurred with host teachers, and one experience occurred with a Curriculum Director.

The following is Marvin's description of community that is created with one faculty member:

We had three [Black] professors, one of whom resigned… One of them, because of our identity, we just bonded really well. And so now I finally feel like I have a mentor teacher. I feel like, [for] the first time ever, there is a mentorship. I have someone who has a very similar ideology, and sees my vision and sees what I want to be. So with that instructor, I feel safe. I feel seen. I feel heard, and that makes me feel good…But that instructor is new. That instructor just came on last year. So all the other iterations of this program didn't have somebody like that instructor…but without him, I wouldn't have anything or a thought partner or somebody to really run ideas through and see what works.

Denise, BPRS, and Minnie shared related experiences about community that was created with a host teacher. Denise had a host teacher whom she described as a "Black woman" who was "very helpful, encouraging and prepared [her] a lot." Similarly, BPRS described her host teacher as "an amazing, strong, independent black woman, and she was like me. We were not

afraid to ask questions." BPRS shared that her host teacher made her "feel safe, and secure going into [her] own classroom." Likewise, Minnie shared her experience with her host teacher, where they shared several similar identities.

> My host teacher. She was a [Black] woman…She actually graduated from the same college I went to, which was the connection...But it's crazy because her mom and dad are from City E, USA, [too]. They went to the college I went to. She graduated from the college I went to. Her birthday is the same day as my mom's. It was like, God, this is alignment…she really is also a reason I am still teaching. I've known her for four and a half years now and we still talk.

Nakeia shared how the TPP's content director, a mathematics scholar, created community among the math teachers. Nakeia shared:

> Dr. D [pseudonym] created a community to be able to talk about things…because being a mathematician, and it's not a lot of Black females in STEM, is powerful. He often encourages me and tells me how unique I am because I am a Black female mathematician. And I feel like that's a big strength because, we're little, but we're a strong population.

Although study participants shared experiences where a thriving community was created from similar identities, participants in the study mainly shared instances where exclusion and silencing of one's voice were experienced because of differences in identity. Each study participant experienced instances of being excluded or silenced along the journey to becoming a STEM teacher in their TPP. The following are the shared experiences significant to this subtheme.

Marvin, whose "host teacher was a white cis-heterosexual man," left them "fully unequipped" as a Black queer STEM teacher. Not only was Marvin unable to "be [their] full authentic self," Marvin felt excluded and silenced in a space that Marvin described as "wasn't mine to own." Marvin further described the exclusion and silencing they experienced with the host teacher by sharing, "I found myself trying to adopt the system that he had in place, and [it] wasn't working because [it] wasn't built for me. [It's] not going to work for me. But that's the only model that I had." Beyond Marvin's experience with their host teacher, Marvin also shared encounters with non-Black teachers in their TPP:

> I would be asking questions [with certain instructors]. And like I said, that philosopher identity, I'm always thinking. So, when I would be asking questions like, "How do we do that? Because I'm trying to get that? What's the pathway? What are some models?" Consistently they would not show up with examples or not do the research, or find out themselves... Instead, their responses would be, "Oh, yeah, that's an interesting point," or, "Let's try to see if we can figure something out." And then it would be a never-ending cycle of asking me, "Oh, did you ever get that?" I believe their initial reaction is to silence us or not hold what we have [to say] as valuable, or not take [what we contribute] that seriously.

Like Marvin, Minnie and BPRS experienced practices of exclusion with non-Black professors in her TPP. Given that BPRS had "maybe two Black professors" the entire time she was in her TPP, she felt the lack of representation of Black professors was "a problem because the teacher prep program is founded on being a non-biased and non-racist organization." Furthermore, BPRS feels that "being Black plays a large role in the communities and in the

schools that we are serving in." The following is an experience that BPRS shared during the focus group:

> When I'm asking my non-Black professors questions, they're like, "Well, why do you have an attitude when you're asking?" and I respond that I don't have an attitude. I'm just asking a question, and I'm expecting an answer because you are here to teach me and to help mold me to be the best teacher that I can be. And if they don't have an answer, or my question wasn't answered at all, they don't try to find an answer. It felt like they said, "Ignore what you said. It wasn't that important. We're going to move on."

To add to this discussion, each of the study participants felt as though the TPP curriculum was not inclusive of those with identities that aligned with non-dominant culture. According to Marvin, "the preparation work did not give them access, did not give them the tools, did not give them the energy, didn't give them the capacity to really feel capable." Minnie expressed that there were moments she felt "incognito" in the TPP classes. Tyrell responded, "I'll often get discounted… even though I was just as intelligent as anybody else in the room." According to Denise, Marvin, and BPRS, this is because "some of the classes are pointless and so superficial because it wasn't built for us." There was a disconnect between "what [they] did in class and what [they] actually see on a daily basis with Black and brown children." While Marvin agreed with Denise and BPRS, they added they also felt excluded as a "Black Queer STEM teacher" because of the TPP's lack of "preparation available for those with their identity."

Ownership of Agency

Ownership of Agency is the third theme that emerged during the focus groups. This theme reveals the perception that the research participants shared about their agency. From the perspectives shared, the research participants limited their conversations about their agency to

their classrooms. As a result of the limited responses during the first focus group, the researcher adjusted the questioning protocol to attempt to capture more in-depth reflections about agency. The findings reflected in this theme were a combination of conversations from both focus groups.

Ownership of agency. "I encourage more Black and brown students to get into STEM just by me being involved in STEM." This section shares the focus group findings of the fourth emerged theme: Research participants cited limitations to their agency as Black STEM teachers. To support the researcher's understanding about how Black STEM teachers perceive their agency, the researcher felt it was important to interrogate the concept of power in the context of becoming a Black STEM teacher. Research suggests the advantage of creating spaces to interrogate racism aids in understanding agency (El-Amin et al., 2017). During the first focus group, the researcher initiated a discussion about agency by having the study participants "describe the power your identity creates." After reviewing the data from the first focus group, the researcher noticed research responses were surface-level and lacked ownership. As a result, the researcher facilitated an additional discussion during the second focus group to further explore whether study participants perceived being Black in STEM as agentic. To initiate dialogue with the focus group, the researcher posed the question, "What parts of your identity have been agentic in your role of either being a STEM teacher or becoming a STEM teacher?" After coding responses from the two discussions, the data revealed a theme that implied limited agentic power among Black STEM teachers.   Appendix H provides coded responses that correspond to this emergent theme. The following section contains data to support this theme.

Tyrell believes his agency occurs through him, "being a mathematician" because he "encourages more Black and brown students to get into STEM just by [him] being involved in

STEM." Although Tyrell was told that he was "making young mathematicians," he "didn't really understand what that meant until [he] got [his] own classroom… could see them work… and talking about math." That is when he realized that he was "truly making young Black mathematicians." This inspired Tyrell to regularly expose his students to historic STEM scholars, such as Benjamin Banneker and Erika Camacho, each week on the classroom's "Scholar of the Week" bulletin board.

Like Tyrell, Marvin also believes that exposure demonstrates their agency. Marvin described moments where they shared stories of Harriet Tubman's and Matthew Henson's use of science for survival. Although Marvin shared, "through a critical lens…I have a vision. I know what I want; I want my kids to be able to be these critical thinkers and occupy these spaces," he admitted this was an area he was still working through to actualize the potential agency he holds fully.

Initially, Minnie began to share about the agency of a white science teacher, who sparked her interest in science, to affirm her personal agency. After redirection from the researcher, Minnie used private thinking time to critically reflect on her own agency as a Black STEM teacher. Afterward, she, like Tyrell and Marvin, believed her agency lay in exposing her students to books, such as *Ada Twist, The Scientist*. Minnie also shared the daily affirmation that she has empowered her students to lead, "I am a mathematician. I am a scientist. I am not afraid to fail. I will not give up."

Nakeia suggested that vulnerability promotes agency. She believes that intrusive thoughts such as, "I don't get this. I'm bad at this" happen when "an educator doesn't take the time to get into those thoughts or what the students are thinking." Like everyone else, she believes encouraging students through the process is a key factor in demonstrating agency.

In a somewhat similar way, BPRS also believes that vulnerability promotes agency. BPRS is open with her students about being a product of the foster care system. She believes that using her stories of survival helps her to relate to "some of [her] kids because some of them are in foster care." By being open about her past, she is able to encourage them to look beyond their "situation" because "there is a way out," and they can "be better than what someone says."

Denise sees agency through the lens of curriculum implementation.

I came in already knowing certain systems and ways [of] teaching. Let's say, Black students, for example, and certain ways that the curriculum is not going to work. I know my kids. I know how they learn. It's up to you to make that decision to take more time to intentionally plan to get them what they need.

Although the data for this theme shifted from the first focus group to the second focus group, the responses suggest that research participants do not fully understand the magnitude of the agency they possess. The discussions about agency and connecting their social identities to their agency seemed to be the most challenging, as demonstrated by long pauses between responses, shifting power to others, and the use of a lot of filler words, such as "like," and "um" which were removed for the final cycle of the coding process. Furthermore, the findings also reveal noticeable limitations that the research participants place on their agency as Black STEM teachers.

Social Identity Map and Follow-Up Interview Findings

The purpose of the social identity maps in this study was to collect qualitative data to answer research question #1, "How do Black STEM teachers perceive the role of social identity in their teacher preparation experience?" and research question #2, "How do Black STEM teacher candidates engage in critical reflection of social identity in their teacher preparation

experience?" A total of six research participants were invited to one social identity map activity and one independent interview that was held one week apart. The social identity map activity and interviews were conducted with six research participants. The social identity map activity and interviews were led using a video conference platform, allowing research participants the flexibility to participate in a location of their choice. Each of the six focus group participants were consented before participating in the research study.

Data was captured from research participants who independently created social identity maps and shared responses during one independent interview to answer both research questions for this study. Similar to the aim of the research question findings for the focus group, the first research question and second research question was asked to determine how Black STEM teacher candidates collectively and independently perceive the role of their social identities as they matriculate through their teacher preparation program. Both questions were asked to hopefully information about themes of social identity theory from the lens of critical reflection, provide insight into how the themes of social identity theory influenced the collective and independent perceptions that Black STEM teacher candidates have about the role of their group membership during various stages of their teacher preparation program. Furthermore, the research questions provided information on whether critical reflection happens and the impact that individualized critical reflection has on the Black STEM teacher candidate's thinking about their identity, and which theme of social identity has the most impact during the period of critical reflection.

The following three salient themes were derived from the data analysis of the social identity maps and interviews. The data derived helped to answer both research questions.

- Multidimensional Cultural Identity: Research participants perceive their identities as multidimensional and a reflection of their culture.

- Identity Aligned Communities: Research participants cited similar identities as an indicator of a thriving community.

- Ownership of Agency: Research participants cited limitations to their agency as Black STEM Teachers.

Table 7 provides codes corresponding to the emergent themes from the social identity maps and interviews, which are used to address both research questions. The following are the findings of the social identity maps and interviews.

Table 7

Coding and Theme Development for Social Identity Map and Follow-Up Interviews

Theme	Multidimensional Cultural Identity	Identity Aligned Communities	Ownership of Agency
Derived Codes	- Racial Identity - Gender Identity - Sexual Orientation - Religion - Geographic Identity - Role	- Similar Identities and Thriving Communities - Teacher Identities - Teacher Communities - STEM Identities - STEM Communities - Identities influencing communities - Impact of Community - Past Critical Reflection - Present Critical Reflection - Future Critical Reflection	- Role - Power

Social Identity Map and Follow-Up Interview Findings

To understand how research participants perceived the role of their social identity within their community, the researcher looked for evidence on social identity maps and listened for reflections during interviews to suggest a connection or relationship between identity, community, and agency. To understand whether critical reflection happens and which theme of social identity has the most impact during the period of critical reflection, the researcher provided each study participant with a social identity map, which is located in Appendix D. During thirty minutes of individual reflection time, participants respond to three main questions: "Who am I?" "While in my Teacher Preparation Program, where did I belong? Who were my people?" "How can your identities, with the help of your community, influence your work as a STEM teacher?" Following, study participants were prompted to use symbols to signify contributions or detractions within the STEM community and use lines to demonstrate connections between their identities, communities, and agency. The following questions were used to derive at the findings of the social identity maps:

- What is in the social identity map that supports or reinforces what was learned from the focus groups?

- What is in the social identity map that contradicts what was learned during the focus groups?

- What is the hidden meaning behind contradictions or missing information?

To better understand the impact that individualized critical reflection has on the Black STEM teacher candidate's thinking about their identity, the researcher conducted individual interviews with each research participant. During each interview, research participants were asked, "What is it about your identities that have created a sense of belonging in the communities

you identified?" Participants were also asked to clarify symbols and connections noted on their social identity maps. Finally, research participants were asked, "What additional information do you have to share about your identity as a Black person in STEM that I have not asked and you feel it is necessary for me to know?" The following data are the findings from the social identity maps and the independent follow-up interviews.

Multidimensional Cultural Identity

This section shares the findings from social identity maps and independent follow-up interviews with study participants, whereas research participants perceived their identities as multidimensional and a reflection of their culture. It is worth noting that the research findings do not suggest the TPP neither added to, nor lessened the identities of the research participants. The researcher coded six interview transcripts and analyzed six social identity maps to conclude the findings that follow. The following summaries, along with Table 8, provide data corresponding to the significant findings about the perceptions research participants have about their identities.

During the interviews, study participants verbally reflected on their identities and the relationship between their identities and their communities. However, during the social identity maps, research participants visually represented their critical reflections. Marvin shared how their identities intersect and support the communities to which he belongs. Marvin discussed and visually represented their identities of being Black, queer, philosopher, scientist, and teacher within their communities of belonging with students, teachers, and Black folks.   Marvin's social identity map was more revealing because it revealed Marvin's perceptions that their identities are assets that contribute to each community they belong.

> …because all of them [identities] are so present and they're just so intrinsic within me, like they are my nature. Like. And those spaces I'm occupying within that community is because of those facets of myself…and because I'm being so vulnerable and willing to share those identity markers with those people is how I build community with them. So with my students, them knowing that I'm a Black queer person gives them a different perspective of what the world around them looks like and it helps them envision it differently. How do Black queer people exist in this space? How do I exist among Black

queer folks? How do I exist among Black scientists and Black teachers and philosophers? How do I belong in those spaces? I think that me being really present and vulnerable and willing to not only share, but like teach about my identities within those spaces of like fellow teachers and other students and even viewing myself as a student.

While Minnie highlighted her identities and how they contributed to her communities, she also shared the perception of her identity as a Black woman in STEM, having a negative impact on her TPP. Minnie's social identity map revealed her identities of competitive, [City E, USA], and creative influence her membership with family and friends, while [City E, USA] and being a Black woman impact her membership with a community of host teachers. Minnie discussed her identities of being competitive, from the [City E, USA], a Black woman, and creative within the community with her host teacher in addition to communities with her peers, family, and friends.

I was disappointed because I wanted to teach STEM in secondary education…I applied to be a secondary education… I was told it was because I did not pass the TPP created math test… but they didn't tell me by how many points… I didn't give any feedback… and they just put me in elementary. Who said I want to teach elementary? …I eventually do want to teach secondary education in math and science. But I also. want to advocate for Black educators to be in secondary math and science because if the program is geared towards getting Black educators and then it is a small percentage of us in secondary math and science, and you're not trying to help them get there…I wasn't the only person from my cohort who applied for secondary math specifically and didn't get in. And we were all Black as well…why wouldn't you do just like you do for Praxis? give us a second chance to pass the test…Because you said you liked my presentation when I presented it for the

interview… if saw that I was able to teach you the Pythagorean theorem, which is secondary math, then why, if I didn't pass the test, why not give me feedback and try to give me another chance to do that?

Denise shared the connections between her identities as Black, woman, Christian, and author with her communities at church, with family, and with the secondary math cohort. Denise's social identity map demonstrates the impact her identities as Black and woman have on her community membership with friends and church family. She also revealed how her membership with her church family is influenced by her Christian identity. However, her social identity map does not demonstrate how her identities as an author and dancer/passionate about the arts connect with any of her communities. During the interview, Denise shared how she felt a sense of belonging to the focus groups, "I enjoyed it [being in the focus group] like even last week when I didn't have a voice. And being able to speak. Now you can hear the passion behind everything I was typing and saying in chat."

Tyrell elaborated on the relationship between his identities and his communities during his interview, but was limited in his response when mapping it on his social identity map. Tyrell's social identity map listed identities as Black, smart, young, gamer, and passionate while revealing they are perceived as assets. On the other hand, Tyrell does not visually represent the impact those identities have within the communities he perceives he had group membership. For Tyrell, his interview was more revealing. He believed that being a Black male in STEM created small community connections with "other Black males in STEM from [his TPP]." While he considers his identities as affirming his belonging in his school community, "I work at a predominately black school, so I don't really have the struggles" he shared how his identity has created some moments of because he is in a "woman dominated field and a woman dominated

building." Nevertheless, the discomforts that Tyrell mentioned are overshadowed by the interactions he has with his students, thereby revealing additional identities.

> …black mothers are often present in homes, but black fathers are not. So when kids see us [Black males], it's conflicted feelings. A lot of times they want our [Black males] attention, but they don't ask for it, they act out or they say things, or they do things that will warrant our attention because they don't know how to actually establish that connection with another Black male. That makes teaching the content so much harder when you have to actually put on a dad hat … and give the student special treatment. You have to attend to their needs more in those moments, just to keep the class moving along. It is not that I value those students more than my other students. It's just he's really demanding the attention more.

Nakeia discussed her identities of being Black, female, funny, educator, and mathematician and the impact of those identities in the communities she identified: being with Blacks, comedians, and nerds. Nakeia also visually represented these identities while offering a visual critique of her identities. Although she did not list a STEM community on her social identity map, Nakeia reported feelings of acceptance and belonging with the STEM community while speaking comparatively about herself within the space of STEM, suggesting she is in STEM spaces with, "white male faces… and black females … like Katherine Johnson." Nakeia used a symbol to indicate she perceives her identity of funny as having a negative impact on her community. During her interview, she further explained this was due to her always being "silly" and "getting on [her] teacher's nerves at the wrong time."

During the interview with BPRS, she spoke about her identities of being Black, dweeb, young, educated, and a woman in communities with Black people, foster care, and science/IT.

She shared her journey into science and reflected on her teaching community with her adoptive mother, who is also a teacher, although this was not noted on her social identity map. Her social identity map indicated her perception of her identities being assets to her communities. For example, she thought that her identities as Black, educated, and woman had a positive impact on being in a community in science/IT. She perceived that her identities as Black and youug had a positive impact on her community membership with foster care. Finally, BPRS also believed that her identity as Black had a positive influence on her community membership with Black people.

Table 8

Alignment of Conceptual Framework to Emerged Themes from Research Findings

Social Identity Theory Framework	Social Categorization	Social Identification	Social Comparison
Researcher's Conceptual Framework	Identity	Belonging	Agency
Researcher's Themes	Identity creates the capacity to educate and learn from others.	Identity offers assets that create a sense of belonging.	Identity as a Black STEM Teacher produces a position in the community that liberates.
Researcher's Themes in alignment with Black STEM teacher experience in their teacher preparation program	Identity offers a capacity to educate and learn from others	Belonging within a community produces assets to offer others	Position as a Black STEM teacher in the community ensures academic equity for all.
Emerged Themes from Research	Theme 1: The role of identity is altruistic. Theme 2: Identity creates an illusion of hierarchy that privileges those with dominant identities. Theme 5: Identity is multidimensional and reflects one's culture.	Theme 3: A similar identity is an indicator of a thriving community.	Theme 4: There is a perception of limited agency among Black STEM teachers.

Note. This table aligns critical reflection with the three components of social identity and the five themes that emerged from this study's research.

Identity Aligned Communities

The theme of Identity Aligned Communities also emerged during the social identity map activity and follow-up interviews. Like the focus group data findings, this theme revealed the experiences of the research participants when they are in a community with others who share similar cultural identities. The social identity maps provided an opportunity for research participants to illustrate the connections between their identities and communities while also showing the impact of their presence within their community through their agency.

This section shares social identity map findings, whereas research participants cited similar identity as an indicator of a thriving community. Similar to the focus group findings, an analysis of each social identity map suggested a connection between the identities of research participants and the communities they perceive group membership. For example, the social identity map findings implied that community is fluid and similar identities produce a thriving community; however, there was the emergence of a third subtheme. Although similar identities produced a thriving community, thriving teacher communities were formed from non-teacher and non-STEM identities. Figure 3 contains social identity map responses from BPRS. Denise's social identity map responses are in Figure 4. The social identity map responses for Marvin are in Figure 5. Figure 6 is Minnie's social identity map responses. Nakeia's social identity map responses are in Figure 7. The social identity map responses for Tyrell are in Figure 8.

Figure 3

Social Identity Map Responses for BPRS
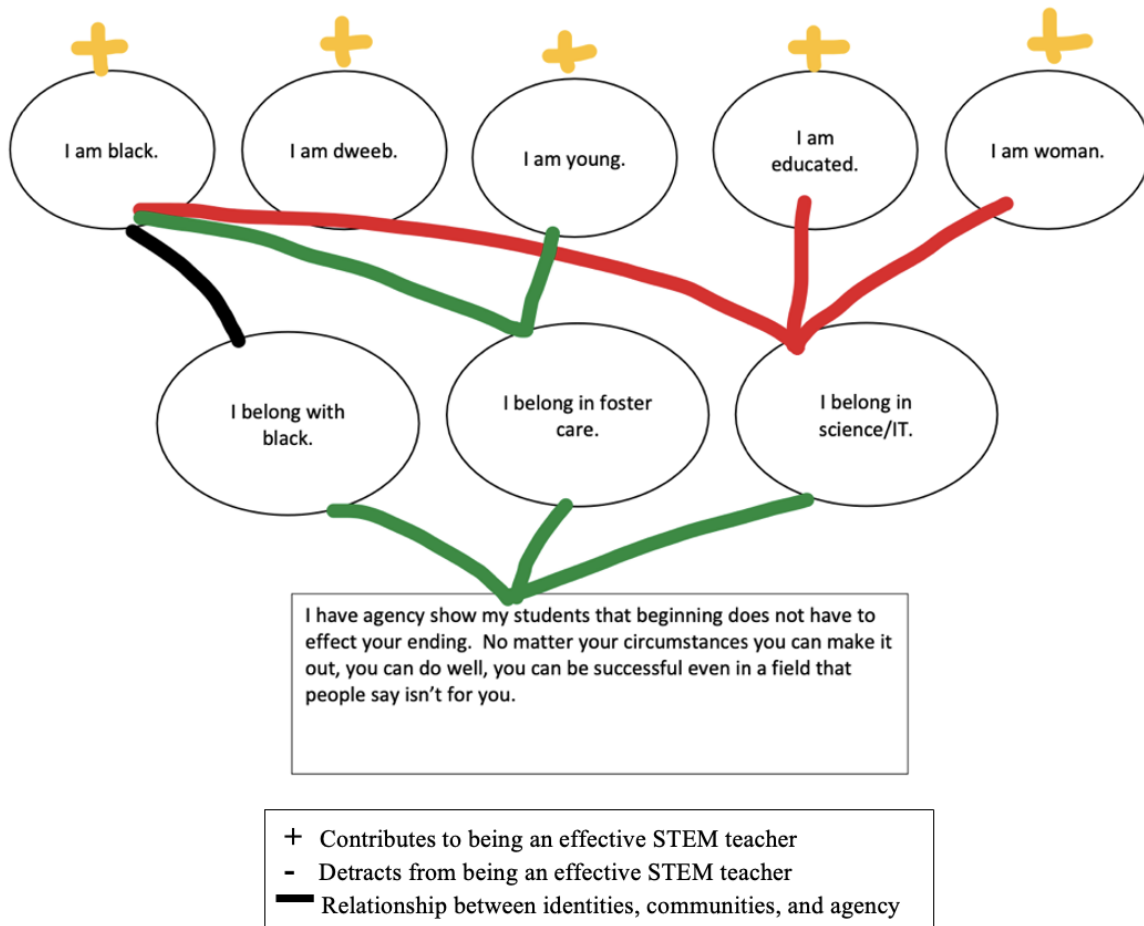
I am black. **I am dweeb.** **I am young.** **I am educated.** **I am woman.**

I belong with black. **I belong in foster care.** **I belong in science/IT.**

I have agency show my students that beginning does not have to effect your ending. No matter your circumstances you can make it out, you can do well, you can be successful even in a field that people say isn't for you.

+ Contributes to being an effective STEM teacher
- Detracts from being an effective STEM teacher
▬ Relationship between identities, communities, and agency

Note. Research participants were provided a social identity map to engage in independent critical reflection about their identity. They began by naming their identities, followed by the communities where they feel a sense of belonging, and finally, one goal they have the power to change. A plus sign is used to demonstrate assets to being an effective STEM teacher, a minus sign is used to demonstrate an identity or community that detracts from being an effective STEM teacher, and lines are used to represent the relationship between identity, community, and area of influence.

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Figure 4

Social Identity Map Responses for Denise

Note. Research participants were provided a social identity map to engage in independent critical reflection about their identity. They began by naming their identities, followed by the communities where they feel a sense of belonging, and finally, one goal they have the power to change. A plus sign is used to demonstrate assets to being an effective STEM teacher, a minus sign is used to demonstrate an identity or community that detracts from being an effective STEM teacher, and lines are used to represent the relationship between identity, community, and area of influence.
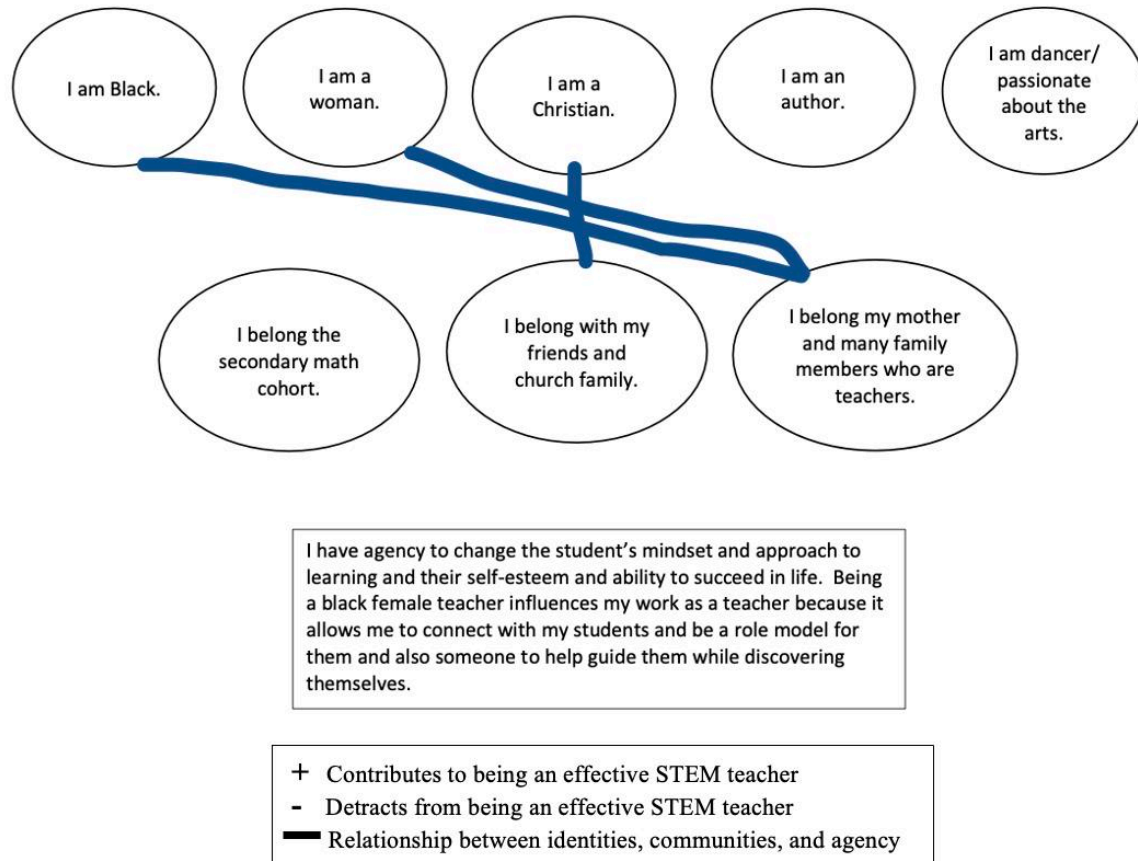
Figure 5

Social Identity Map Responses for Marvin

Note. Research participants were provided a social identity map to engage in independent critical reflection about their identity. They began by naming their identities, followed by the communities where they feel a sense of belonging, and finally, one goal they have the power to change. A plus sign is used to demonstrate assets to being an effective STEM teacher, a minus sign is used to demonstrate an identity or community that detracts from being an effective STEM teacher, and lines are used to represent the relationship between identity, community, and area of influence.

Figure 6

Social Identity Map Responses for Minnie

Note. Research participants were provided a social identity map to engage in independent critical reflection about their identity. They began by naming their identities, followed by the communities where they feel a sense of belonging, and finally, one goal they have the power to change. A plus sign is used to demonstrate assets to being an effective STEM teacher, a minus sign is used to demonstrate an identity or community that detracts from being an effective STEM teacher, and lines are used to represent the relationship between identity, community, and area of influence.
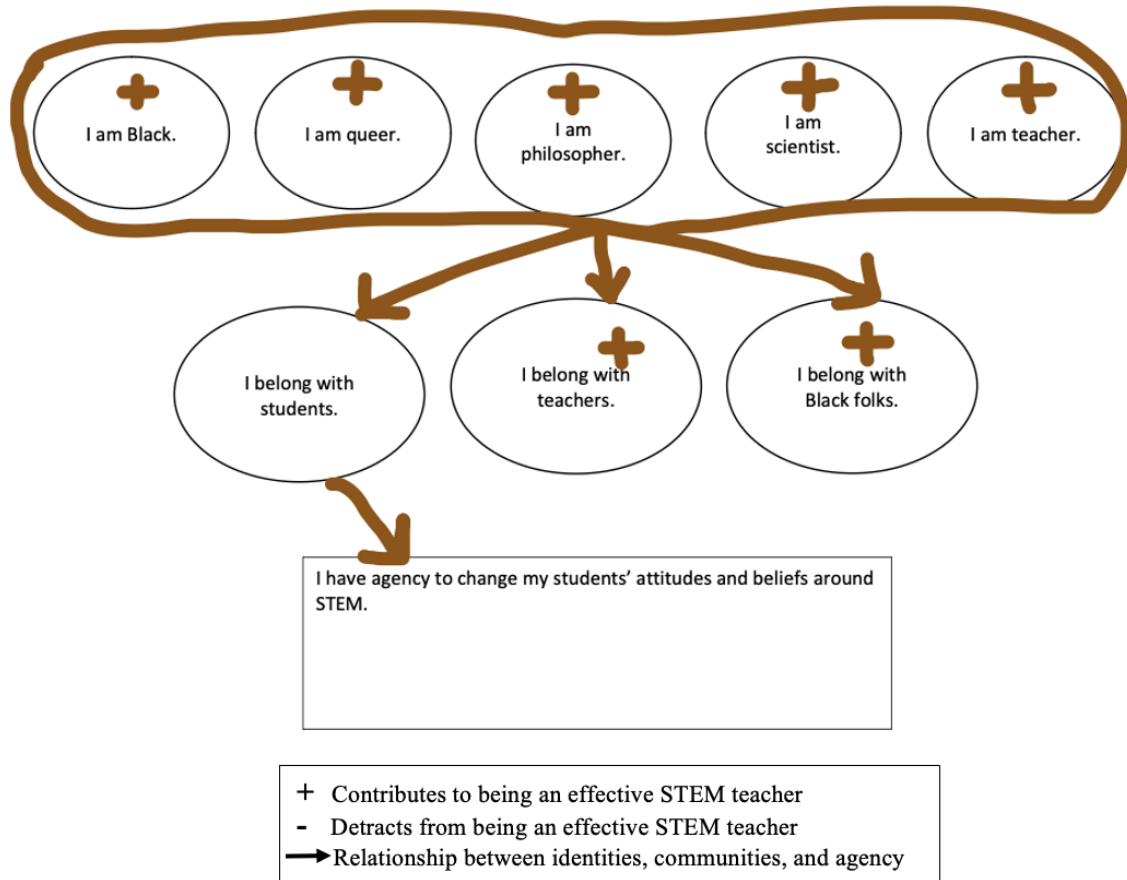
Figure 7

Social Identity Map Responses for Nakeia
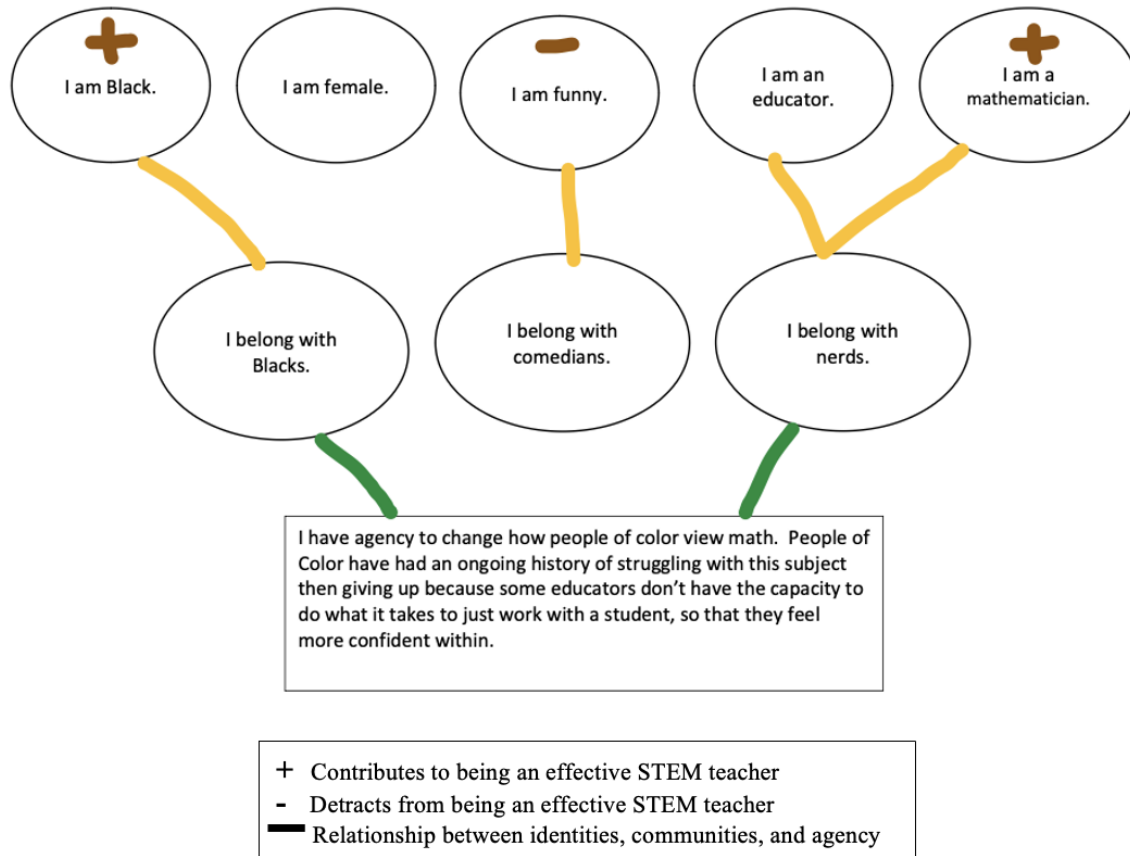
Note. Research participants were provided a social identity map to engage in independent critical reflection about their identity. They began by naming their identities, followed by the communities where they feel a sense of belonging, and finally, one goal they have the power to change. A plus sign is used to demonstrate assets to being an effective STEM teacher, a minus sign is used to demonstrate an identity or community that detracts from being an effective STEM teacher, and lines are used to represent the relationship between identity, community, and area of influence.
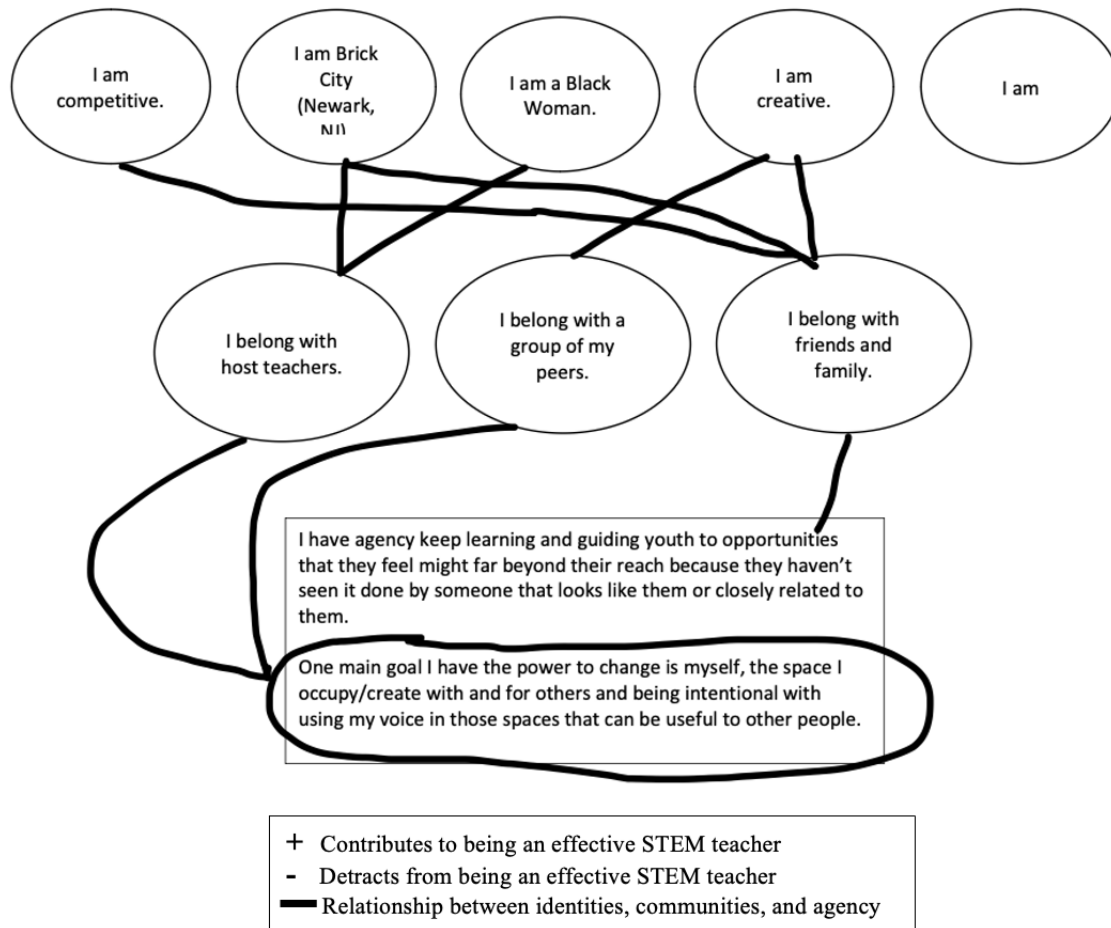
Figure 8

Social Identity Map Responses for Tyrell

Note. Research participants were provided a social identity map to engage in independent critical reflection about their identity. They began by naming their identities, followed by the communities where they feel a sense of belonging, and finally, one goal they have the power to change. A plus sign is used to demonstrate assets to being an effective STEM teacher, a minus sign is used to demonstrate an identity or community that detracts from being an effective STEM teacher, and lines are used to represent the relationship between identity, community, and area of influence.
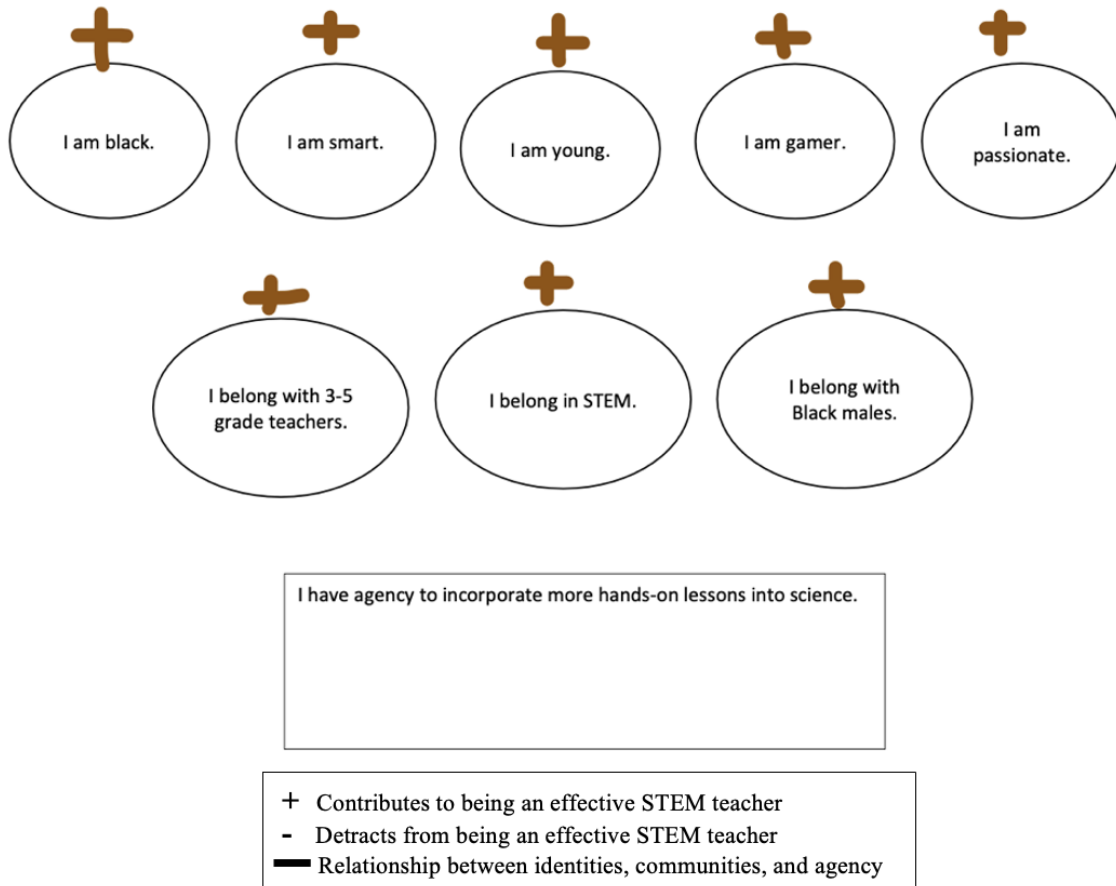
The following are the findings of the social identity maps that demonstrated the relationship between teacher identity and teacher-related communities. Based on the data, Marvin was the only research participant to identify as a "teacher," while also noting they felt a sense of belonging "with teachers." Tyrell, Minnie, and Denise omit "teacher" as their identity, but indicate they perceive a sense of belonging to "3-5 grade teachers," "host teachers," and "teachers," respectively. Although Nakeia noted one of her identities was an "educator," she did not perceive a sense of belonging in a teacher-related community. On the other hand, BPRS did not identify as a teacher or indicate a sense of belonging to a teacher community.

An analysis was done to interrogate the relationship between STEM identity and STEM-related communities. Nakeia and Marvin both indicated an identity in STEM. Nakeia listed one of her identities as a "mathematician," while Marvin listed one of their identities as a "scientist." Yet, neither suggested those identities resulted in a sense of belonging in STEM. Neither Tyrell nor Denise indicated an identity in STEM, but they both indicated a sense of belonging to a STEM-related community. Tyrell indicated a sense of belonging to "STEM" whereas Denise indicated a sense of belonging to "the secondary math cohort." Neither BPRS nor Minnie disclosed either a STEM identity or a sense of belonging in a STEM-related community.

The researcher studied the social identity maps to look for evidence of independent critical reflection among research participants. The following data suggests Black STEM teachers engage in critical reflection about their social identities. The social identity maps for each study participant indicated they engage in some degree of critical reflection about their social identities. Nakeia, Tyrell, BPRS, and Marvin used symbols to signify reflection about their past. Tyrell, BPRS, and Marvin used symbols to denote the identities that contribute to their ability to be effective STEM teachers, while Nakeia used symbols to suggest her identity

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both contribute to and detract from her ability to be an effective STEM teacher. Nakeia, BPRS, Marvin, Denise, and Minnie represented the relationship between their identity, communities, and agency. Everyone discussed agency as a goal that they have the power to change.

Further examination of the social identity maps both affirmed the aforementioned data as well as revealed contradictions in data from focus groups. For example, during the focus group discussions, Marvin, Nakeia Minnie, and BPRS discussed a shared sense of belonging to STEM communities when discussing their undergraduate experiences, but failed to express a sense of belonging to STEM during their social identity map activity. Marvin shared that he has an undergraduate degree in "Earth Science." Nakeia shared that she has an "undergraduate degree in mathematics." Minnie shared that she has an "undergraduate degree in science… and was the smartest in science and math." BPRS shared that she had "Associate, Bachelor, and Master degrees in IT." In addition to mentioning their degree, Marvin, Nakeia, Minnie, and BPRS discussed their community affiliation with those STEM fields. While Tyrell did not indicate a STEM identity, he did share a sense of belonging to a STEM community. During the focus group discussions, Tyrell also shared that he was "two classes away from having a dual degree. That degree was biomedical science." Based on the discussions held during the focus groups, it is possible these contradictions exist because research participants expressed a perception of harm in their undergraduate and TPP STEM spaces because of their identities in STEM and STEM teacher communities.

Ownership of Agency

The social identity maps were also beneficial in confirming and adding to the focus group finding about agency. Independent reflections from the social identity maps about agency suggested that research participants do not understand they have the capacity to take ownership

of their agency. The research participants confirmed their limited thinking on their social identity maps as well as during the independent interviews.

Most of the reflections suggested their agency can change their student's mindsets by using themselves as the standard of excellence. For example, Marvin shared, "I have agency to change my students' attitudes and beliefs around STEM." Similarly, Denise shared,

> I have the agency to change the student's mindset and approach to learning and their self-esteem and ability to succeed in life. Being a Black female teacher influences my work as a teacher because it allows me to connect with my students and be a role model for them…

Nakeia, BPRS, and Minnie shared similar reflections about agency, whereas they believe their agency can change how people believe in the overall ability of marginalized groups. For example, Nakeia responded, "I have agency to change how people of color view math. People of color have an ongoing history of struggling with this subject…" Likewise, BPRS commented,

> I have agency to show my students that the beginning does not have to affect your ending. No matter your circumstances, you can make it out, you can do well, you can be successful even in a field that people say isn't for you.

Additionally, Minnie believes her agency gives her the "power to change herself" while she,

> …keep learning and guiding youth to opportunities they feel might be far beyond their reach because they haven't seen it done by someone that looks like them or closely related to them.

Finally, Tyrell believes his agency affords him the autonomy to "Incorporate more hands-on lessons into science." All in all, each reflection demonstrates the limitations research

participants place on their agency due to a lack of ownership in understanding the full magnitude

of their position as Black STEM teachers.

Summary

Two research questions were answered using qualitative methodologies. The focus

groups provided answers to Research Question 1 and the Social Identity Map and Interviews

provided answers to Research Question 2. The outcomes revealed themes in Table 8, which

suggest the need for Black pre-service teachers in STEM opportunities to engage in critical

reflection about their social identities. The focus groups revealed four salient themes around

identity, belonging, and agency. The social identity map and interviews revealed two salient

around identity and belonging. The implications of the findings and a more detailed analysis are

further discussed.

CHAPTER FIVE: DISCUSSION

Summary of the Study

The purpose of this study was to explore the critical reflections of Black STEM teachers' social identity. In essence, this qualitative exploration into the experiences of Black STEM teachers during their preparation program is to provide insights that will positively contribute to this field of research about Black STEM teachers by illuminating how research participants negotiated their unique identities while thriving at one Historically White Institution (HWI) during their teacher preparation experience. Despite the residual damage of 319 years of cognitive oppression coupled with low expectations about Black people making it too challenging to reimagine a Black person's cognitive worth and abilities, the research participants continue making a difference in the Black community as STEM educators. While this research focuses on the ability to thrive, understanding and elevating the historical context rooted in systemic trauma should not be forgotten. What is most impressive is that this group of Black educators is thriving as marginalized members of a group that is not welcoming of their identities. This study intended to deconstruct negative thinking about Black STEM teachers to contribute asset-based literature about the Black STEM teacher pipeline. Framed by the integration of Tajfel's three-part social identity theory and Freire's critical reflection, an essential dimension of critical consciousness, this study interjects Dumas's critical framework of anti-Blackness to interrogate the Black STEM teacher preparation experience. The following questions were answered by this study:

1. How do Black STEM teachers perceive the role of social identity in their teacher preparation experience?

2. How do Black STEM teacher candidates engage in critical reflection of social identity in their teacher preparation experience?

Using a dialogical approach to qualitative research, the researcher gathered data from semi-structured focus groups, social identity maps, and follow-up interviews with six participants from one alternative certification teacher preparation program (TPP) at an HWI in northeastern America with campuses in three different cities. Following analysis of focus groups, social identity maps, and follow-up interview data, the researcher identified five themes that best described the experiences of the research participants during their teacher preparation experiences. The themes are:

- Multidimensional Cultural Identity: Research participants perceive their identities as multidimensional and a reflection of their culture.

- Identity Aligned Communities: Research participants cited similar identities as an indicator of a thriving community.

- Ownership of Agency: Research participants cited limitations to their agency as Black STEM Teachers.

This chapter applies these themes to address the preceding research questions, provides implications for teacher preparation programs, and addresses future research.

Research Question 1

How do Black STEM teachers perceive the role of social identity in their teacher preparation experience?

Two focus group sessions, one social identity map activity, and one follow-up interview for six research participants were designed from the lens of a culturally responsive researcher and structured so that there were opportunities for the power to shift from the researcher to the

research participants, which supported the exploration of Black STEM teachers' experiences during their teacher preparation program at an HWI. Therefore, the sessions were semi-structured and utilized a video conferencing platform, which allowed flexibility and privacy. Three themes emerged from the conversations, which this study discusses in the following sections.

Multidimensional Cultural Identity – Blackness is Altruistic

Each participant indicated they perceived their role of their racialized identity as Black as altruistic and influencing their role as a STEM teacher. For each research participant, becoming a Black STEM teacher allowed them to give back to the Black community unselfishly. Their actions support studies suggesting altruism occurs most among people with similar identities (Dent, 2005). There were examples of benevolence and selflessness rooted in their responses that connected their social identities to their motivation to become a teacher, as well as ongoing kindness towards their students once they entered the TPP. This finding is significant because research participants described altruism in the context of being "help" for others together with times when they "needed help" for themselves.

Research participants silently implied that STEM lacks Black identity due to a lack of access and exposure to STEM among K-12 students. They openly shared the value in diversifying the STEM field. The subtle hint and candid statements were extracted from responses that suggest they became STEM teachers to "help," "empower," and "model perseverance" for students who look like them. Further unpacking of their altruistic responses suggests that research participants perceive that an education in STEM fulfills a need in the Black community. Although not explicitly stated, there is an indication that they collectively regard STEM education as elite, highly selective, and exclusive. It is likely that this is among

the many instances of lingering damage from generations of deficit discourse and thinking about the cognitive abilities of Black students. Today, systemic practices still exist that attempt to weed out and deny Black students access to advanced math and science courses. Therefore, the altruistic nature of research participants seeks to undo systemic structures that reject Black students in STEM. It is worth noting that research participants were altruistic in unideal situations. Their desire to help, empower, and demonstrate perseverance happened when they needed someone to help, empower, and model perseverance for them as a preservice teacher. Instead, they acted selflessly, denying their needs, by independently discovering what was needed for their students. When higher education and K-12 leaders are aware of the altruistic nature of Black STEM teacher candidates, they can help by supporting the creation and enactment of sustainable goals.

Multidimensional Cultural Identity – Illusions of Hierarchy

The illusions of hierarchy described during the focus groups suggested that identity affiliation with the dominant culture grants privilege. Two illusions within multidimensional cultural identity emerged: (a) illusions of hierarchy exist within the African diaspora, and (b) illusions of hierarchy exist between Black people and non-marginalized groups. Based on the data extracted from the focus group discussions, some instances occurred in K-12 and higher education settings. Although research participants did not mention specific policies during the focus groups, there is evidence to suggest that the illusions of hierarchy manifest in academia. It manifests as structural practices that are allowed to exist through the negotiation of marginalized identities or carrying out practices that Black teachers actively work to dismantle through decolonizing actions (Bang & Marin, 2015; Carlton Parsons et al., 2011; Ladson-Billings, 1994; Malcom & Feder, 2016; McGee, 2020; Russo-Tait, 2022; Vakil & Ayers, 2019).

Black American STEM students often have less-than-ideal experiences in STEM courses before college. At the same time, Black American STEM students are also at an increased risk of having decreased self-efficacy in STEM (Packard & Fortenberry, 2016). When biases, stereotypes, and deficit ideologies persist and are left unchecked, they suppress the advancement of Black people in STEM education. Somehow the thought of American Black STEM students continues to be tainted with and overruled by deficit narratives, whereas the American Black STEM student is portrayed as incapable. This type of thinking is dangerous because it gives the oppressor an upper hand and mentally defeats the oppressed. Nevertheless, the research participants shared stories of resilience through their experiences where there were perceived illusions of hierarchy. Instead of embracing the mental oppression from the perception that they were subpar, they overcame the oppression by graduating with STEM degrees and addressing illusions of hierarchy that attempted to persist in their classroom community.

Identity Aligned Communities

Overall, this theme elicited rich dialogue during both focus groups. The findings suggest that community is fluid, and identity creates a sense of belonging or exclusion within the defined community. When there is a greater alignment of identities, there is a stronger sense of belonging, thus the creation of a thriving community. In the same way, when identities are misaligned or different, practices that exclude and silence the Black STEM teacher's voice are more likely to occur (Burson & Godfrey, 2019; Hildebrandt & Trüdinger, 2021). Ironically, study participants suggested that community was an essential theme; however, it was a space in which they experienced the most rejection. Although the study participants discussed accounts of harm within their academic community as being Black in STEM, they did not suggest that these negative experiences prevented them from providing STEM instruction to their students.

They often spoke about perseverance and altruism, as previously discussed in the section on altruism. Given these points, the data suggests that community is fluid, with a heavy reliance on similarity in identity for it to thrive.

TPPs must be attentive to the intersections of a preservice teacher's identity when developing systems and communities that influence educational outcomes (Buchanan-Rivera, 2022; McGee, 2013). Often, TPPs and K-12 schools unknowingly create communities of harm by assigning Black preservice teachers to mentors (i.e., host teacher, cooperating teacher, instructional coach, mentor teacher) solely based on role similarity. When there are cultural mismatches, especially racial mismatches, Black STEM teachers must either become bicultural or raceless to not appear adversarial in the community the TPP created (Fordham, 1996; McGee, 2013).

The expectation of being bicultural places a heavier burden on the Black STEM preservice teacher to be proficient in their native culture and the dominant culture of their mentor. Aside from feelings of being an outsider in that space, the Black STEM teacher must determine which parts of their cultural identity they must negotiate and shamelessly hide because it is not welcomed. However, when Black STEM preservice teachers choose to reject the notion they should be bicultural or raceless, they are often mislabeled, seen as troublemakers, and risk dismissal from their TPP for not being a good fit for the program. Often, such deficit thinking and dehumanizing ideologies are rooted in identity threats, which seek to ignore identities that do not align with or subscribe to dominant culture and colonized thinking (Buchanan-Rivera, 2022; McGee, 2019; Packard & Fortenberry, 2016). On the other hand, research participants shared prospering experiences when placed in community with others with similar cultural identities.

Leaders of TPPs and K-12 settings can create communities of belonging by reconsidering the matching of preservice teachers and mentor teachers.

Ownership of Agency

Research participants perceive their agency as restricted to the Black STEM teacher's classroom. When discussing agentic moments, research participants only spoke about agency in terms of what they could do independently and disregarded their communities for support. Although research participants recognized agency through encouraging words, presence, and sharing stories, their responses also lacked references to suggest they have taken ownership necessary to realize their position within the dominant culture and privilege to actualize liberation within STEM (Cohen, 2011; El-Amin et al., 2017; Godfrey & Wolf, 2016; Goodkind et al., 2020; Jemal, 2017; McDonough, 2009; Vezzali et al., 2015; Windsor et al., 2018).

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Research Question 2

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How do Black STEM teachers perceive the role of social identity in their teacher preparation experience?

Two focus groups, one social identity map and one follow-up interview for six research participants were designed to support the researcher's culturally responsive researcher lens by humanizing the research participant experience. Providing a social identity map and asking semi-structured questions during the focus groups and follow-up interviews allowed research participants to have their voices heard while talking about their identities and experiences in a safe and supportive environment. Three themes provided findings on how Black STEM teachers independently critically reflect on their social identity. The following is a discussion of the three themes.

Multidimensional Cultural Identity

All research participants viewed their identities as complex, fluid, and not something static. Responses during the follow-up interviews affirmed their multi-faceted perceptions about identity and contributed to the researcher's understanding of the research participants' perceptions about the role of critical reflection. As previously discussed, research participants acknowledge their cultural identities as significant during their teacher preparation experience. Instead of seeing their teacher preparation experience as adding value to their identities, research participants maintained their original identities during and after their teacher preparation program experience. In essence, the TPP had no impact on the identities of the research participants. Since culture is a big part of research participants' social identity, and they perceive their identities as cultural, their multidimensional cultural identities became a prominent factor within their communities for representation and problem-solving (Aldana et al., 2012; Gutiérrez, 1995; Mathews et al., 2019; Yee, 2005).

Knowing how multidimensional cultural identities supported the Black STEM teachers from this study during their teacher preparation experience can be helpful to assist leaders in higher education and K-12 schools in designing program experiences that contribute and add value to the identities of program participants. Understanding identity involves understanding the core of knowing who you are, similar to understanding the nature of a tree. Like trees, each person also has historical roots. Historical roots carry prior generational experiences related to one's culture. In the case of this study's research participants, their historical roots are grounded in historical traumas related to Blackness, particularly anti-Blackness, in explaining how Black people became marginalized, disregarded, and disdained in schools, especially in STEM education. Moreover, the historical roots encompass the afterlife of oppression influenced by the

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cultural values of dominant culture (Dumas, 2016; Dumas & Ross, 2016; Wynter, 1989). Yet,
these roots still provide the underpinning and vigor needed to branch out into the real world to
shape cultural identities (Nevzlin, 2019).

Historical roots are a part of the Black STEM preservice teacher's identity. Since
historical roots cannot change, historical roots are embraced as cultural identities. Having this
type of connection to one's roots provides assurance of self and an understanding of and
connection to what makes us who we are. When cultural identities are carried into the teacher
preparation spaces, it influences decision-making and interactions with others (Brown, 2017).
Because identity is fluid and complex, it will be helpful to provide opportunities for Black STEM
preservice teachers to critically reflect on their social identities in a way that promotes (a)
individual connection to and understanding of one's historical roots, (b) flexibility to choose
cultural identities, and (c) understanding the magnitude of the intersectionality of cultural
identities to create liberation in STEM education. Although there is value in providing time for
Black STEM teachers to engage in independent critical reflection, creating a space for shared
critical reflection can create a sense of belonging that enhances the value of the many facets of
the cultural identities represented within the group.

Identity Aligned Communities

Overall, the theme of community emerged as a significant component of the teacher
preparation experience for Black STEM teachers. Similar to the discussion about the focus
group findings, research participants collectively shared positive outcomes because of being in a
homogeneous community and adverse outcomes when in heterogeneous communities. However,
the individual critical reflections exposed additional ways research participants delineated
identities necessary for a thriving community. Despite research participants indicating they felt a

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sense of belonging to teacher and/or STEM communities, most neglected to cite "teacher" or "STEM" as part of their identity. Instead of embracing "teacher" and/or "STEM" as part of their identities, research participants acknowledged cultural identities as contributing attributes of their communities. Nevertheless, research participants' perceptions about the assets they have to offer others contributed to creating a sense of belonging within the community (Watts et al., 2011; Watts & Hipolito-Delgado, 2015). This finding continues to support the importance of assigning preservice teachers to mentor teachers based on their cultural identities as opposed to role identity similarity.

Ownership of Agency

The research participants perceive the role of social identity as placing limitations to their agency. Research participants were limited in their abilities to conceptualize agency beyond their classroom and, therefore, unable to imagine how to actualize the agentic powers they have as Black STEM teachers. As they reflected on their pre-service teacher preparation program experience, they lacked describing instances where the teacher preparation program required them to use their agency. For each of the research participants, the idea of agency beyond the classroom or being a model for others seemed taboo and unobtainable.

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Alignment to Research and Literature

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The following section aligns the study findings with the research and literature on the conceptual framework for this study. The conceptual framework for this study is grounded in the social identity theory from the lens of critical consciousness' component of critical reflection. Within the social identity theory, three processes create a pathway to explore in-group and out-group relationships: social categorization, social identification, and social comparison. Using the prior alignment of social identity theory with critical reflection in Figure 1 and Table 1, Table 8

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contains an alignment of the study's conceptual framework to the study's findings. The

following, along with Figure 9, aligns the study's findings with the conceptual framework.

Table 8

Alignment of Conceptual Framework to Emerged Themes from Research Findings

Social Identity Theory Framework	Social Categorization	Social Identification	Social Comparison
Researcher's Conceptual Framework	Identity	Belonging	Agency
Researcher's Themes	Identity creates the capacity to educate and learn from others.	Identity offers assets that create a sense of belonging.	Identity as a Black STEM Teacher produces a position in the community that liberates.
Researcher's Themes in alignment with Black STEM teacher experience in their teacher preparation program	Identity offers a capacity to educate and learn from others	Belonging within a community produces assets to offer others	Position as a Black STEM teacher in the community ensures academic equity for all.
Emerged Themes from Research	Theme 1: Identity is multidimensional and reflects one's culture.	Theme 2: A similar identity is an indicator of a thriving community.	Theme 3: There is a perception of limited agency among Black STEM teachers.

Note. This table aligns critical reflection with the three components of social identity and the

five themes that emerged from this study's research. This table is a duplicate table from an

earlier section in this chapter.

Social Categorization – Identity

Social categorization, or identity, is the first component of the social identity

theory. Critical reflection results in recognizing self-identities during social categorization,

thereby forming social groups. As a result, the identities of group members inform the formation

of social groups, resulting in an "us" versus "them" mindset (Tajfel & Turner, 2004). Social

categorization from the lens of critical reflection draws attention to how one has the capacity to educate and learn from others based on their identity. The following is a discussion of the emerging themes that align with the conceptual framework component of Social Categorization – Identity.

Multidimensional Cultural Identity – Altruism. The emerging subtheme of altruism explains how research participants perceive the role of their social identity. Altruism aligns with research on structural-historical thinking styles. A structural-historical thinking style stimulates reflection on injustices and oppression among marginalized groups. As a result, group members acknowledge similar identities, which result in shared outcomes that collectively work to resist injustices. (Burson & Godfrey, 2020; Cortland et al., 2017). Evidence of this alignment occurred during focus groups when research participants shared stories about using their identity as a Black teacher in STEM to disrupt the perceptions about who is the holder of knowledge in STEM. Therefore, research participants were able to be "the help" for traditionally marginalized students, despite needing help themselves.

Multidimensional Cultural Identity – Illusions of hierarchy. Illusions of hierarchy align with the research on socially constructed systems of hierarchy that intersect and result in oppression, domination, and discrimination (Nash, 2008; Robinson, 2017). This subtheme also aligns with research that suggests social identity can create a status of privilege while oppressing traditionally marginalized groups (Robinson, 2017). Alignment was demonstrated during focus groups in conversations about illusions of hierarchy between dominant and non-dominant races and within the African diaspora within academia.

Multidimensional cultural identity. Identity is multidimensional and aligns with the individual's culture is an emergent overarching theme that aligns with research on

intersectionality, which affirms multiple identities of individuals and how they intersect with privilege and the oppressor-oppressee dichotomy. (Crenshaw, 2017; Jemal, 2017). Alignment of Theme #5 and this research was evident from the interview responses of the research participants when they shared how the intersectionality of their identities creates a sense of belonging in their communities. Furthermore, alignment was also supported by social identity map responses about identity.

Social Identification – Belonging

Social identification, or belonging, is the second component of the social identity theory. During social identification, one identifies as a member of a social group, creating a sense of belonging. Group membership informs behaviors, and group members work to boost their self-esteem (Tajfel & Turner, 2004). Social identification from the lens of critical reflection emphasizes one's perceptions about the assets they have to offer others in the community, where they perceive a sense of belonging (Watts et al., 2011; Watts & Hipolito-Delgado, 2015). The following section discusses how similar identities supporting a thriving community align with the Social Identification – Belonging component of this study's conceptual framework.

Identity-aligned communities. "Similar identities support a thriving community" aligns with research on solidarity and social support. Solidarity is achieved through identity alignment within in-group membership resulting in accomplishing goals (Burson & Godfrey, 2020). Social support relies on identity alignment within communities of belonging that creates access to fellow in-group members who function in a higher status, such as a mentor (Diemer, 2009; Jemal, 2017). The alignment of theme #3 and the research on solidarity and social support was apparent during focus group discussions about sharing similar identities with TPP instructors, host teachers, and content directors.

Social Comparison – Agency

Social comparison, or agency, is the third and final component of the social identity theory. During social comparison, there is a comparison between group membership, whereby in-group members recognize how their identity and group membership have created agency to elicit and evoke liberation (Tajfel & Turner, 2004). Research on social comparison from the lens of critical reflection demonstrates how position as a Black STEM teacher in the community ensures educational equity (McGee, 2020). The following section discusses the alignment of the theme of agency being limited among research participants.

Ownership of agency. Research participants perceive limitations to their agency as Black STEM Teachers. This theme aligns with research on critical reflection and agency. Providing opportunities for teachers to engage in critical reflection causes critical examination of one's position and power while creating an opportunity to reflect on ways to deconstruct systems of oppression (Cochran-Smith & Lytle, 1993; Robinson, 2017). Research on agency suggests it occurs along a continuum that begins with practical, ethnic consciousness and results in problem construal that promotes liberation (Gutiérrez, 1995; Longres, 1982; Padilla, 1985; Parsons, 1991). Evidence of alignment to these studies occurred during focus group discussions and the social identity map activity. Dialogue about agency and the limitations research participants placed on agency suggest research participants are in the early stages of agency awareness and would benefit from more opportunities to engage in critical reflection.

Figure 9

Conceptual Framework Aligning Findings to the Literature
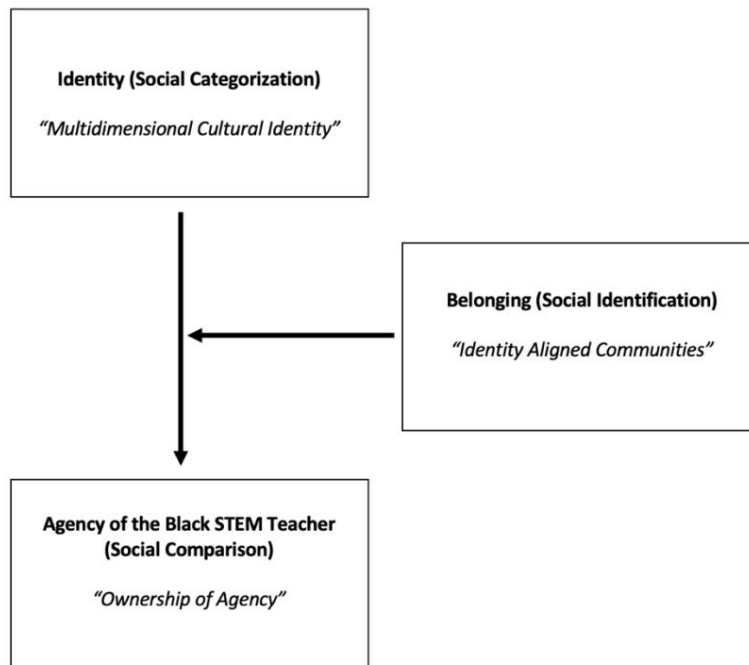
Note. This figure is an extension of Figure 1 and represents the alignment of the conceptual framework for the Black STEM teacher pipeline to the findings of this study.

What Do These Findings Mean?

The findings of this study indicated that research participants engage in collective and independent critical reflection about their social identities, which leads to how they function within their communities. Although slight differences existed when research participants engaged in collective reflection versus independent reflections, overall, the study indicated the existence of anti-Blackness, which has shaped identity, belonging, and agency. Furthermore, this study demonstrates the significance of community during the Black STEM teacher preparation experience.

Before entry into their TPP, Black STEM teachers were aware of their identity and the intricacies associated with their identity. They understood that their identity was multifaceted and unique, contributing to the complexities of their definition of self-identity. Furthermore, they were aware of the assets and the disadvantages connected to their identities. Still, they chose to enter the field of education out of an act of benevolence, seeing it as necessary to deconstruct prior thinking about the cognitive abilities of Black people and an opportunity to reimagine STEM with Black people leading the instruction and conversations in a K-12 setting. Furthermore, they sought nothing in return, only a desire to permeate a once taboo field with traditionally marginalized students, even though the same efforts may or may not have been reciprocated to them.

Research participants also understood that identity created illusions of hierarchy that privileged Black international students within the African diaspora in education in addition to dominant groups. Regardless, research participants value the cultural components of identity as how identity is defined rather than through role affiliation. Black STEM teachers in this study were aware of their historical roots, shaping their cultural identities, before entering the TPP. While in their TPP, they relied on their cultural identities to inform their decisions and interactions with others. Their cultural identities established and maintained their self-worth and self-efficacy while in the program. Moreover, critical reflection among research participants did not suggest that the role of a STEM teacher became a part of one's identity with the help of their teacher preparation experience.

Communities, whereas Black STEM teacher candidates shared similar cultural identities, established trust, safety, and an opportunity to learn. Instead, communities with different cultural identities but similar role identities created distrusting spaces that produced practices of

exclusion and silencing of the Black STEM teacher's voice, worth, and contributions. There were instances of feeling a sense of belonging to STEM and teacher communities without identifying as a "teacher" or "STEM" while also sharing experiences of "exclusion" and silencing in communities with members with similar roles, but divergent cultural identities.

Research participants only reported experiencing a sense of belonging in communities with members who shared similar cultural identities as opposed to experiences of exclusion and silencing when in community with members based on identical role identities; therefore, the type of identity influences community. The collective and individual responses imply that cultural identities take precedence over role identities during the teacher preparation experience. One possible reason that research participants do not recognize "teacher" or "STEM" as significant identities necessary for a thriving STEM teacher community could result from experiences of harm by rejection, exclusion, and silencing while in role-based STEM communities. Nevertheless, the existence of a community that creates a sense of belonging is necessary not to disrupt the Black STEM teacher pipeline because it can impede agency.

Research participants regard community as having the most impact during collective and individual critical reflection. The fluidity of community during the teacher preparation experience shifted based on cultural identity markers, which influenced a sense of belonging. Throughout the study, research participants shared numerous experiences about their communities where they felt a strong sense of belonging, along with communities where they felt rejected. Although they spoke highly of their communities and the relationships formed within those communities involving a sense of belonging, research participants mainly provided reflections where they functioned independently of their community members to solve problems or be "the help" for their students. There was a heavy reliance on the self to get the job done or

solve the problem. While this speaks to the perseverance and degree of resilience demonstrated by the research participants, this also contradicts the research participant's reliance on similar cultural identities to create a sense of belonging within the community. This could suggest that research participants may not fully feel a sense of belonging during their TPP, even when aligned with those with similar cultural identities. Furthermore, the perception of "resilience" and "perseverance" add to the stereotypes of Black people and perpetuate structures of oppression.

There was alignment between the independent and collective critical reflections of research participants about their agency. In both collective and individual critical reflections, research participants demonstrated a lack of ownership to recognize the power within their position as Black STEM teachers in dominant culture to disrupt historical legacies of discrimination beyond their classrooms. In every instance, the Black STEM teacher took on the role of a marginalized ally without fully realizing the need to be a co-conspirator to achieve true liberation. There is a possibility that this limited thinking about agency has been impeded by the negative experiences when placed in communities that lacked cultural identity alignment.

Alignment to Critical Theories

The findings of this study suggest that the residual damage from hundreds of years of deficit discourse about the abilities of Black people, coupled with systemic oppression against Black people, is impacting the Black STEM teacher pipeline. Since anti-Blackness seeks to explain the quest to eliminate Black people from accessing opportunities in STEM, anti-Blackness can be used to explain the systemic structures that prevented and limited the research participants' access to STEM prior to entry into the Teacher Preparation Program (Dumas, 2016). In this study, one can see how anti-Blackness disrupted the community, which prevented the Black STEM teacher candidates from feeling a sense of belonging and affirmation. Since

community had the greatest impact on the Black STEM teacher pipeline in this study, community is essential for a thriving community that natures the development of Black STEM teachers. However, current practices that deliberately sabotage a Black person's community only perpetuate the continued acts of violence, but on a more sophisticated level.

In each case, the research participants reported being made to feel like a member of the out-group while their non-Black peers were a part of the dominant in-group and accepted. One can see the impact of the systemic structures to eliminate Black people from the experiences of the Black STEM teachers in this study prior to entry into the TPP, during the admissions process to the TPP, and while in the TPP. Marvin and Tyrell spoke about being members of the out-group when they were one of a few Black science majors in their undergraduate institutions. In Tyrell's case, his undergraduate institution not only made him feel like a member of the out-group, but they ousted him from his STEM major through a practice of weeding out Black students in a particular science class when they reached the end of their program. This is a practice that research participants suggested was a common theme at universities. Not only did elimination from the STEM major result in emotional and financial trauma as a result of the inequitable and unjust practices, but the Black STEM teacher never had a fair chance to complete the degree. Furthermore, the Black STEM students never had a chance to connect with a thriving community of peers who shared similar cultural identities because of a historical practice that limited the number of Black students who entered the STEM degree program.

Minnie shared how she was denied entry into the TPP program where she could become certified to teach secondary mathematics. Instead, she revealed she was only offered a spot in the TPP's elementary certification program. Minnie shared that although she taught a demonstration lesson on the Pythagorean Theorem as part of the admissions process and received positive

feedback, the TPP never disclosed why she was not allowed entry into the secondary math program. She could only conclude it was because of her race.

When programs have additional admissions requirements for some programs and not all programs, that puts up an illusion of hierarchy that privileges those with access to certain knowledge. Furthermore, systems that lack transparency often harm Black people the most. In this case, anti-Blackness can be used to explain why Minnie was perceived being incapable of being admitted into the secondary math program regardless of her undergraduate transcript from her MSI, which suggested otherwise. This type of trauma continues the cycle of deficit thinking and mimics the historical trends that existed shortly after the passing of *Brown v. Board of Education at Topeka, Kansas*. Not only does this structure harm the Black STEM teacher pipeline, but it also adds to the deficit discourse about the abilities of Black students in STEM education.

All of the research participants discussed the need to have more Black faculty and mentor-like teacher representation to create a community where they felt like they belonged. Having misaligned faculty and mentor-like teachers disrupts the development of a thriving community for the Black STEM pre-service teacher. Misaligned communities lacked the cultural relevance and connection to develop, support, nurture, and affirm the Black STEM teacher candidates. Furthermore, it created a feeling of rejection where Black STEM preservice teachers experience microaggressions, prejudice, and stereotypes from biased views about Black people. Just as Black children perform better when being taught and led by Black teachers, Black college students share the same sentiment. Anti-Blackness can be used to explain why colleges and universities lack Black faculty and mentor-like teacher representation in STEM subjects. When Black voices are not present in faculty and mentor-like teacher roles, society

sends a subliminal message about who is the holder of knowledge. This contributes to thinking about who should be privileged enough to engage with STEM education in the first place.

These findings align with the literature about anti-Blackness and how it persists in teacher preparation programs, which impacts the Black STEM teacher pipeline. The only way to resist anti-Blackness is through deliberate and strategic practices and policies aimed at advancing the Black person's knowledge about STEM and representation of Black STEM teachers in all levels of education. When Black people feel safe, seen, and heard in STEM spaces, they can thrive in their communities.

Recommendations

This research aimed to make recommendations to leadership at Teacher Preparation Programs (TPP) and school districts for potential changes to improve the Black STEM teacher candidate's preparation experience. Based on the focus groups, identity maps, and follow-up interviews, the following recommendations should be considered:

Program Design Recommendations:

- Providing focus groups as a means to elicit feedback from Black STEM preservice teachers instead of solely relying on the use of surveys.   Using focus groups is a more culturally responsive way to collect data from marginalized groups. This would include end-of-course evaluations, regular program feedback data, and any clinical placement survey data being collected.

- Provide culturally relevant training to faculty, mentor-type teachers, and higher education/school leadership on ways to best support Black STEM teacher candidates during their teacher preparation experience. This includes having the foresight to identify

when "help" is needed and provide the help that is needed and how to create a culturally responsive sense of community based on trust and needs.

- Provide opportunities for Black STEM preservice teachers to regularly engage in independent and collective critical reflection about their social identities. Use the critical reflections of Black STEM preservice teachers to make changes to the program design as needed. This involves moving from a static to a more fluid program design model that is culturally responsive to the needs of program participants.

Clinical Experience Recommendations:

- Pair Black STEM preservice teachers with mentor-type teachers (i.e., host-teacher, cooperating-teacher, instructional coaches, teacher mentors) based on similarities in cultural identities instead of relying on similarities in role identities. Before the start of clinical placements, administer surveys to preservice teachers and potential mentor-type teachers to capture cultural identity markers along with rankings for preference for matching. Use the survey results to pair preservice teachers with their mentor-type teachers.

- Redesign the clinical experience to add value to the Black STEM teacher's identity. Consider strategies that maximize the assets teacher candidates bring as part of their cultural identities as a foundation for adding value to Black STEM preservice teacher candidates.

Curriculum Design Recommendations:

- Use a focus group to pilot course syllabi with Black STEM teacher candidates as part of the curricular revision process. Determine culturally responsive identity markers that embrace the experiences of Black STEM participants and elicit liberation from the

curriculum. Use the focus group results to make curricular revisions that humanize the learning experience for Black STEM teacher candidates.

- Humanize the learning experience of Black STEM pre-service teachers by maximizing their prior lived experiences and adding value to their development. Deconstruct systems of oppression that align with dominant culture (i.e., timebound assessments, requiring essays when a presentation could suffice, quantifying constructed responses through word/page count).

- Add a liberatory action culminating project as part of the coursework. Checkpoints along the way. Ensure it demonstrates ownership agency beyond the classroom and maximizes the full potential of the power as a Black STEM teacher.

Future Research

My initial research goal was to explore the critical reflections of Black STEM teachers' social identity during their teacher preparation experience. During my exploration, research participants provided significant data about the perceived experiences of preservice STEM teachers within the African diaspora. Given my focus on Black American STEM preservice teachers who lacked representation from Black international research participants, it is essential to examine their experiences further. Future studies could replicate this research and explore the critical reflections of Black international STEM teachers' social identity during their preparation experience.

Research on the critical reflections about the social identities of Black STEM preservice teachers can also benefit from a study on the role of cultural identity during critical reflections. This study focused on the role of social identities during critical reflection and asked a broad range of questions about social identity. It will significantly benefit the literature and teacher

preparation programs to learn more about the role of cultural identities during the teacher preparation experiences of Black STEM preservice teachers. This will inform higher education and school leaders on how to structure programs to provide Black STEM preservice teachers with positive program experiences. Future research could use a longitudinal research design to explore the cultural identities of Black STEM teachers during the entire teacher preparation program.

My research explored all three components of Tajfel's social identity theory in alignment with Freire's critical reflection component of critical consciousness. It will benefit the literature to interrogate social comparison from the lens of agency to determine why Black STEM teachers perceive limitations to their agency. A better understanding of agency and its liberatory power can help reimagine STEM with more Black people.

Personal Reflection

This section contains my reflections as a culturally responsive researcher. This research was inspired by three different sets of goals: personal, intellectual, and practical. According to Maxwell (2013), personal goals motivate the researcher, but not necessarily anyone else. Intellectual goals are based on general investigation and analysis purposes. Practical goals are focused on the needs and concerns of study participants.

As a Black STEM educational leader in higher education, I am personally motivated to understand the intersection of identity and experiences during a pre service teacher's preparation experience. According to Earnest House (2017) and Karen Kirkhart (2015), failure to deal with your personal goals can contribute to biased findings. Therefore, the following are my reflections which acknowledge my personal goals for this study.

My journey as a Black STEM educator began as an eighth grade pre-Algebra teacher at a middle school situated in a community where the high school graduation rate was 17%. During my first year as a teacher, my students defied deficit discourse and negative perceptions about their cognitive abilities by outperforming White student groups who attended school "across town." Almost twenty years later, that included too many accolades and accomplishments to count, I am still in the profession, except now I lead a MAT program that prepares preservice teachers. However, I often reflect about my teacher preparation experience. During my teacher preparation experience, it was assumed that one course, Multicultural Education, should prepare me to teach my students who were not reflected in the assigned textbooks, assignments, or readings. Not only were my students excluded, but my identities as a Black woman and first generation college student were also silenced. I recall experiencing micro-aggressions from my White male cooperating teacher, which ultimately left me ill-equipped to teach in an urban school. I only had one teacher who looked like me, but she really was not "like me." Although I had other White teachers who tried to create belonging for me, they never really understood what it meant to be me, a Black woman, because they had the privilege of being themselves without judgement. If it were not for my experiences from being in my gifted program during my K-12 education, I would not have known how to re-negotiate myself in a graduate space. On the other hand, if it were not for my personal experience living in the hood, I would not have known how to negotiate myself among my students and their families.

Therefore, this research is personal for me. Being a successful Black STEM teacher, I want to hear from other successful Black STEM teachers about their engagement in critical reflection about their identities during their teacher preparation experiences. I wanted to learn along with them, and not conduct research on them. Being emotionally invested in this research

is an understatement because this research is my contribution to the literature to change the discourse about who we, Black STEM educators, are.

Several times during the research, I found myself wanting to interject. At times, it was difficult to remain quiet. I truly wanted to engage in the dialogue and provide my perspectives along with my experiences about my journey. Although my research participants and I were separated by a generation, we shared several experiences in common. Nevertheless, I had to remain neutral, to illuminate their voice. This work, as I told them, was about them.

My intellectual goal was to emphasize the Black STEM teachers' marginalized identities and explore how Black STEM teachers demonstrate awareness of oppressive realities that shape their lives and their 'capacity' to transform that reality. As an aspiring scholar, I maintained a focus on using this research as a contribution to literature as counter narratives to deficit discourse and ideologies about Black people. The Black STEM teachers are so much more than just Black STEM teachers. Each of their multidimensional identities intersect in such a beautiful way that created six of the most unique and talented people that I enjoyed meeting. Merely referring to them as Black STEM teachers is insulting because they bring so much more to the table.

As I reflect on this journey, I learned a lot during this experience. First, this work will add to literature to inform TPPs about the significance of cultural identity for Black STEM teacher candidates. Since cultural identity is often overlooked within TPPs, this study can support with initiating critique of current practices. While I approached this work with an idea that identity was important, I was surprised to learn the connection between cultural identity and community.

Second, this work shines a light on the need for TPPs to add value to the identities of preservice teachers. I was surprised to learn that attending the TPP had no value-added benefit to the identities of any of the research participants. Again, this is another area that leaders in higher education and K-12 settings should critique to improve the experiences of Black STEM preservice teachers.

My final goal, practical goal, was focused on the needs and concerns of Black STEM teachers. I wanted to complete this study to listen for the collective and individual needs and concerns of the research participants. I approached the study with an open mind about the needs and concerns that would be expressed by the study participants. I did not want my personal biases to impact what I heard them say were their needs and concerns.

During this study, I heard explicit and subtle needs of Black STEM teachers. I was surprised to hear study participants express an appreciate for the space that was created for them to engage in critical reflection during their focus group sessions. I originally thought having them participate in multiple focus groups would create too much a time burden for them because of their limited schedules. However, they warmly embraced and attended the focus group sessions with eagerness.

I also heard the research participants hint at needing a more culturally responsive curriculum in their graduate courses. They implied feeling excluded from the curricular space, which silenced their prior experiences and contributions to the classes. I was somewhat surprised to hear this because I knew the curriculum revisions targeted humanizing the mathematics and science courses in the TPP.

Overall, I learned a lot about the experiences of the research participants during their TPP experience. I learned the value of identity and how identity can impact so many. It is my hope

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that this work will not become an overlooked piece of literature, rather, it will be embraced and

used to initiate individual, collective, and organizational critique to improve the experiences of

Black STEM teacher candidates during their TPP experience.

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APPENDIX A

This table represents the alignment between the researcher's conceptual framework and the themes represented in the literature within the critical consciousness dimension of critical reflection. The table relies on the research to demonstrate the alignment between Social Identity Theory and Critical Reflection.

Social Identity Theory	Social Categorization	Social Identification	Social Comparison
Themes of Social Identity Components	• First step, no groups = no social identity • Identify the groups • People into categories	• Identify as a group member • Behavior-based on the way group member behaves • Impacts Self-esteem	• Direct comparisons made between in/out-group • Tend to make biased comparisons • Self-esteem hypothesis • Prejudice, stereotypes, and discrimination based on your group • Positive distinctiveness
Researcher's Conceptual Framework	Identity	Belonging	Agency
Researcher's Themes	Identity creates the capacity to educate and learn from others.	Identity offers assets that create a sense of belonging.	Identity as a Black STEM Teacher produces a position in the community that liberates.
Research Article 1 Pathways to Critical Consciousness: A First-Year Teacher's Engagement with Issues of Race and Equity (McDonough, 2009)	Racial Identity Reflection	Awareness of Inequity	Challenges to Engagement

Social Identity Theory	Social Categorization	Social Identification	Social Comparison
Research Article 2 Critical Consciousness: A Critique and Critical Analysis of the Literature (Jemal, 2017)	Intersectionality	Psychosocial Support Co-learning	Reflective Questions Group Process Exclusion of Oppressor/privileged Absence of Privilege
Research Article 3 Developing a Critical Consciousness for Diversity and Equity Among Pre-service Music Teachers (Robinson, 2017)	Intersectionality	Access	Myths, Misconceptions, and Misdirections
Research Article 4 Developing Cultural Critical Consciousness and Self-Reflection in Pre-Service Teacher Education (Gay & Kirkland, 2003)	N/A	Divert or Diffuse Attention Away from the Targeted Topic	Benevolent Liberalism Silence
Research Article 5 Intraminority Solidarity (Burson & Godfrey, 2019)	Similarity	Intraminority Solidarity	N/A
Research Article 6 Race is a Big Deal (Schauer, 2021)	Collective Identification Colorblind Stances	White Privilege	Critical Reflection to See Race
Research Article 7 Critical Consciousness: A Key to Student Achievement (El-Amin et al., 2017)	Teach the language of inequality (recognize inequality and injustice)	N/A	Create space to interrogate racism (understand the depths of inequality and the myriad forces that sustain it)
Research Article 8 Critical Consciousness: A Developmental Approach to Addressing Marginalization and Oppression (Diemer, et. al., 2016)	Individualism	N/A	N/A

Social Identity Theory	Social Categorization	Social Identification	Social Comparison
Research Article 9 Feeling Like a Group After a Natural Disaster: In-group Out-Group Identity and Relations with Out-Group Victims Among Majority and Minority Young Children (Vezzali et al., 2014)	Perceived threat	N/A	Positive out-group attitudes
Research Article 10 Clinical Experiences and Mediational Activities in Urban Teacher Preparation: Learning and Critical Consciousness (Willey & Magee)	Understanding the fragile nature of a Critical Consciousness	Appreciating and understanding families	Recognizing problematic school practices that disproportionately impact students of color
Research Article 11 Understanding the Empowerment Process: Does Consciousness Make a difference? (Gutierrez, 1995)	Ethnic Consciousness	Problem Construal	Empowerment
Research Article 12 Awakening, Efficacy, and Action: A Qualitative Inquiry of a Social Justice-Infused, Science Education Program (Kozan et al., 2017)	N/A	Relationship between social and ecological systems	Reflecting on how dominant cultural and sociopolitical factors affect people's environment and health
Research Article 13 Developing Critical Consciousness or Justifying the System? A Qualitative Analysis of Attributions for Poverty and Wealth Among Low-Income Racial/Ethnic Minority and Immigrant Women (Godfrey & Wolf, 2016)	Semi-intransitive Consciousness Acritical Adaptive	Naïve Consciousness Pre-critical	Critical Consciousness Critical Liberation

APPENDIX B

Focus Group #1 Discussion Guide

Duration: 60-90 minutes

Physical Requirements: Notebook, pen or pencil, recorder

Researchers: 1

Expected Output: notes (field research)

Two research questions will also guide the observation.

Research Questions:

1. How do Black STEM teachers perceive the role of social identity in their teacher preparation experience?

2. How do Black STEM teachers engage in critical reflection of social identity in their teacher preparation experience?

Introduction	
Say	*Notes*
Thank you for being a part of the first of two focus groups. My name is Sherita Flake. I am a doctoral student in the University of Memphis' Department of Leadership in the School of Education.	
The purpose of this first focus group is to gain an understanding of how Black STEM teachers perceive the role of social identity in their teacher preparation experience and how Black STEM teachers engage in critical reflection of social identity in their teacher preparation experience. This should last about 60 -90 minutes. Basically, what will happen is that I will ask a series of leading questions that I'd like to get your thoughts on through group dialogue. The questions will cover topics about identity, belonging, and agency.	
You do not have to answer all the questions or participate in the discussions. If there is	

Questions	Notes
one you prefer not to answer, just let me know. Additionally, if at any point during the focus group you decide that you no longer want to participate, you can let me know that you'd like to withdraw your participation. No matter what, you will still receive the gift card.	
With your permission, I'd like to record this focus group. The recording helps me capture with accuracy what you share. The only people who will listen to the recording and reading the notes are my dissertation chair and me. We will be discussing what you share, with the hopes of strengthening the experiences of Black STEM preservice teachers during their teacher preparation program. Do I have your permission to record this focus group? Please type your response in a private message to me in chat.	
Do you have any questions? If a question comes to you later, feel free to ask at that point.	

Social Categorization (Identity)	
Questions	*Notes*
Let's introduce ourselves to the focus group. Begin by stating your pseudonym, pronouns, and your current teaching status (pre-service or in-service). Feel free to update your Zoom name with your pseudonym, pronouns, and teaching status.	
<u>Question 1</u> For the first question, I will ask you to use the annotation tool to record your responses. If you were to introduce yourself using your identities, how would you introduce yourself? Who are you? Why did you choose those identities?	
Probing Questions (if needed)	
Based on your identities, what are your strengths and limitations within the STEM community?	
How have your identities helped/hindered your ability to be a respected STEM teacher? (or learn from others?)	

Social Identification (Belonging)	
Questions	*Notes*
Question 2 What part of your identity do you believe has the most effect on your interactions with [peers, instructors, students, school leaders, host teachers, parents]?	
Probing Questions (if needed)	
What/Who influenced the group(s) that you felt most connected with?	
What/Who prevented you from being yourself around everyone?	
Social Comparison (Agency)	
Questions	*Notes*
Question 3 Which of your identities influence how you show up in STEM education?	
Probing Questions (if needed)	
Describe the power your identity creates.	
Ending	
Questions	*Notes*
Question 4 Do you have anything else to add?	

Focus Group #2 Discussion Guide

Duration: 60-90 minutes

Physical Requirements: Notebook, pen or pencil, recorder

Researchers: 1

Expected Output: notes (field research)

Two research questions will also guide the observation.

Research Questions:

1. How do Black STEM teachers perceive the role of social identity in their teacher preparation experience?

2. How do Black STEM teachers engage in critical reflection of social identity in their teacher preparation experience?

Introduction	
Say	*Notes*
Thank you for being a part of the second and final focus group. My name is Sherita Flake. I am a doctoral student in the University of Memphis' Department of Leadership in the School of Education.	
The purpose of this second focus group is to gain an understanding of how Black STEM teachers perceive the role of social identity in their teacher preparation experience and how Black STEM teachers engage in critical reflection of social identity in their teacher preparation experience. This should last about 60 -90 minutes. Basically, what will happen is that I will ask a series of questions that I'd like to get your thoughts on. The questions will cover topics about identity, belonging, and agency.	
You do not have to answer all the questions. If there is one you prefer not to answer, just let me know. Additionally, if at any point	

during the focus group you decide that you no longer want to participate, you can let me know that you'd like to withdraw your participation. No matter what, you will still receive the gift card.	
With your permission, I'd like to record this focus group. The recording helps me capture with accuracy what you share. The only people who will listen to the recording and reading the notes are my dissertation chair and me. We will be discussing what you share, with the hopes of strengthening the experiences of Black STEM preservice teachers during their teacher preparation program. Do I have your permission to record this focus group? Please type your response in a private message to me in chat.	
Do you have any questions? If a question comes to you later, feel free to ask at that point.	

Social Categorization (Identity)	
Questions	*Notes*
Let's introduce ourselves again to the focus group. Begin by stating your pseudonym, pronouns, and your current teaching status (pre-service or in-service). Feel free to update your Zoom name with your pseudonym, pronouns, and teaching status.	
Question 1 How do/have your identities shaped your experiences in your teacher preparation program?	
Probing Questions (if needed)	
What does it mean being [identity] in the context of learning to teach a STEM subject?	
What do you believe is the cause for these experiences?	

Social Identification (Belonging)	
Questions	*Notes*
Question 2 How has your identity shaped the assets you have/had to offer the STEM community during your teacher preparation program?	

Probing Questions (if needed)	
What/who contributed to you either feeling valued or not valued as a member of the STEM community?	
Social Comparison (Agency)	
Questions	*Notes*
Question 3 How does being Black help/hinder dismantling historical legacies of discrimination within STEM education?	
Probing Questions (if needed)	
What is within your locus of control?	
Ending	
Questions	*Notes*
Question 4 Do you have anything else to add?	

Social Identity Map in Teacher Preparation Programs

Duration: 30-45 minutes

Physical Requirements: Social Identity Map, notebook, pen or pencil, recorder

Researchers: 1

Expected Output: notes (field research)

Two research questions will guide the observation.

Research Questions:

1. How do Black STEM teachers perceive the role of social identity in their teacher

    preparation experience?

2. How do Black STEM teachers engage in critical reflection of social identity in their

    teacher preparation experience?
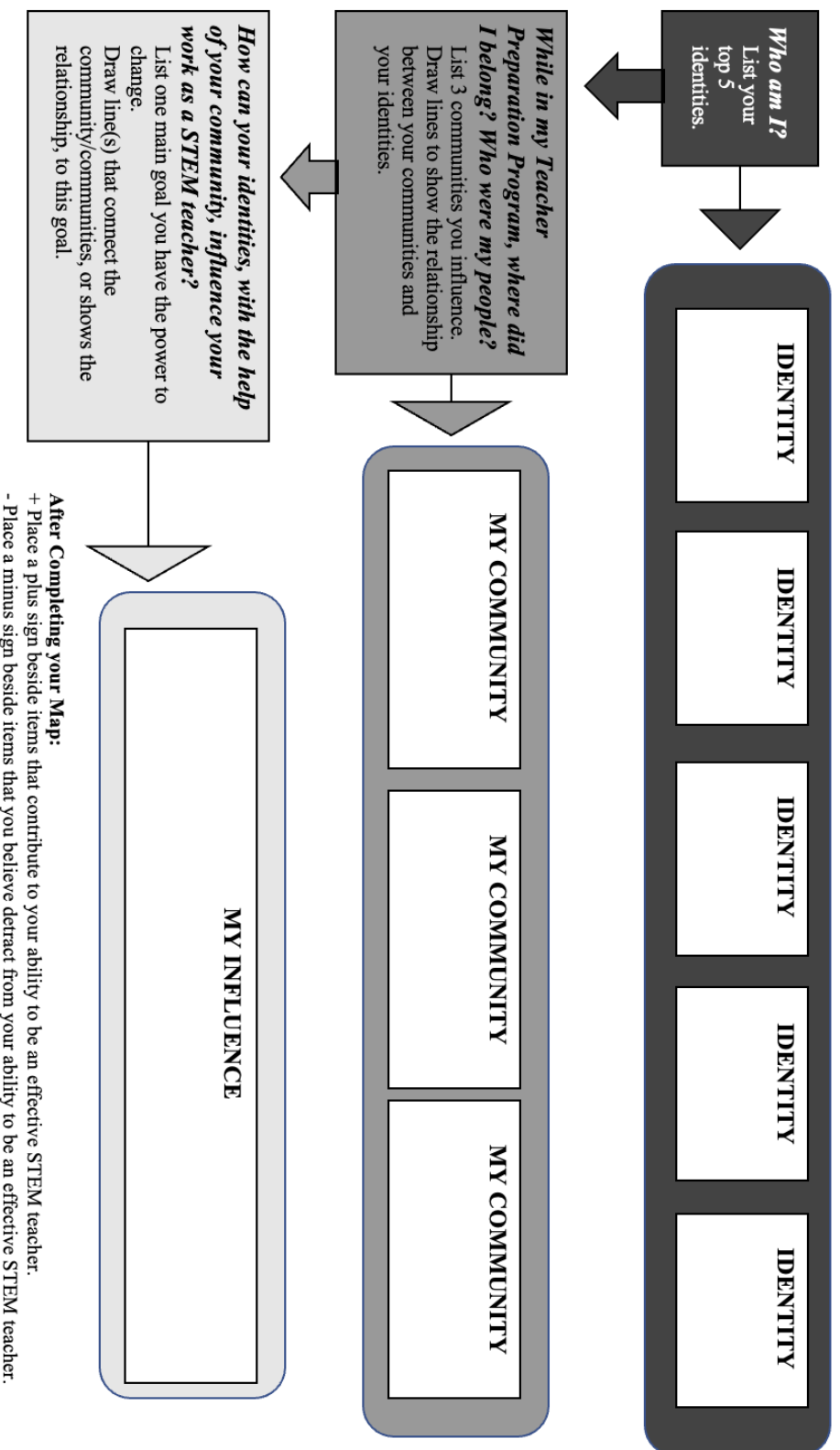
Critical Reflection Directions

Each participant will be provided a blank social identity map. Each participant will work

independently and at their own pace.

Directions to Participants:

1. Think about your experience in your teacher preparation program.
2. Then, follow the prompts below to create your social identity map.

Social Identity Map in Teacher Preparation Programs

Think about your experience in your teacher preparation program. Then, follow the prompts below to create your social identity map.

Who am I?
List your top 5 identities.

| IDENTITY | IDENTITY | IDENTITY | IDENTITY | IDENTITY |

While in my Teacher Preparation Program, where did I belong? Who were my people?
List 3 communities you influence. Draw lines to show the relationship between your communities and your identities.

| MY COMMUNITY | MY COMMUNITY | MY COMMUNITY |

How can your identities, with the help of your community, influence your work as a STEM teacher?
List one main goal you have the power to change.
Draw line(s) that connect the community/communities, or shows the relationship, to this goal.

MY INFLUENCE

After Completing your Map:
+ Place a plus sign beside items that contribute to your ability to be an effective STEM teacher.
- Place a minus sign beside items that you believe detract from your ability to be an effective STEM teacher.

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This table contains quotes from Focus Group 1 and Focus Group 2. Focus Group

comments about Theme 1: Research participants perceived their role in STEM education as

altruistic are represented in the following table.

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
MINNIE	"It's not about me."
DENISE	"…[I] want what's best for them at the end of the day and [my] job is to serve them, that's what [I] signed up for."
TYRELL	"I have always want to share information that I've learned with other people."
MINNIE	"I feel like that's what led to me to becoming a teacher, me wanting to share the information that I've always learned, me wanting to educate people because as Black people we need to know this because we're the ones dying the most."
NAKEIA	"The reason why I wanted to become a teacher is because I saw my peers around me when I was in school struggling with math, but I didn't [struggle]. I didn't have the same struggle. So I'm like, OK, I don't want to feel like I'm a genius or anything, but like I want to help the people that look like me get to my level."
NAKEIA	"If I have this ability to be good in math, why not help the other people that look like me try to be as good as me? Or try to feel like they can surpass me?"
DENISE	"Being a Black female in STEM really encourages my kids to know, that no matter what, you really can do it."
MARVIN	"If we're talking about teacher preparation and my [TPP] program being [help] for me, I'm doing that all externally. That's all me. That's because I care."
MINNIE	"What I carried into my [TPP] was not asking for help. And I think a lot of Black students do that…I think it's because we haven't been taught how to ask for help and we've been taught that asking for help is weak…Why can't I ask for help? I believe this is why we see so many students falling behind because they don't want to ask for what they need."
MINNIE	"I know I did not [ask for help] in my [TPP] because I didn't feel comfortable."

Appendix E (Continued)

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
MINNIE	"So it started with me wanting to educate my family members and then wanting to educate my friends and its like, OK, how can I reach the masses? How can I help people who look like me? And I started with the kids in my community whose parents might have been on drugs or parents weren't as active as mine."
DENISE	"I'm going into the classroom to see what the issue is. And I'm a find solution."
BPRS	"While I was living with my last set of foster parents who eventually adopted me, there was a desktop computer that was about to go in the trash. I was playing with it one day… and I fixed it. When they found out that I was really good at [fixing] computers, they encouraged me…and from then on he was like, "Oh, you're good at this!" So to the military base we went, and he knew some people in the IT department, and he would take me there every single weekend. I would get to stay there for as long as I wanted to see what they were doing, and to help with the computers, and to learn how to use the software. And then, when I knew how to do something, I would teach other people how to do it, which is how I first discovered my love for teaching… I wanted to able to give back to other children who did not have much growing up like I did."

APPENDIX F

This table contains quotes from Focus Group 1 and Focus Group 2. Focus Group

Comments about Theme 2: Research participants perceived illusions of hierarchy that privileged

dominant groups are captured in the table that follows.

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
MINNIE	I went to an HBCU, so I was surrounded by nothing but people that looked like me. But there was still a divide where you knew Black people who weren't from the US. It was a different type of stigma where they were held on a pedestal if they "Black people" weren't from the U.S…And it's like, you try not to go against people who look like you, but you're taking away from my access. Students who were not from the U.S. were given more time and effort.
MINNIE	It was really a divide between Black people. Even though we could party together. But if I came to them [Black international students] for help when we were in class, it was like they did not know me. …I am like we all Black; we should all uphold each other and uplift each other. That's why we came to a Black school. But there's still a divide where you're still looking down at me because of what you heard about Black people like me when you were in your country.
NAKEIA	I also went to HBCU and we have a lot of international students, which is cool, OK, like, you know, let's go. I think, you know. Don't want to be like stereotypical or anything, but, you know, internationals go for the higher degrees math, you know, engineering, computer science, all the gusto. So I spent a lot of time with them, which is cool or didn't have a problem. I think there was a social divide on my campus [between] Black people from the U.S. and the Black internationals. The Black international [students] would always hook up and I felt they had to be like that. It was the opposite of Minnie. I felt like [we] as Americans treating them badly because they were internationals.
DENISE	I graduated from [the same HBCU] and yes there is definitely still a divide."
NAKEIA	The international [students] got treated differently even though we looked the same…but they were treated differently. And I recognize that while my major was math, I took a lot of classes with them because a lot of the internationals focus on STEM….

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
MINNIE	There was another professor that I would see how he treated other students and me differently until the point I told him that I was Black American because he was under the notion that I was from another country and I was an international student.
TYRELL	it does play a role in the black diaspora of academia, and how we have perceive race based off of our country of origin. So I think it would be it should be bigger.
MINNIE	Aw, you from [City E, USA], you from the trenches you're from, like you sure you ain't part of a gang,
BPRS	the being black is a large part of my limitations and strength in STEM.
BPRS	I grew up in foster care
MINNIE	And I know for a fact that this person who might get all A's won't last the minute in a class with kids who look like me.
NAKEIA	I had a run in with one of my peers who are in the program with me. My peer whom I had the run in with is white and all my other peers look like me. We broke up into groups for one activity and each group had to come together to present their work. She [my white peer] stood up in front of the class and said, "Well, I feel like I should not represent because I'm the minority." I could not believe she said that because this teacher prep program is geared toward people of color to help people of color. How could she suggest someone else present because she's white and we're Black? That doesn't give her the right to not present.
MARVIN	It's these identities automatically put up a wall. a lot of negotiation and decolonizing, right?
DENISE	There is a [white] student in my class that is very smart. One of my Black students was like, "Oh, my goodness, I'm finally in a group with him. That means I'm smart!" I told her that was not the truth and that was not how she should see it. So I sat down with her and then began to have a conversation [with her]. I told her that she was already great. But like, they always see this white student as the smartest in the class. And I don't know if they think it's because he's white or something else. My main thing is not to let them continue to think, "Oh, if I get in with him now, I'm great."

This table contains quotes from Focus Group 1 and Focus Group 2. Focus Group

Comments about Theme 3: Research participants cited similar identity as an indicator of a

thriving community are in the table below.

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
BPRS	…undergrad I was at, I was an IT major in computer information systems with a concentration in cybersecurity, and I was one of two blacks that graduated with the degree. But there was fifty-five of us that started out and I was the only female that graduated because our teachers pushed us out. They said that we did not belong in the STEM field and that we would not amount to anything
MARVIN	I'm so happy that we have this space.
MARVIN	I actually was, I think, only one or two like people of color period that graduated from I got my undergraduate degree in Earth science. being in a chemistry lab and like, you're doing all these mathematical calculations and you're like, Can I check my numbers real quick? And nobody's helping

It was just like we were the only two people of color like period. And, you know, I'm light, So it was like, where are the dark skinned folks where all the other people that should be coming up with me and. And so I was I was it was really tough for me, like not having anybody to fall back on and I'm also first gen. So like, who am I going back home to like, help me or give me tools or like I'm saying, Hey, this is.

And when I was struggling in undergrad, I would be telling my family and oh Marv, we don't. We don't know how to help you. Like we because I was failing for the first time in their eyes, like they had never really seen me in a vulnerable state like that in terms of academics or like that success. So they were like, We don't know how to help you. So that is kind of like some of the limitations that I was facing. |
| TYRELL | being like one of the only black people in that space. I was two classes away from having a dual degree. That degree was biomedical science. |

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
BPRS	through my teacher prep program, I had maybe two black professors in that being black plays a large role in the communities in the schools that we are serving in. So when I'm asking my non-black professor a question, they're like, Well, why do you have an attitude when you're asking? I don't have an attitude, I'm just asking a question, and I'm expecting an answer because you are here to teach me and to help mold me to be the best teacher that I can be. But when? Like, if they don't have an answer, then my question wasn't answered at all. They didn't try to go find an answer. None of that. It was just like, Whoa, what you said, it wasn't that thing. We're going to we're going to move on. And I think that's a problem because the the teacher prep program that I'm in is founded on being a non-biased and non-racist organization.
BPRS	So how can what we're doing in coursework and in class reflect what we actually see on a daily basis? And that is something that really affected and changed the way that I had to interact with professors and with my institute and my teacher prep program.
MINNIE	all of my professors knew what I knew my nickname because they never called me mama. But they knew me by my nickname, which was another part. So they kind of knew me a little bit more, I guess. I guess I should say got to know me a little bit more than what they were supposed to.
MINNIE	I be feeling incognito.
MARVIN	We had two or three, three, at least because ya'll are part of [Teacher Preparation Program], I am in the Baltimore cohort. So we had three professors, one of whom I think she's like, resigned because she was like, I want to focus on something else.
MARVIN	One of them because of our identity, like we just bonded really well. And so now I finally feel like I have like a mentor teacher. I feel like the first time ever or like a mentorship period to be honest about, like someone who has very similar ideology and like sees my vision and sees what I want to be. So like with that instructor, I feel safe. I feel seen, I feel heard, and that makes me feel good. But that instructor is new, like that instructor just came on last year. So all the other iterations of this program didn't have somebody like that instructor,

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
MARVIN	you saying something with certain instructors and it not being interpreted or like registered in a meaningful way was something that I felt like I was coming into a lot because I would be asking questions. And like I said, that philosopher identity, I'm always thinking. So when I would be asking questions, it'd be like, How do we do that? Because I'm trying to get that? What's the pathway? What are some models like and consistently like them not showing up with examples or like not doing the research or finding out themselves, then being willing, but also like not acting on it? What they'd be like? Oh, yeah, that's an interesting point. And let's try to see if we can figure something out. And then it would just never cycle back to like, Oh, did you ever get that?
BPRS	being black in America, like you have to be strong. You don't have room or time to be weak because you will get smashed to the ground.
TYRELL	I'll often get discounted, when I will talk in labs or talk in groups, even though I was just as intelligent as anybody else in the room.
MARVIN	I found myself trying to adopt the system that he had in place, and they weren't working because they weren't built for me. They're not going to work for me. But that's the only model that I have.
MARVIN	I found that that mentorship through the through [teacher preparation program] with that instructor, but without him, I wouldn't have anything or like a thought partner or like somebody to like, really run those ideas through and see what works.
BPRS	My host teacher was amazing. Honestly, if it wasn't for her, I probably would not have stayed and finished out just because of, like the previous things that we've been talking about. But it was a strong, independent black woman and she was like me, like we were not afraid to ask questions.
MARVIN	it's a radical act to be a black person in academia
MINNIE	I'm not supposed to be in this field. I'm not supposed to do this. No, we were some of the innovators. We were some of the people who actually started this
MINNIE	Just being black puts up a wall like that, is a wall itself. that I feel like we go our whole lives trying to kind of slowly but surely put that break now. But of course, it's still there.

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
NAKEIA	when I got into [TPP], I didn't know how I wanted to introduce that part of me
NAKEIA	…a transgender. And so it's like wishing that he could share more of his story
NAKEIA	I shed light on it just a little bit so that they can put it in their minds, OK, even though I made it known to the world later on in my life, there are students who know at those ages at, 11 at 12, you know, this is their lifestyle. This is who they are so like trying to. Give them the mind like, OK, when this is showing up in my classroom to accept this or not, to question this.
BPRS	really helped to get me to where I felt like I felt safe, and secure going into my own classroom with all of these different methods and skills that next year.
MINNIE	host teacher. She was black, a woman, a veteran teacher of 22 years. She actually graduated from the same college I went to, which was the connection. And it was just like, it was fate. And I'm not being from here. But it's crazy because her mom and dad is from [City E, USA]. So mom and dad from [City E, USA], they went to the college I went to. She graduated from college. I went to. Even though she's from a different area and it was just like fate. We and her birthday the same day as my mom. Louis is like, God, you are. This is alignment. This is like alignment. And when I thought you still work in the same school, I took over her position. She looped with her kids. But basically, she really is also a reason where it's like she made me more comfortable because I am from where I'm from and I'm living and teaching in a different area. even to this day, I've known her for four and a half years now and she's still on me calling my last name. Did you do this? Did you make sure you got this done?
DENISE	host teacher last year was black woman, but my classroom had 4 women teachers. My host teacher was amazing very helpful and encouraging and prepared me a lot. This year i work with a team of 3 one black male and one black women. We have been working well together
DENISE	I really think that sometimes in this program we're talking about like culturally relevant teaching and like changing the word,

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
NAKEIA	check ins or SEL things that we do and before we start class, you know, going through this program is like we have some of those things where we create those communities to be able to talk about those things.
DENISE	some of the classes I felt were pointless. Like sometimes I looked at the topic and I'm like, What is this going to look like? How is this going to help me? Was like my main thing, and I started feeling like my kids.
DENISE	being a black Christian woman plays a big part in teaching STEM learning to teach STEM. I am a Christian. It shaped my morals and my approach with teaching. I have a very joyous and youthful personality. I'm very passionate about the arts in education, so I love learning about my students so that I can empower and support their whole self.
NAKEIA	And a strength I feel like from being a mathematician, like, it's not a lot of black females in STEM. And so like, I feel like that's a big strength because, you know, we're little, but we're a strong population. Like even though we're small, like we're a strong population because it's like, we're here, we're not going nowhere. So it's like once you see a black person in STEM, it's like, Oh, like, you know, you're you know, you're going against the grain. Everybody doesn't major in STEM. Everybody doesn't, you know, find something interesting to like, focus on and be like, you know, master that skill. So it's like different. I find that being a strength.
MARVIN	my host teacher was a white cis-het man that left me wholly unequipped, like fully unequipped. And especially. Because I couldn't be my fullest authentic self in that space because it wasn't mine to own right.

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
MARVIN	When I say negotiation, it is that push and pull of like, OK, this is my identity, these are the identities that I hold. And there are students who are still developing that sense of self. to be black and queer in the context of teaching a STEM subject is means we ourselves have to do a lot of researching and gathering and collecting and archival work. being a black queer educator who is teaching STEM subjects, it means that I'm collecting an archive and creating a legacy that they have access to. [TPP] does a horrible job trying to prepare black queer educators to be in that space. I was sitting there telling them, These are the things that I'm experiencing. I need help. And what kind of assistance that I get. Literally nothing.
NAKEIA	when I got into [TPP], I didn't know how I wanted to introduce that part of me. But like, because you can't tell from the naked eye that I am a part of the community, people don't. So they always think, OK, you know, she's, you know, she's heterosexual. She, you know, likes this and does that. And so like when I do actually open up my mouth and say that I like, it's kind of like a shock of people looking around because it's like, OK, I didn't think that or you don't look like that. So we didn't think and I'm like, there's not a certain way you're supposed to look. So it's like trying to. Educate my peers while in class, because we're talking about certain things
MARVIN	their initial reaction is to silence us or to not hold what we have as valuable or not take that seriously
MARVIN	I think the reason why a lot of us might be jumping the gun is because. The most learning that I am doing about what it means for me is right now, the preparation work did not give me access, did not give me the tools, did not give me the energy, didn't give me the capacity to really feel not necessarily capable, but like. To be intentional about it I think a lot of us are jumping the gun because I'm really thinking about last year and I'm thinking about the prep work for last year, and it was so superficial because it wasn't built for us, right? The prep work was like null and void, because it goes back to some of the conversation we were having last week where like, BPRS was like these, this program still is not accommodating to us, it's still not really answering our questions. And when we are bringing up those questions,

MARVIN	They automatically create an affront for you to have access and for you to be great because intrinsically, these identities that we are holding are detrimental to the system that is currently in place.
MINNIE	when I ask question, OK, well, well, why did you give me this? Or, Well, what? What can I do for this to make it better? And you just say, Oh, just read the syllabus. Well, clearly I read the syllabus. Clearly, it wasn't. You want us to unpack it. I want you to unpack the syllabus for me. I need more details on how to make this better because I'm used to getting A's and B's and now I am getting Cs.

APPENDIX H

This table contains quotes from Focus Group 1 and Focus Group 2. Focus Group Comments about Theme 4: Research participants cited agentic moments within their teaching classroom community are in the following table.

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
MARVIN	The critical lens that I have and the way that I see this as a product of these systems and how I'm willing and able to change them like I have a vision, I know what I want, I want my kids to be able to be these critical thinkers and occupy these spaces. So yeah, that is the strength that we are bringing to the to STEM.
TYRELL	making it a point to have a Black space for science, Black scientists, if that makes sense, and others don't see the need for it
MINNIE	we're doing these programs to teach us how to exist in the classroom, but not to exist in a classroom with students who may not or may look like us.
MARVIN	I could show up for the kids the way that I wanted to. But that was like still a limited and restrictive environment in.
TYRELL	I empower our Black boys to see something different other than athletics, and I encourage more black and brown students to get into STEM just by me being involved in STEM
BPRS	just know that you can be black and you can be in science and you can do well in it. It was made for us. It is meant for us. And you have the right and you deserve to be a part of that.
MINNIE	if I'm in there and I'm not reading Ada Twist, which is like a science series of a little black girl, my class gets mad at me and puts me in my space, in my place, in my space. And it's like, Nah, you can't leave this room until you read this book because I want to see somebody that looks like me doing something that we're doing right now that we like to do.

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
MARVIN	like I read like the narrative of Harriet Tubman, right? And I told her I told her, I told my students that she was a scientist and they're like, What are you talking about? And what she would do is she would go out into the woods with her father and they would identify plants. And that is one of the ways that she would help other enslaved people navigate because she knew what was safe to eat. She knew where we were safe to rest our heads. She knew what to stay around what not to stay around. This is scientific work. You are doing observations you are gathering. You are note taking you are creating, you know, like you're creating a system of like, how am I navigating the world? Also like the story of Matthew Henson and being like the first person to ever reach, I think it's the North Pole. And like the science behind that and like, how do you survive in Arctic passage and how do you do all of these things?
TYRELL	I actually rely on my veteran teachers or my other colleagues and go there for answers and just ideas and stuff like that, so I can better present to my students on the concept I am trying to give them.
MINNIE	Be soft, but also Stand firm in my just teaching STEM in different ways and showing them how the world looks outside of their neighborhood because that is science too
MARVIN	now that I have students who I am having to nurture and care for and I want them to know about the world and know, and have a critical lens
MARVIN	a black queer educator look like teaching STEM? And I'm like, what? Like I said, I'm building that archive because that archive is what is giving me, like the tools and the pathway to be like, OK, yes, this is what I need to be doing
DENISE	if I want to make change in education, I can't just not be in a classroom

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
DENISE	learning how to adapt and switch myself a little bit to help the kid more or switch my lesson or switch my groups even if it took more time for me.
DENISE	I came in already knowing like certain systems and ways that they're teaching. Let's say, black students, for example, like certain ways that the curriculum is like, this is not going to work like it's not. I know my kids, I know how they learn. That's not it. Right? And so it's up to you then to make that decision to take more time to plan or intentionally plan to get them what they need and sometimes it's easier to just do what's already gone, but to be honest, is not working.
MINNIE	one of three white teachers I had, she was my science teacher and I started loving science after that. And I was like, Why did it take this white woman, this white woman?
TYRELL	My agentic behavior is me being a mathematician and I've been told since my first year in the TPP, that when I teach I'm making young mathematicians. I didn't really understand what that meant until I got my own classroom when I could see them work and I could see them talking about math and I'm truly making young black mathematicians. And I feel like that's very important to change the perception of who is good at math and who does math like they. I impress my students sometimes they ask me questions and I start doing math off the top of my head And they'll get so dumbfounded and Astonished at it and I feel like those moments are really important for them because they see themselves in math. They see themselves doing well in math. If that makes sense. And I also started incorporating a scholar of the day where I highlight a black or brown mathematician, scientists or whoever. And I think that also plays a role in just seeing themselves more and more

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
TYRELL	I just pull from history, like one person I used was Benjamin Banneker. He is African-American. He made the first kind of clock and I pulled somebody named Erika Camacho, got her Ph.D. from MIT, so it's just I really keep it black and brown. I think that would be very impactful, I had not thought of it that deeply or think that I could highlight my students in that way I think that would be very impactful for them to see themselves as scholars and identify themselves as scholars. that would be very impactful, too.
DENISE	Like we when I when a student mastered something and other students, don't have it yet. Usually what I do is I say, OK, so-and-so, Can you teach me? I'm like, Yeah, you just got it right. Can you go there and explain it? Can you teach it to your classmates? And they're excited. I see them at lunch like the Ms. Denise let me teach. She let me do it and I was just yall excited, that's what I want. And so I like seeing them go from, I don't know how to do anything. I don't understand word problems. I don't understand any of this. So like I got it. And like, to raise their hand and even I have this student SPED student. And I think his parents, everybody that's ever had him has told him, like, you are below, like, you don't know anything. And so to hear him always wanting to share out even when it doesn't quite sometimes make sense. I just usually redirected it or like I see his peer jump in and say, No, I can help you. I'll do this. And then sometimes I'll explain it, and the student will be like Ms. Denise. That's not how we get it. Hold up. Let me say it. I'll be like, OK, I step out the way I let them say it. And I the kids are like, we get it now. I'm like, OK, cool.
NAKEIA	I didn't get the answer right and the way I took it was not right. Like, I don't get this. I'm bad at this. That's where those thoughts start coming from, when an educator doesn't take the time to get into those thoughts or what the students are thinking.

RESEARCH PARTICIPANT	FOCUS GROUP COMMENTS
MINNIE	They have to an affirmation where they have to repeat after me. I am a mathematician; I am a scientist. I am not afraid to fail. I will not give up. So basically, we say the same thing every day. Where now some of my students can actually lead that.
NAKEIA	I didn't know how much it meant for me to be in STEM until I graduated or until I was about to graduate

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