2023

Integrating Historically Marginalized Students' Funds of Knowledge for Culturally Responsive Teaching and Learning

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August 1st, 2023

A thesis/dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

Acknowledgements

Thank you to my dissertation chair, Dr. Christine Bae, as well as the committee, Drs. M. Rudasill, Strunk, and Gray. I am appreciative of the Virginia Commonwealth Foundations of Education Department and all of the support I've received on the doctoral journey. Thank you as well to my family and friends especially my parents, Dana and Steve, and brother, Kevin. My research continues to be inspired by and dedicated to Black and Brown students.

Abstract

The United States historically has not always recognized the unique knowledge, or Funds of Knowledge (FoK; Moll et. al, 1992) that Black (and other historically marginalized) students' have as assets to classroom learning and much of today's mainstream curriculum represents White cultural norms as the basis (Sjursen, 2021). Because of this reality, marginalized students must navigate mainstream cultural norms alongside their own culture to be successful in the classroom. This three-paper dissertation includes 1. a systematic literature review of Black U.S. k-8 students language and identity in relation to achievement, 2. a qualitative case study centered on middle school urban Southeastern science teachers' perspectives on FoK as well as FoK integration into the classroom, and 3. a *QuantCrit* case study that critically examines rural Midwestern kindergarten teachers' survey responses regarding historically marginalized students.

The systematic literature review examined previous findings related to elementary and middle school Black students' FoK, or knowledge based on their personal experiences and identities (Oughton, 2010; Baker, 2005; Moll et. al., 1992; Vélez- Ibáñez & Greenberg, 1990). The review determines 1. how Black students' FoK can be leveraged to increase academic achievement, 2. how FoK has been incorporated and measured, and 3. the nature of the relationship(s) between the languages, racial/ethnic identity(ies), and academic learning of Black students.

The qualitative case study analyzed examples of students' FoK and teacher incorporation of FoK into classroom lessons through the interviews of seven science middle school teachers in diverse and urban classrooms. This study used asset-based and culturally inclusive pedagogies that recognize students' diverse identities, languages, and lived experiences (funds of knowledge, FoK) as valuable resources for learning (Moll et al., 1992). The goal of this study was to 1) explore teachers' recognition of marginalized students' diverse FoK, 2) examine teachers' FoK and its relation to students' FoK, as well as 3) investigate to what degree teachers integrate students FoK into their pedagogical approaches.

Finally, the goal of the *QuantCrit* case study was to quantitatively evaluate the experiences of historically marginalized student populations within a rural Midwestern kindergarten sample within the CRT framework (Garcia, et. al., 2018). The study drew upon multiple resistance frameworks (i.e. Critical Race Theory [Delgado & Stefancic, 2000], Critical Race Pedagogy [Curenton & Iruka, 2020; Yoo, 2010; Lynn, 1999], and Quant Crit [Garcia et. al., 2018; Garcia, & Mayorga, 2018]) aiming to promote equitable and positive culturally relevant pedagogies (Barrio, et. al., 2017; Kugler & West-Burns, 2010).

I. FIRST MANUSCRIPT.....

Abstract

The United States historically has not always recognized the unique knowledge (Moll et. al, 1992) that Black (and other historically marginalized) students' have as assets to classroom learning and much of today's mainstream curriculum represents White cultural norms as the basis [Sjursen, 2021]. Because of this reality, marginalized students must navigate mainstream cultural norms alongside their own culture to be successful in the classroom. This systematic literature review examined previous findings related to elementary and middle school Black students' Funds of Knowledge (FoK), or knowledge based on their personal experiences and identities (Oughton, 2010; Baker, 2005; Moll et. al., 1992; Vélez- Ibáñez & Greenberg, 1990). This review determined 1. how Black students' FoK can be leveraged to increase academic achievement, 2. how FoK has been incorporated and measured, and 3. the nature of the relationship(s) between the languages, racial/ethnic identity(ies), and academic learning of Black students. The importance of this research was further explicated, relevant theoretical frameworks discussed, followed by a detailed outline of the literature review and results.

The Relationships among Black Students' Racial/Ethnic Identity, Languages/Dialects, and Academic Experiences in the U.S.: A Systematic Literature Review

The United States' (U.S.) education system does not provide equitable support for all students to ***become successful*** within the ***hierarchical system***. The value of historically marginalized and/or low-income students are discredited and rejected because traditional U.S. curricula and research are based on populations of White and/or upper socio-economic status (SES) students (Lerner, 2009; Hilliard, 2002; King, 2005; King & Swartz, 2014, 2016; Watkins, 2005; Fanon, 1963; Woodson, 1933/1990). Equity and emancipatory research created the term "historically marginalized groups" to recognize individuals who are less benefited by societal privileges because the prioritization or marginalization/trivialization of ones' grouping (e.g. race, class, and/or sex) is the reality of Western cultures (Swartz, 1992). This article specifically considers the BIPOC (Black, Indigenous, and People of Color) community as historically marginalized individuals and results of this review more specifically highlight Black students in the U.S.In light of the research and practical inequalities that continue to plague the classroom, this systematic research focuses on how researchers have discussed Black students' language and cultural references within classroom contexts in order to promote future research as well as teacher implementation of funds of knowledge (FoK) into the curriculum. The importance of this research will further be discussed, relevant theoretical frameworks will be overviewed, followed by a detailed outline of the methodology of this systematic literature review, and overview of the findings.

Significance of This Research

It is imperative to recognize how historical and present contexts of racial injustice have informed the society encircling Black individuals in America today, including and specifically for Black students' academic achievement within the classroom (DeCuir-Gunby & Schutz, 2014). Inequality in Black U.S. education is a reflection of the overarching inequality in the U.S

(Milner, 2021; 2010; DeCuir-Gunby & Schutz, 2014). It is important to recognize the genesis of the problem began with the involuntary arrival of Africans for the use of commercial slavery. For instance, many U.S. history books credit Christopher Columbus' 1492 exploration as the date that America was 'discovered' and many recognize the colonization of Jamestown, Virginia in 1607 as the start of American history which neglects the indigenous Americans who first discovered the U.S. and instead centers the arrival of Europeans (Sjursen, 2021). It was in Virginia that the enslavement of African people became normalized and 'after 1676 a class-based system morphed into a race-based system of labor and social structure' (Sjursen, 2021, p. 6). It was more cost effective to enforce African slave labor rather than pay White indentured servants and use race as a visible marker to segregate Africans from the societal hierarchy that was maintained (Sjursen, 2021). Even after the abolition of slavery, racism continued through segregation, and still has a long-lasting effect (Boutte, 2021; Boutte, 2017; Urban, 2009; Duncan, 2002; Delgado, 2000). Historical societal events such as slavery prohibited and restricted the education and the rights of African American individuals who were not considered citizens, but property. Even after the abolition of slavery, racism and discrimination continue to permeate society at every level which perpetuates injustices for BIPOC individuals.The Civil Rights movement, specifically Brown vs. the Board of Education in 1954, was the first step in changing education from a privilege to a human right (Bell, 1980). This movement allowed society to begin to recognize that students have the right to equal education regardless of sex, race, creed, or learning capabilities (Lerner, 2009). Although persistent and detrimental effects to BIPOC communities (i.e racism, discrimination, access) continue, the Brown vs. the Board of Education ruling was a hallmark case which declared government-enforced segregation in public schooling to be unconstitutional; because the law disproved the 'separate but equal' societal normalities, Black and Brown students could begin to receive the same education as their White peers(Lerner, 2009; Stephan, 1978). However both then, and in todays' classrooms, historically marginalized students continue to face numerous disadvantages (e.g. discrimination, opportunity/achievement gap, higher behavior chastisement, less access to resources, alienation) which often places them academically behind their peers from dominant racial and/or higher socioeconomic groups (Jencks & Phillips, 1998; Varenne & McDermott, 1998; Oakes, 1995). Many Black students are from low-income populations because of the historical hegemonic cycle that started through slavery and the generational struggle for these citizens to gain rights and capital that the majority of White citizens already possessed. Low socio-economic status students thus experience an increase in academic disadvantage through hegemony that creates an opportunity-gap (Bauer et. al., 2020; Milner, 2021; Gramsci, Hoare, & Nowell-Smith, 1971).

This systematic review focuses on ***Black students in the United States***. The Black race label is used to reference any and all individuals who are descendants of Africans (Hollie, 2001). The African continent comprises individuals with various features, languages, and dialects. Today in the United States, Black students may be a) descendants of African slaves who were involuntarily taken from their countries into the United States, the Caribbean, or other North American and South American countries (spanning multiple generations in the U.S.) b) or Black students may be descendants of Africans who voluntarily came to the United States since the abolishment of slavery. Thus Black students in the U.S., though often grouped homogeneously, are more likely to be exposed to and/or participate in multiple dialects or other languages (e.g., African American English, Creole, French, Spanish) depending on their ancestral arrival in the U.S., cultures, and geographical location/social exposure. Black individuals within the U.S. may be influenced by one or more dialects or languages other than Standard American English. Today

in the United States, much of the curriculum and educational research continues to center Western, White, and male ways of thinking and being (Bang, et. al., 2013; Kumar & DeCuir-Gunby, 2023; Matthews & Lopez, 2022). For instance, the majority of classroom curricula highlight the achievements of White males throughout history, and only discuss slavery when referencing Black culture (Morton, 2022; Gray, et. al., 2018). Non-diverse research on majority White/non-marginalized populations continues to be generalized and utilized to create standardized education that may not translate to Black and Brown historically marginalized youths (Lerner, 2009; Urban, 2009). Black students in the U.S, including African American students, may have a multitude of cultural influences, languages, and traditions while also navigating societal racism related disadvantages; for these students in particular, cultural and communal belonging are essential aspects of positive identity and development (Gray et. al., 2022; Gray, et. al., 2018; Watts et. al., 2003). It is therefore important that research continues to diversify, and classroom cultural relevance continues to increase.

Race, Ethnicity, and Racial Ethnic Identity

This review focuses on **race and ethnicity** which is often a concrete physical characteristic that can be visually determined from a young age. Race is often recognized as a group dependent of country of origin (e.g. Back, White, Latinx, Asian) whereas ethnicity refers to variation within race related to country or other sub-cultural aspect of identity (e.g. African American, Haitian, Nigerian-British) (Delgado & Stefancic, 2000). Beliefs and conceptions of others as in-group or out-group depending on race/ethnicity are often taught and learned either implicitly or explicitly throughout one's life. For instance younger children concentrate on physical appearance, sex, and belongings when determining self-identities (Holmes, 1995) therefore it is necessary to analyze racism and discrimination even within younger populations. Because of the historial negative consequences of racism on U.S. education, educational psychologists are beginning to recognize that race is not simplistic or a categorical variable that can be controlled statistically; Race and ethnicity require education researchers to thoroughly investigate the complexity and multifaceted aspects of race/ethnicity that affects the individual and the greater community (Matthews & Lopez, 2020).

Critical Race Theory (CRT) encompasses multiple tenets that assert 1. that physical racial stereotypes and beliefs are embedded in American society due to the historical beliefs of individuals from specific racial groups, 2. racism is maintained within the society because it allows for the advancement of White and/or upper class 3. Race is socially constructed based on physical features rather than individual characteristics 4. racial stereotypes are used as a tool by those in power to benefit them 5. identities intersect and are multifaceted and 6. the voice of the Historically Marginalized is needed to enact change in a way that those who do not understand their experience could (Garcia & Mayorga, 2017; Bell, 2018; Dixson & Rousseau Anderson, 2018; Crenshaw, 2010; Delgado & Stefancic, 2000; Ladson-Billings and Tate 1995). The theory maintains that, specifically in American society, "social meanings connect our faces to our souls" (Delgado, 2000). Additionally, LatCrit extends CRT to suggest that discrimination based on ethnicity and nationalism is also systematically embedded into societal practices and therefore continues beyond CRT to discuss 'language, immigration, ethnicity, culture, identity, phenotype, and sexuality' (Solorzano & Bernal, 2001, p. 311). As a result, positive or negative intrinsic attributes are assumed of an individual merely dependent on external biological features that are related to a specific racial group. Historically, individuals of the racial majority maintained dominance by controlling minority races, claiming superiority, and using governmental laws in

order to restrict minority individuals' power (Delgado, 2000). In the United States, racial tensions still exist and permeate societal beliefs and stereotypes; however, today in American society, race and ethnicity intersect and are more interrelated than ever before (Shields et. al., 2002). CRT, suggests that connotations of physical genetic identities permeate through American society (Delgado, 200). Racism and discrimination occurs throughout one's life and young children recognize aspects of these connotations which may cause issues in their self perception overtime (Clark, 1988). Previous research suggests that students who socialize with a variety of peers, who have differing experiences and identities, are likely to be more understanding, kind, creative, or even intellectual (Clark, 1988).

As described above, student socialization and academic growth are important factors contributing to student identity beliefs. Similar to adults, some young children recognize the complexity of identity and culture at an early age (Jones, 2020; Holmes, 1995). A majority of existing research regarding identity focuses on adolescent populations. This is likely because, although beliefs of sociocultural identity evolve throughout one's life, adolescents are at a critical developmental milestone that focuses on self-conceptualization (Umaña-Taylor et. al., 2017). Even though self-perception and identification becomes more complex and profound during adolescence, physical identification beliefs "appear early in the life of children and affect the ideas and behavior of children in the first grades of school" (Clark & Clark, 1955, p. 18). Although identity beliefs develop alongside the student's development, it is critical to examine the foundation and root of their beliefs.

Language

Next we refer to language as the dialect or language patterns not only in the classroom, but learned within the home community (Garcia & Kleifgen, 2020; Yosso, 2005; Moll, et. al., 1992). We recognize that Standard American English (SAE) is the official dialect used in United States classrooms; therefore, all other dialects used by students are broadly referred to as non-SAE. In previous literature, the language used by Black Americans is often called a dialect rather than a language. In this paper, the terms Black American dialect or African American English (AAE) are used synonymously. Regardless of the official linguistic or dialectical status of this usage, the phenomenon of Black individuals in the U.S. speaking differently and as a result having more difficulty in the classroom still exists and needs to be addressed. All articles included in this systematic literature review include Black students yet some articles may also include historically marginalized and/or White student populations.

Sociocultural theory suggests all aspects of an individual's life are situated within "cultural contexts, are mediated by language and other symbol systems, and can be best understood when investigated in their historical development" (John-Steiner & Mahn, 1996, p. 194). This theory recognizes that ecological systems related to capital exchanges inform an individual's language usage and therefore directs their opportunities. Italian philosopher and sociologist Gramsci, wrote in the first volume of his prison notebooks that "all men are intellectuals…but not all men have in society the function of intellectuals" (Gramsci, Hoare, & Nowell-Smith, 1971, p. 131). In addition to the goal of bettering the comprehension of each society member, the competitive nature of a capitalist education system often prepares individuals to become experts in a field from which they can earn monetary compensation and, in this way, forms a survival of the fittest education system (Varenne, & McDermott, 1998). Through the accumulated experiences within one's life, expertise forms over time and influences future decisions and behaviors (Kim, 2015).

In other words, any individual has the opportunity to be an intellectual within a given field, yet Gramsci suggests that the societal depiction of intellectuals intersects with social class. In the United States, language usage relates to cultural contexts and continues to be highly diverse and individual; this is particularly true due to the constantly evolving racial and ethnic diversity that continues to escalate in the United States through generations (Shields et. al., 2002). The majority of the United States population is composed of citizens who are from, or descendants of, a country that speaks a language other than English (Shields et. al., 2002). With the increase of languages spoken in the United States, there is also an increase in dialects. Cultures and languages merge and are influenced by one another. Today, critical linguists suggest that English Language Arts classrooms shift pedagogical approaches to be more mindful and inclusive of Black American and other American minorities who bring language and dialects to the classroom beyond SAE (Baker-Bell, 2020; 2017; 2013; Ball & Larner, 2005).

Since language is spoken and used as a communicative device within a social-ecological context, this perspective ultimately recognizes that various languages and language dialects develop within cultural and ethnic communities and an individual often must assimilate to the cultural aspects associated with a language/dialect to be proficient. (Brown, & Wild, 2019; Agar, 1994). According to previous literature, SAE continues to be the preferred dialect in the classroom and academic evaluations (Hollie, 2001; Smitherman, 1986). The majority of Black American students speak a language, or language dialect, at home that is distinct from the SAE used and required for advancement within academia; conversely, the majority of White American students speak SAE within the home (Dillard, 1972). Students who vocalize using dissimilar language to SAE may "undergo perceptions of inferiority, incapability, illegibility, and illegitimacy" (Smith, 2019). The fear of inferiority is then heightened when educators attempt to eradicate what students know from their home environment rather than incorporating it into a novel learning opportunity (Smith, 2019; Emdin, 2011; Hollie, 2001).

Theoretical Frameworks

Theories mentioned in this review are related to the research questions and assist in highlighting the importance of context because the environment, culture, and community all directly and indirectly influence what students know, what they believe, and their educational experiences.

Asset Based Frameworks/Approaches

> "Asset-based pedagogies offer counter narratives to deficit ideology outcomes. Key examples include culturally relevant/responsive/sustaining pedagogies (Gay, 2000; Ladson-Billings, 1995; Muhammad, 2020; Paris & Alim, 2016), funds of knowledge approach (Moll et al., 1992), and Afrocentric praxis (King & Swartz, 2017). Asset-based pedagogies place value on students' insights, languages, and cultural practices, as well as seek to critique injustices, oppression, and other social-political issues."
>
> - (Flint & Jaggers, 2021, p. 255)

This literature review draws upon asset based theoretical frameworks that recognize cultural variations as beneficial to learning when implemented intentionally. Deficit based approaches often label marginalized and/or low-SES communities as at-risk, only emphasizing how these communities are unequipped for U.S. classrooms rather than asking how U.S. classrooms could become more adept at supporting these student populations (Anastasiow & Hanes, 1974; Cole & Bruner, 1971). Asset approaches recognize the benefits of students'

cultural resources for learning; for instance, researcher William Labov was one of the first linguistic researchers who examined African American English (AAE) and recognized the dialect as highly structured cultural difference rather than deficit (Anastasiow & Hanes, 1974; Labov, 1970). Modern literature continues to support these asset-based frameworks and reject the more mainstream deficit approaches by using culturally and contextually sensitive terminology. For instance, the opportunity gap perspective suggests that there are intersecting contextual factors (e.g., lack of resources, discrimination, and other socially constructed barriers) affecting the education of historically marginalized and low-income communities; this perspective, unlike the achievement gap perspective, points at systemic issues within the broader social-context surrounding students' educational experiences rather than suggesting an internal deficit within the individuals affected by these contexts (Bae et al., 2021; Bae & Lai, 2020; Bauer et. al., 2020; Milner, 2021).

Funds of Knowledge (FoK)

In order to create socially just classrooms for Black and/or African American students, it is important to recognize these students' FoK (Oughton, 2010; Baker, 2005; Vélez- Ibáñez & Greenberg, 1990). FoK recognizes that out of classroom experiences, such as home settings, encompass "ample cultural and cognitive resources with great, potential utility for classroom instruction" (Moll, et. al. 1992). For instance, students' native dialect/language as well as student racial and ethnic identities are major aspects of FoK that are not often utilized or expressed in classroom settings. The notion of FoK is extremely important in highlighting the cultural richness, intelligence, and uniqueness of low income and historically marginalized students to discredit "deficit models" that measure these students within White/marginalized educational models therefore suggesting that these students are incompetent or incapable of learning (Oughton, 2010). FoK suggests that these marginalized students can prosper within a system that recognizes their existing expertise and experiences, and that does not coerce/require their assimilation into White/mainstream culture. Scholars argue that it is essential that teachers use representative symbols and demonstrations of student FoK although it requires effort beyond typical class requirements (Esteban-Guitart et. al., 2019). Incorporating students' FoK is also important in classrooms that aspire to create socially just platforms for a diversity of student populations (Esteban-Guitart et. al., 2019; Vélez-Ibáñez & Greenberg,1990).

Many Black and African American students in the United States experience dissonance between school curriculum and their FoK (Bae, et al., 2022; Kumar et al., 2018; Usher, 2018). One fundamental dissonance within their FoK and the classroom curriculum is language and dialect distinctions (e.g. AAE promoted in the community yet condemned in the classroom and SAE/academic talk condemned in the community yet required in classrooms). Language is necessary for communication within a productive social society (Schieffelin, & Ochs, 1986; Bourdieu, 1977). Within a capitalist society, how one communicates is linked to capital as well as academic ability (Avenia-Tapper, 2015). However, much of the Black and African American population are fluent in an English dialect beyond Standard American English (SAE) which is the standard language spoken throughout U.S. classrooms (Dillard, 1972). In order to critically reflect multi-perspectives in pursuit of social justice within the education system, it is important to evaluate relevant theoretical frameworks in order to avoid deficit models (e.g., blaming students or further causing detriment in education research on marginalized populations). In this study, FoK is recognized as an asset framework that aligns with CRT and promotes students' unique contributions to the classrooms. Further, this study specifically focuses on two types of Black students' FoK: identity and language.

Ecological Systems Theory

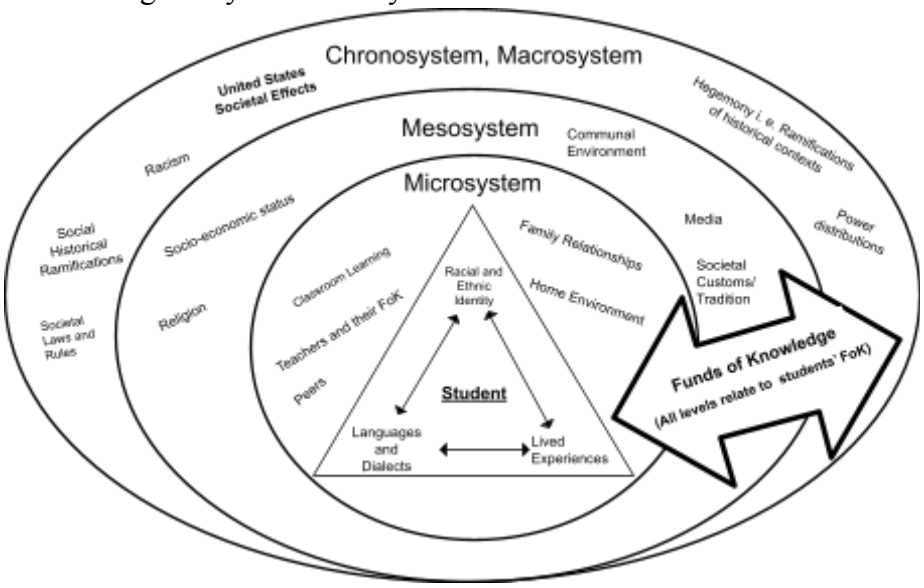
Bronfenbrenner (1977) proposed the ecological systems theory that he initially termed *the ecology of human development* (p. 514). The theory posits that students grow and learn within four overlapping and overarching systems that reciprocally influence their academic opportunities (Bronfenbrenner, 1977). The first and most directly influential level is the *microsystem*, which includes an individual's immediate and daily environment. For most students this comprises their home and classroom. For Black/African American students' research suggests that family/home relationships and connections are especially vital (Waskington, et. al., 2020). Next, the *mesosystem* includes both daily environments as well as all environments that an evolving individual interacts with within their lifetime. For a student, this could extend beyond the school and home to include extracurriculars, a community, or extended family. The third level, the *exosystem*, includes the previous systems as well as all governing agencies that both indirectly and directly determine an individual's *local, state, and national* regulations (Bronfenbrenner, 1977). Finally, the *macrosystem* entails the direct and indirect influence on an individual by "overarching institutional patterns of the culture or subculture, such as the economic, social, educational, legal, and political systems, of which micro-, meso-, and exo-systems are the concrete manifestations" (Bronfenbrenner, 1977, p. 515). The complexity of these systems results in highly variable and individual student outcomes, trends, and patterns. The various external factors within these systems affect student language exposure and usage and ultimately may be beneficial or detrimental for each student' academic progress.

At the macrosystem level, racial discrimination in the United States has shaped, and continues to influence, the policies and practices in our education system (Kelly et. al., 2020). Historically, White Americans of European descent immigrated to the United States. They became the dominant power and maintained racial dominance by physically displacing Native American inhabitants, creating governments and laws to enforce their status, and compiling wealth through enforced African enslavement (Urban, 2009; Duncan, 2002; Delgado, 2000). Laws were eventually passed in order to decimate this coerced hegemony; however, using the ecological systems theory, it's argued that this initial hierarchy continues to influence how individuals communicate within the society, current American academic achievement outcomes, and ultimately socio-economic status (Gramsci, Hoare, & Nowell-Smith, 1971). These societal effects often have direct negative influences on historically marginalized populations' access to social and cultural capital as well as other resources essential to navigate the U.S. education system and employment opportunities (Coll & Pachter, 2002).

Figure 1 maps out the current research onto the ecological-systems model to demonstrate examples of students' varied experiences at various levels in the U.S. specifically. The model represents how a student is positioned within Bronfenbrenner's model today, and specifically recognizes culture and language. Racial discrimination in the United States is at the macrosystem level, yet everything on the macro level bleeds into the overlapping levels that sit within it. Language and culture are often aspects of a students' microsystem. For instance, a student may speak a multitude of languages, each to a specific extent and combination (e.g., a Black student who uses moderate SAE yet high AAE, and minimum amounts of Haitian creole). The model also recognizes how languages and the dialects that derive from different languages continue to influence one another (e.g., how music written in AAE influences SAE or how SAE classrooms influence AAE within a community). The FoK arrow represents how each student gains

awareness about various levels of their environment and uses it as a basis of forming new knowledge.

Figure 1. Conceptual Model proposed by the researcher. The model represents examples of Bronfenbrenner's ecological-systems theory model in the context of the United States.



Vygotsky and Sociocultural Theory

Lev Vygotsky and his collaborators were the first known to write about this theory in Russia during the early 1900's (John-Steiner & Mahn, 1996). Identity beliefs develop within the context of an individual's society and culture; therefore, it is important to recognize these factors as ingrained in an individual's experiences. Younger students' worldviews are highly influenced by the individuals whom they come in contact with and how those individuals express their beliefs (Harris, 2012). In the classroom, the teacher drives student critical thinking and beliefs. Vygotsky's zone of proximal development (ZPD) approach "is the distance between the actual developmental level [of a child] as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1980). According to the ZPD approach, teachers can build upon students' existing knowledge and therefore expand their comprehension beyond what they recognize on their own. Relating this approach to sociocultural identity, this review suggests that students comprehend their individual sociocultural identity as well as how much the teacher combines cultural ideas and practices of their students with classroom lessons. Students come from a variety of environments and balance a variety of existing knowledge before encoding novel knowledge in the classroom. This is particularly true due to "the increasing demographic heterogeneity of North American society" (Shields et. al., 2002). Teachers who scaffold with students' existing knowledge may increase student comprehension and critical thinking.

Summary

Overall, several theoretical lenses are necessary to recognize how Black students' FoK (e.g. culture and language) can be useful tools in expanding their academic achievement and the cultural relevance of the U.S. education system. The ecological system theory posits that there are multiple factors influencing each individual's opportunities and behaviors, sociocultural theory suggests that the cultural capital of White Americans is viewed as superior and that the

cultural capital in Black cultural is often deemed inferior or insufficient, and lastly, Language-cultural theories recognizes that communication differs across cultures and individuals. Together, these theories support the understanding that SAE is used in classrooms because it is the dialect of the majority of White America, therefore deemed superior, and that by using this form of language in the classroom, students whose native dialect or language differs will have more difficulty. This systematic literature plans to acknowledge these various asset frameworks to analyze Black students' racial/ethnic identities and languages in relation to achievement.

Purpose

This systematic review aims to synthesize empirical articles that primarily discuss Black students' experiences and achievement within U.S. classroom contexts. Early FoK literature operationalizes the term to refer to students' culturally developed knowledge and practices (e.g., native dialect) of students' households and communities (e.g., Gonzalez & Moll, 2002; Moll et al., 1992). For instance, Moll et al. are some of the first scholars focused on Mexican Arizonian students' 'household' knowledge (1991, p. 132). They argue that "the classrooms seem encapsulated, if not isolated, from the social worlds and resources of the community" (p. 134). This article emphasizes their asset-based perspective that household, and we further suggest all out-of-school, FoK can be integrated into the classroom to transform student learning.

This research borrows yet expands upon Moll et. al.'s project in multiple ways. Firstly, this article focuses primarily on Black students' FoK. Secondly, we suggest that every aspect of the ecological systems model influences a student and therefore their cognitive and developmental view of the world is their FoK. FoK, in this review, includes cultural knowledge , experiences both within and outside of the classroom and household, identity, as well as student language and dialect usage (Oughton, 2010; Baker, 2005; Vélez- Ibáñez & Greenberg, 1990).

Additionally, this research uses a FoK asset based theoretical approach, similar to Moll et. al. (1992), to analyze how students' FoK is discussed and or utilized within each included article. Therefore, articles that examine a type of students' FoK as well as achievement outcomes was included even if the article may not necessarily utilize an asset based approach and instead argues the less critical and deficit angle which suggests that FoK conflicts and deters student achievement without the belief that diverse FoK perspectives could be useful or beneficial to all students. The goal of this paper is to systematically review published peer reviewed articles that focus on Black/African American k-8 students' FoK, with a specific focus on language and racial/ethnic identity. Three research questions guide this proposal (Table 1):

Table 1.Three research questions guide this proposal.

Identify and describe the languages and racial/ethnic identity(ies) of Black students
RQ1: How have the languages and/or racial/ethnic identity(ies) of elementary and middle school Black students been conceptualized and defined in the literature?
Measurement
RQ2: How are the languages and/or racial/ethnic identity(ies) of Black students measured?
Relationship between the' languages and racial/ethnic identity(ies) and academic learning of Black students

RQ3: What is the nature of the relationship(s) between the languages and racial/ethnic identity(ies) and academic learning of Black students?

Positionality

The first author is a Black American woman, student, educator, and education researcher. Based on her own experience, she recognizes that intentional incorporation of customized multicultural perspectives has not been historically provided for marginalized student populations in U.S. public schools. Within her research she aims to integrate students' ecologically based Funds of Knowledge (FoK) with academic knowledge to critically impact historically marginalized BIPOC, multilingual, and low-income students' achievement, belonging, and engagement which in turn will foster their critical consciousness (i.e. social-political cognizance and communal responsibility; Gray, et. al. 2022; López, 2017; Ladson-Billings, 1995).

Methodology

The purpose of this systematic literature review is to evaluate how previous research articles have discussed and conducted research related to Black students' FoK in U.S. classrooms. Studies published between the years of 1969-2020 were included in this review. The data analysis began in 2020. This means that literature discussed in this article does not consider the additional traumatic effects of the COVID-19 pandemic on education. Additionally, data were manually analyzed in Excel. The review proposes to incorporate five chronological components: 1. Collecting relevant articles, 2. Reviewing abstract for inclusion or exclusion, 3. Reviewing full text for inclusion or exclusion, 4. Coding of the full text articles, and finally 5. Discussion of combining all steps into a completed systematic review (Xiao & Watson, 2019). This study utilizes a more 'Textual narrative synthesis' because of this systematic inclusion and coding process at every stage; particularly, the literature matrix that organizes the final articles organizes them into multiple subgroups and comparisons that is used to find thematic patterns (Xiao & Watson, 2019; Lucas et al., 2007; Popay et al., 2006). All five stages will be conducted as detailed below.

Stage 1: Collecting Relevant Literature

The first stage of this process was created using published articles from five databases: PsychINFO, ERIC, Education Research Complete, Academic Search Complete, and Web of Science. In order to filter through the articles within the databases, specific key terms were utilized to represent the intended population as well as the research questions (table 2). Firstly, this literature review specifically focuses on Black and or African American students within the United States context, so it is important to only review articles that mention this population within their abstract. Although the term "student" was used to collect, the term "classroom" is not. Therefore, if student research in home settings or other settings prove to be relevant to the current topic, this caveat may be expanded upon. Next, classroom contexts are the focus of this literature review. Although connections to home or other contexts are expected, this literature review specifically aims to review articles that mention the classroom in the abstract because classroom variables as well as outcomes are relevant to all three research questions. Finally, student FoK, particularly racial/ethnic and language, are an essential variable within the research questions; therefore, only articles that describe these FoK elements within the title are utilized for this literature review. In order to have a more focused result, articles needed to have English

text, have been published, have been peer reviewed, and dissertations were excluded. This was important because the population of interest are historically marginalized students who are assumed to experience academic disadvantages and these advanced filters were used to ensure the articles were thoughtfully written and reviewed by multiple researchers. From this initial stage, 1,705 articles emerged using the key terms.

Table 2. Key Terms used to yield systematic review results

Final Key Terms Result: 1,705
"lang*" OR "ling*" OR "identi*" OR "funds of knowledge" - title
AND
"Black" OR "african am*" – abstract
AND
"student*" OR "child*" OR "adolesc*" -abstract
Advance Search Filters
Published Articles
English language only
Peer reviewed
Exclude dissertations

Stage 2: Abstract Screening

After the articles were downloaded from the five databases into Zotero, they were then exported into an excel file. In this stage, duplicates were removed, and article abstracts were evaluated for inclusion or exclusion by the criteria list below (table 3). Due to multi-database sourcing of articles, there were 550 duplicates (i.e. an article is represented twice); therefore, the duplicates were excluded from the total count and 1,155 articles were screened in total.

Using only the article title and abstract, this stage determined if the included articles focused directly on Black K12 student samples and outcomes and the type of FoK that was examined in the study (e.g. language, culture, media, family) was documented. The grade level is important in relation to the near-future research that this review will inform. Notes were also taken regarding questions to inform the full text screening (example notes/questions: grade level needed, FoK unsure, sample demographics, academic focus, etc.). Table 3 demonstrates all of the inclusion and exclusion criteria that both inform stage 2 and stage 3 of this review.
Non-academic related articles could often be excluded from reading the abstract. These were excluded because Black student academic achievement is a major focus of this research. However, this caveat highly influenced article inclusion because many articles discussed student FoK yet did not make explicit connections between FoK and achievement. Requiring academic outcomes resulted in an overrepresentation of quantitative studies, and conversely, an underrepresentation of mixed and qualitative studies.

Table 3. Inclusion and Exclusion Criteria

Inclusion Criteria
*USA
*English Text

*Black Student sample/results
*K-8 (elementary and middle school)
*academic, i.e. academic achievement, behavior problems
*self-esteem, i.e. perceived ability, identity, ethnic identity, positive adjustment
*racism
*social support

Exclusion Criteria
*Non-academic
*Outside of Pk-12
*Non-student subjects, i.e. teacher focused, parent focused, etc.
*university/college

Stage 3: Full Text Screening

After abstracts were screened, articles that did not explicitly discuss inclusion factors (roughly 150 articles) were read entirely following the same criteria. This was especially useful because there were over 100 articles coded as 'maybe' as it was uncertain for one or more reason if they fit within the inclusion requirements of the study. There were several reasons why an article may have been excluded during this stage of analysis. It became clear from key terms, research questions, and inclusion criteria that the focus is Black students' language and identity in relation to achievement. Although funds of knowledge was a search term, it did not yield significant results or findings; therefore, identity and language were the focus. The largest caveat beyond this focus was a need to relate to classroom or academic achievement which often eliminated several interesting studies. For instance, two studies were considered for inclusion because they examined academic identity within Black/Brown student populations, but after full text reading they were excluded because the studies focused on motivation, self regulation did not have a racial/ethnic identity measure although it is discussed in relation to the student samples (Matthews, 2014; Matthews, et. al, 2014).

Additionally, while reading each article a literature matrix was created to collate notes on the included articles. The literature matrix includes major themes, theories, and patterns that can be compared across articles (Appendix). This matrix will be a useful visual to clearly compare and contrast articles to one another and to the research questions.

However, during abstract and full text screening, 'inclusion of teaching practices' was removed from the inclusion requirements and instead became a coding option on the literature matrix. This is because academic focused articles were limited and the majority of articles, especially articles from more of a deficit perspective, did not include pedagogical practices. So this choice was made so as not to further limit inclusion. After full text screening, 41 articles were included and coded in the literature matrix (see table). The next major decision to increase the precision of the FoK discussion, was to focus on identity and language specifically, articles that overlapped with cultural or lived experiences were included, but 4 articles that only looked at culture/lived experiences, but not language or identity were excluded (Shnabel, et. al., 2013; Cook, et. al., 2012; Keck-Staley & Lavette, 2010; Hughes, 2009). A total of 37 articles were included for synthesis.

Stage 4: Coding

When reading the full texts of the articles, research questions and emergent themes were useful in creating codes. Twenty two code columns were used to categorize essential aspects of included articles within a literature matrix. There are some codes that are highly related to the current research questions and theories (e.g. article methods, findings, type of FoK, theoretical framework used, pedagogical approach) and other codes were created to understand the general study and population characteristics (e.g. title, year, student population/geographic region, grade level; see table). The codes directly derived from the literature that this proposal covers thus far as well as key aspects of the research questions. The codes also change throughout the process of constant comparative qualitative analysis (Huberman & Miles, 2002). For instance, as briefly mentioned above, pedagogical approach was intended to be an inclusion/exclusion criteria; however, majority of abstracts did not explicitly describe pedagogical perspectives or evidence-based intervention and therefore pedagogical approach approach was used to code full text articles rather than to include abstracts. Due to this change, articles with detailed pedagogical approaches are highlighted and several articles that explicitly utilize evidence-based knowledge systems that take an asset based approach with BIPOC students (e.g. intervention studies) found more positive results than articles that did not. By coding articles, patterns and themes are quantifiable and systematic trends are discussed; additionally, results and conclusions incorporate frequency counts to represent the importance of various codes.

Table 4. Codebook for the literature matrix.

Codes

- Dialects/ Languages
    - SAE
    - AAE (African American English)
- Theoretical Frameworks
- Forms of culture described
- Contexts: Urban, suburban, rural
- Black students:
    - Involuntary descendants (i.e. descendants of slaves)
    - Voluntary descendants (i.e. descendants of a recent generation of immigrants to the U.S.)

Stage 5: Synthesis of findings

Finally, after articles were reviewed and read the final inclusion count was created (37). Included articles are discussed within the results by the three research questions and sub-themes that emerged within each research question. Tables are included to emphasize the frequency and patterns derived from the literature matrix coding. Results are also organized by FoK type (i.e. language or identity) and articles with asset approaches are discussed in greater detail because of the theoretical frame and research goals of this study.

Table 5. Excluded studies

Exclusion Frequency Details	
non K-8	173
non- USA	65
no Black or African American students	66
No clear FoK measured	160
not academic focus	395
conducted in a learning setting	206
no student data	212
no academic results	281
not empirical nor primary data	124
not an article	28
not general ed/generalizable	86
duplicates	550

Included Article Results

Three major frameworks guide the analysis of studies included in this systematic literature review: Asset-based frames, Ecological Systems Theory, and Sociocultural Theory. 1,705 downloaded articles were carefully screened according to the stages described in the methodology and 1,668 articles were excluded from the review because they did not qualify for inclusion due to one or more exclusionary criteria (see table). Of all exclusionary criteria, many articles were excluded due to lack of academic focus (395), academic setting (206), or academic findings and results (281).

Finally, 37 articles on US Black/African American K-8 students' language or identity as well as academic achievement spanning 1969-2020 were included and analyzed within the final results of this systematic review. Characteristics and findings of these studies will be discussed below in relation to this articles' three research questions. Although articles include non-Black students and or students beyond the k-8 scope, this review specifically discusses the themes and results in relation to how articles discussed the k-8 Black students in their sample specifically.

Results by Research Question

RQ1: The first research question is: How are the ***languages*** and/or ***racial/ethnic identity(ies)*** of elementary and middle school Black students **conceptualized** and **defined** in the literature?

All 37 articles were included in this study because they include recognition and identification of historically marginalized students' out-of-classroom language or identity (FoK) with academic achievement; however, only 19 articles described students' FoK as a beneficial resource that could be incorporated intentionally into the classroom. Of the 37 final articles, 15 analyzed racial and or ethnic identity and 22 articles analyzed non-SAE language practices within the classroom (table x). These two forms of students' FoK were approached both using an asset based lens (19 articles) as well as through a deficit frame (18 articles). Although not all 18 articles were completely deficit framing and may have some positive or good intentions, overall terminology or positioning of students' languages and identities in these articles were not aligned with the asset framing of FoK. Examples of both deficit and asset framing are described below.

Table 6. Included article frequencies

Identity	**Language**
15 articles	22 articles

Asset / Positive Framing	**Neutral, Detrimental, or Deficit Framing**
19 articles	18 articles

RQ1 Theme 1: Fundamentally Deficit Perpetuation

Some articles either implicitly or explicitly perpetuated harmful, deficit perceptions of Historically marginalized youths. For instance, some articles and especially more historical articles used language that was harmful to these youths (e.g. "Negro nonstandard English dialect", Anastasiow & Hanes, 1974; "Black ghetto vernacular", DeStefano, 1972; "economically disadvantaged Negro children", Baratz, 1969). Many articles discussed both deficit and asset perspectives and aimed to remain neutral in analyses (e.g., Genshaft & Hirt, 1974; Anastasiow & Hanes, 1974; Baratz, 1969).

The majority of the articles within this study with deficit perpetuating perspectives were quantitative articles that utilize methodology that is biased and make statements about achievement gap and deficits of Historically marginalized students rather than acknowledging the opportunity gap, the innate racism within some of the quantitative measures, and recognition of knowledge/cultural differences; it is important that quantitative research recognizes the historic eugenic purposes of quantitative statistics and that being within a smaller/ minority group biases statistics towards the majority (Garcia, et. al. 2018; Garcia & Mayorga, 2017; Zuberi, 2001).

For instance, one article measures and compares the ethnic identity, other group orientation, and academic achievement of Black, Asian, Latinx, and White American students who are considered 'academically talented' (Worrell, 2007). The quantitative study includes a larger representation of Asian (n = 171) and White (n = 92) American compared to Black (n =

28) and Latinx (n = 28) American students which adds generalizability disadvantages due to the small sample sizes of these Historically marginalized students which the author does discuss in the limitations. The article acknowledges that there's a lack of representation of minoritized students in gifted classrooms in comparison to White and Asian students (Worrell, 2007). However, their theoretical reasoning "for academic performance and performance deficits involve social identity constructs" and an example they provide is John Ogbu's Oppositional Theory which explains that Black and other historically marginalized populations have cultures and identities in opposition to that of the main culture (Worrell, 2007; Ogbu, 1978, 1989; Ogbu & Simons, 1998). The reasonings that the article provides may likely be true variables that confound with the academic achievement of marginalized students; however, the article does not acknowledge or discuss social injustices (i.e. racism, discrimination, economic gaps, and historical ramifications). This article does conclude that ethnic identity is significantly related to academic achievement which is an important contribution to the literature. This article is an example of how research can perpetuate deficit perspectives;. Ideally, scholars would not only research marginalized students, but utilize theoretical frameworks that acknowledge racial injustice, and further, test interventions or other pedagogical approaches that center students' FoK as assets to their learning.

RQ1 Theme 2: Positioning Students' FoK as Assets

Several articles discussed historically marginalized students' FoK in a positive light and many even provided results on what interventions that utilize these students' out of school resources (FoK) as an asset in the classroom that can benefit their overall education. Several relevant frameworks have emerged through this literature review. These frameworks include asset based pedagogy (specifically FoK), ecological systems, sociocultural, as well lingua-cultural theories. ***Articles with asset based approaches within this study often discuss theoretical frameworks and/or previous studies that acknowledge Historically marginalized students' a. innate strengths, b. the difficulties they face , and/or c. their talent at maneuvering through these challenges resiliently*** (see table). Many of these more asset-approaching articles are dated after the late 90's; however, Marsha DeLaine and others' (1985) research are the earliest documented asset approach in this review. Their study aimed to determine if there were positive effects to student learning by speaking 'Black English'; they found that 'Black Language Ability' positively affected 'sounding skills' and therefore SAE 'figurative language comprehension'. Further, David Miller and Randall MacIntosh's 1999 article is the first in this review to analyze racial ethnic identity with an asset approach; their study recognized that African American students balance cultural and educational identities and center resilience and adaptive socialization as coping mechanisms to assist in managing life stressors**.** These articles dated over two decades ago demonstrate that the battle for educational equity has been and continues to be a necessary protest of the societal racism that continues to affect BIPOC students' both long before and long after Brown vs. Board of Education (1954).

Theme 2.1 Teacher pedagogical approaches through asset interventions. Many articles included specific pedagogical approaches or intervention plans to intentionally incorporate students' languages and identities into their curriculum based on the premise that integrating students' out-of-school FoK improves the learning experiences and outcomes for Black youth. Some of the studies developed asset-based programs or interventions that explicitly incorporated Black students' FoK (languages, race/ethnicities) to examine their effects on student learning outcomes (Bauer, et. al. 2020; Gray, et. al., 2019; Morales & Hartman, 2019;

Mills & Fox, 2016; Gholson & Martin, 2014; Ball, 1995). Ball, 1995 is a study that incorporated a linguistic pedagogical intervention and found positive results. This article replicated Torrey's Explicit Instruction Program. Gholson and Martin found that when there was a Black teacher who incorporated students' media references (e.g. Movie '*Are We There Yet?'*), physical/bodily engagement, and other cultural resources (e.g. singing the Black National Anthem) related to students comprehension of material; additionally, this relationship is mediated by students' social and peer power dynamics (e.g. good student, bully; 2014). One language study showed that when students were encouraged to utilize their full dual/multi-lingual spectrums they could facilitate their own learning in a Spanish classroom; they found a broader spectrum of linguistic usage per student and noted students' autonomy and self-regulation (Bauer, et., al., 2020; García & Wei, 2014). For instance, the Black students within this qualitative case study on kindergarten students ($N = 6$; Patton, 1990; Yin, 1989) utilized AAE, SAE, and standard Spanish within this classroom and the access to AAE and SAE related to their encoding of Spanish. These asset centered studies show that when Black students have increased authority and ability to utilize the full spectrum of their cultural resources to navigate the classroom and deepen their learning.

Table 7. Identity articles with asset approaches and the theoretical framework used

Asset-Based Theoretical Frameworks in Identity Studies	
'Resilience' (Richman and Bowen, 1997; Rutter, 1987; Beardslee, 1989; Gordon, 1995; Zunz, Turner, & Norman, 1993; Garmezy, 1991)	Miller & MacIntosh, 1999
"An integration of Chestang's (1972) **character development** and and Clark's (1991) **bicultural identity theory**"	Miller & MacIntosh, 1999
Phenomenological variant of ecological systems theory (PVEST)	Spencer, et. al., 2001
"**Structural racism in American society**" (Spencer, Harpalani, & Dell'Angelo (in press)	Spencer, et. al., 2001
'**Group Affiliations in Identity**' McCarthey and Moje (2002)	Compton-Lilly, 2006
'**Popular Culture in school curriculum**' Dyson (2003)	Compton-Lilly, 2006
Intersection of ethnic identity and academic achievement (Phinney, 1990; Smith, Walker, Fields, Brookins, & Seay, 1999)	Adelabu, 2008
Negative relationship between ethnic identity and achievement (Ogbu, 1987, 1991, 2004)	Adelabu, 2008
Positive relationship between ethnic identity and achievement (Bowman & Howard, 1985; Perry, 2003; Taylor, Casten, Flickinger, Roberts, & Fulmore, 1994)	Adelabu, 2008

Sociological construction of childhood James, Jenks, and Prout (1998)	Gholson & Martin, 2014
"Black girlhood" (cf. Brown, 2007)	Gholson & Martin, 2014
'**Black Feminist Thought**' (cf. Collins, 2005; Crenshaw, 1991)	Gholson & Martin, 2014
Intersectionality (Grant & Zwier, 2011)	Gray et., al., 2019
Multidimensional Model of Racial Identity (MMRI) (Sellers, Smith, Shelton, Rowley, and Chavous, 1998)	Butler-Barnes et., al., 2018
"**The Integrative Model for the Study of Developmental Competencies in Minority Children**" (Garcia Coll et al.'s, 1996)	Butler-Barnes et., al., 2018
'**Theory of Motivation**'; **Engagement** (Skinner and Belmont, 1993)	Butler-Barnes et., al., 2018
Ecological frameworks (Bronfenbrenner, 1998; Ogbu, 1981; Spencer et al., 2006)	Legette, 2018
Domain identification framework & symbolic interaction perspective (James, 1997; Mead, 1934; Osborne & Jones, 2011).	Legette, 2018

Table 8. Language articles with asset approaches and the theoretical framework used

Asset-Based Theoretical Frameworks in Language Studies			
Linguistic Theory (William Labov, 1968; 1969; 1972; 1982)	DeLain et. al., 1985	Ball, 1995	Roy et., al., 2013
– Linguistic Theory (grammar) (Coles, 1998; Green, 1993; Jackson, 1998; Jackson et al., 1996; Johnson, 2001; Mufwene, Rickford, Bailey, & Baugh, 1998; Sells, Rickford, & Wasow, 1996)	Coles-White, 2004		
– linguistic constraints in AAE & SWE (Sankoff, Tagliamonte, & Smith, 2005; Bailey & Maynor, 1985; Baugh, 1980; Blake, 1997; Childs & Malinson, 2004; Rickford, 1998; Rickford, Ball,	Roy et., al., 2013		

Blake, Jackson, & Martin, 1991; Romaine, 1982; Walker, 2000; Winford, 1992; Wolfram, 1969, 1974)		
– Linguistic transfer theory (Cummins, 2014; 1980)	Bucknam & Hood, 2020	
Mitchell-Kernan,1972	DeLain et. al., 1985	
Smitherman, 1977	DeLain et. al., 1985	
Baratz, 1970	Ball, 1995	
J. W. Torrey, 1972	Ball, 1995	
Washington J. A. et al, 1994; 1998	Craig et. al., 2002	Craig et. al., 2005
H. K. Craig, 2002, 2003, 2004	Craig et. al., 2005	
a theory of mind (ToM) (Astington, 1993; Miller, 2006)	Mills & Fox, 2016	
Positioning and Language Learning Theories 'situated within the social constructivist or relational perspective' (McVee, 2011)	Morales & Hartman, 2019	
Translingual approaches (Zapata, Kuby, & Thiel, 2018)	Morales & Hartman, 2019	
Opportunity Gap Perspective (Harper, 2013; Milner, 2010)	Bauer, et., al., 2020	

RQ2. The second research question is: How are the languages and/or racial/ethnic identity(ies) of Black students ***measured***?

In terms of measurement, details of how achievement and FoK were measured in each of the studies (see table) as well as whether or not the study utilized quantitative, qualitative, or mixed methodology design formats(see table). The majority of articles within this study used quantitative methods (23 articles) and fewer articles used mixed methods (7 articles) or qualitative methods (7 articles). This methodology distribution relates to the requirement of this

study that all included articles include both an achievement (e.g. GPA, standardized test, teacher reported) and a FoK measure (i.e. language or identity) as well as results related to these required measures. The languages and/or racial/ethnic identity(ies) of Black students were **measured** using questionnaires (particularly for identity), student interviews, and standardized assessments (particularly for language). For instance, the majority of articles utilized grade point average to measure standardized achievement. Multiple included Identity Articles utilized the Multigroup Ethnic Identity Measure (MEIM; Adelabu, 2008; Worrell, 2007; Miller & MacIntosh, 1999; Phinney, 1992). Finally, the majority of the included language articles measured registers of non-standard (e.g. AAE; Craig, et. al., 2005; Craig & Washington, 2002) and standardized (e.g. Standard Spanish; Morales & Hartman, 2019) student discussion and often coded the transcriptions. Many language articles utilized standardized linguistic measurements such as the Woodcock Johnson (Gatlin, et. al., 2016). One language article utilized the Diagnostic Evaluation of Language Variation–Screening Test (DELV-ST; Seymour, Roeper, & de Villiers, 2003) to measure students' dialect variation (Washington, et. al., 2018).

Some of the mixed methods studies used multiple measures. Three articles measured students' language using mixed methods (Caesar & Kerins, 2020; Mills & Fox, 2016, Roy et., al., 2013). Caesar and Kerins examined AAE & dialect density (DD) within a 100% Black/African American student population ($N = 64$), however some students were from a midsized urban Midwest town (56.3%) and the other students were from a large East Coast metropolis (43.8%; 2020). Students were in second through sixth grade. Two linguistic assessments were administered, such as 1. The Comprehensive Test of Phonological Processing (CTOPP; Wagner et al., 1999) which was given to assess students' phonological processing abilities as well as 2. The GORT was conducted to evaluate the participants' proficiency in reading fluency (either GORT-4 [Wiederholt & Bryant, 2001] or GORT-5 [Wiederholt & Bryant, 2012]), additionally language samples were collected, transcribed, and coded. They found that East Coast vs Midwestern geographic location related to language performance on multiple tests; younger students had higher dialectical density; East Coast students had higher dialectical density. Also with an all Black/African American student sample ($N = 50$), Mills & Fox (2016) examined students who were between second through fifth grade; multiple linguistic assessments were run and language samples were collected, transcribed, and coded to measure AAE . Their bivariate correlational analysis found a null connection between language variation and the 3 ToM indicators (Mills & Fox, 2016).

In an article by Roy et., al. (2013), students were between pre-kindergarten to first grade (n = 62). This article measured AAE, Southern White English (SWE), theory of mind (ToM), and narration. Additionally, language samples were collected, transcribed, and coded using theSystematic Analysis of Language Transcripts (SALT) software (J. Miller & Chapman, 1992). This study measured the 'Be' production in both AAE (38.7%) speaking and SWE (61.3%) speaking students in the rural south (Be production is the usage of the verb be). They found that AAE child speakers demonstrated a lower frequency of explicit marking compared to the SWE child speakers and suggest that all of these dialect-speaking students "reach adult levels of use for BE at an earlier age than do children who speak MAE" (p. x).

Four articles measured students' identity using mixed methods (Gray et., al., 2019; Carter, 2006; Zoller Booth et., al., 2014; Chavous et., al., 2008). Of these four mixed methods articles, Gray et., al., 2019 in particular take an asset-based approach by using an intersectionality framework to incorporate Grant and Zwier's "seven components of pedagogy that is culturally responsive to students' intersectional identities". This study created an

intervention that combined art, spatial thinking, traditional African cultures, and inquiry approach for aBlack/African American fifth grade students (n = 8) in which approximately 55% of the student population is White. Based on the results of pre- and post-intervention tests, they found that overall students gained social studies knowledge about four traditional African cultures, applied cultural universality between these cultures and their own, and positively increased in racial identity perceptions.

Chavous et., al., 2008, which is described further in RQ3.3, uses mixed methods to examine Black/African American students in 'high-risk' urban neighborhoods; middle-class suburban neighborhoods; and longitudinally between 8th and 11th grade (n = 410). Through analysis of covariance, bivariate correlations, and hierarchical ordinary least squares regression analyses they found relationships between racial centrality, school discrimination, sex, and achievement perceptions; racial centrality positively related to achievement whereas discrimination related to longitudinally and particularly for male students.

Table 9. Included articles methodology frequencies

Quantitative Methods (23 articles)	**Mixed Methods (7 articles)**	**Qualitative Methods (7 articles)**
Adelabu, 2008	Caesar & Kerins, 2020	Bauer, et., al., 2020
Anastasiow & Hanes, 1974	Carter, 2006	Bucknam & Hood, 2020
Ball, 1995	Chavous et., al., 2008	Compton-Lilly, 2006
Baratz, 1969	Gray et., al., 2019	Gholson & Martin, 2014
Butler-Barnes et., al., 2018	Mills & Fox, 2016	Lee, et. al., 2007
Chang, 2012	Roy et., al., 2013	Legette, 2018
Coles-White, 2004	Zoller Booth et., al., 2014	Morales & Hartman, 2019
Craig, et. al., 2005		
Craig & Washington, 2002		
DeLain, et. al., 1985		
DeStefano, 1972		
Gatlin, et. al., 2016		
Genshaft & Hirt, 1974		
Grill & Bartel, 1977		
Kerpelman & Mosher, 2004		
Kim, et. al., 2014		
Miller & MacIntosh, 1999		
Quay, 1974		
Spencer, 1982		
Spencer, et. al., 2001		
Thomas et., al., 2009		
Washington, et. al., 2018		
Worrell, 2007		

Table 10. Included articles measures

Racial/Ethnic Identity & Language and Academic Achievement Measures

	Identity FoK Measure(s)	**Language FoK Measure(s)**	**Achievement/Standard Measure(s)**
Adelabu, 2008	Multigroup Ethnic Identity Measure (MEIM; Phinney, 1992)		Cumulative Grade Point Average (in English, math, social studies/history, and science)
Anastasiow & Hanes, 1974		Registers in 'Negro nonstandard English dialect'	Sentence Repetition Task and a discrimination, seriation and numeration task (Elkind, 1964; Anastasiow et al. 1969)
Ball, 1995		Registers in African American English (AAE); the suffix /-s/ in AAE	Replication of Torrey's spontaneous speech, context cue, and picture meaning subtests
Baratz, 1969		Registers of nonstandard structures (non-addition of third person s, zero copula, double negation and ain't, did-he flip, zero past marker, zero possessive marker, and use of "be")	Registers of Standard English structures (third person singular, presence of copula, treatment of negation, if-did, past markers, possessive markers, and plural markers)
Bauer, et., al., 2020		Registers of English (including Mainstream American English [MAE] and African American Vernacular English [AAVE])	Registers of Standard Spanish (knowledge of vocabulary, syntax, semantics, and pragmatics)
Bucknam & Hood, 2020		Registers of English (including Creole)	Registers in Mandarin (in mathematics and Language arts)
Butler-Barnes et., al., 2018	Multidimensional Inventory of Black Identity–Teen scale (MIBI-Teen scale;		Beliefs Scale for Academic Engagement (Wellborn, 1991); Inventory of School Climate–Student (ISC-S)

	Scottham, Sellers, & Nguyen, 2008)		scale (Brand et al., 2003)
Caesar & Kerins, 2020		Registers in African American English (AAE)	The Comprehensive Test of Phonological Processing (CTOPP; Wagner et al., 1999); The GORT (either GORT-4 [Wiederholt & Bryant, 2001] or GORT-5 [Wiederholt & Bryant, 2012])
Carter, 2006	Semi-structured group interviews and surveys		Grade Point Average (self reported)
Chang, 2012		Identification as Dual Language Learners (DLL), English Language Learners (ELL), English Only	Item Response Theory (IRT) scores (mathematics and reading)
Chavous et., al., 2008	Survey (self-perceptions, sense of efficacy, identity, social competencies, discrimination)		Survey (academic performance, educational and occupational goals and expectations)
Coles-White, 2004		Registers in African American English (AAE)	The Double Negative Comprehension (DNc) Task
Compton-Lilly, 2006	Interviews		Observation Survey (Clay, 2002); Record of Oral Language (Clay et al., 1983); Dominie Reading and Writing Assessment Portfolio (Deford, 2000)
Craig, et. al., 2005		Registers in African American English (AAE)	Registers in Standard American English (SAE)
Craig & Washington, 2002		Registers in African American English (AAE)	A picture description task; two comprehension tasks (Wh-q and Rev)

DeLain, et. al., 1985		Registers in 'Black language'	General language ability; sounding skills; figurative language comprehension
DeStefano, 1972		Registers in 'Black ghetto vernacular'	Language Instruction Register
Gatlin, et. al., 2016		Identification as African American (Implying Registers in African American English [AAE])	Woodcock Johnson III (WJ III) Test of Achievement (ACH) Picture vocabulary (Woodcock, 1977); Kaufman Brief Intelligence Test [verbal knowledge (KBIT-VK; Kaufman & Kaufman, 2004); Test of Language Development (TOLD–P:3; Newcomer & Hammill, 1997)
Genshaft & Hirt, 1974		Vocabulary task in 'nonstandard black dialect'	Vocabulary task in 'standard English'
Gholson & Martin, 2014	Semi-structured focal interviews; Classroom artifacts, videos, audios		Interview (mathematics); Scores from 3 district benchmark tests (unless absent; scores from state-standardized assessments; classroom Grade Point Average
Gray et., al., 2019	Multidimensional Inventory of Black Identity–Teen (Scottham, Sellers, & Nguyen, 2008)		Open-ended questionnaire (content knowledge)
Grill & Bartel, 1977		Registers in nonstandard English	The Grammatic Closure subtest of the Illinois Test of Psycholinguistic Abilities (ITPA) IQ;the Grammatic Closure subtest, the Northwestern Syntax Screening Test (Lee 1969); language tasks (Grill 1973)
Kerpelman & Mosher,	The Ego Identity Process		The Future Orientation Questionnaire (FOQ; Nurmi,

2004	Questionnaire (Balistreri, Busch-Rossnagel, & Geisinger, 1995)		Seginer, & Poole, 1990)
Kim, et. al., 2014		M-DCOLPS-R for DLL screening and assignment to ESOL services (E.g. registers in Spanish, Kreyól, etc.)	Learning Accomplishment Profile-Diagnostic
Lee, et. al., 2007		linguistic experience	Science conceptions (Greenhouse Effect & Global warming)
Legette, 2018	Interview (racial identity)		Interview (schooling experiences, tracking, racial identity, and perceptions of future opportunities)
Miller & MacIntosh, 1999	Multigroup Ethnic Identity Measure (MEIM; Phinney, 1992); Racelessness Scale (RS; (Arroyo & Zigler, 1995); Collective Self-Esteem Scale (CSES; Luhtanen & Crocker, 1992)		Grade Point Average (self reported)
Mills & Fox, 2016		Registers in African American English (AAE)	Diagnostic Assessments (overall cognitive, vocabulary, and narrative abilities); ToM Assessments (Theory of mind)
Morales & Hartman, 2019		Registers in African American Language (AAL)	Registers of Standard Spanish; Registers in Standard American English (SAE)
Quay, 1974		Stanford-Binet Test of Intelligence translated into non-standard dialect	Standard-English version of the Binet

		(Quay; 1971)	
Roy et., al., 2013		Registers in African American English (AAE; Be production)	Registers in 'Mainstream American English' (MAE; Be production)
Spencer, 1982	Race awareness task; race dissonance measure; self concept measures		Verbal measure; inference tasks; generalizability measures
Spencer, et. al., 2001	Racial Identity Attitude Scale (Cross, 1971; Parham & Helms, 1985; McDermott & Spencer, 1996)		Standardized Test (Iowa Test of Basic Skills)
Thomas et., al., 2009	Multidimensional Measure of Black Identity (MIBI; Centrality, Public Regard, and Private Regard scales; Sellers & Shelton, 2003); Everyday Discrimination Scale (Williams, Jackson, & Anderson, 1997)		Grade Point Average (self reported)
Washington, et. al., 2018		Diagnostic Evaluation of Language Variation–Screening Test (DELV-ST; Seymour, Roeper, & de Villiers, 2003)	The Test of Language Development–Primary: Fourth Edition (TOLD-P:4; Hammill & Newcomer, 2008b); The Test of Language Development–Intermediate: Fourth Edition (Hammill & Newcomer, 2008a)
Worrell, 2007	Multigroup Ethnic Identity Measure (MEIM; Phinney, 1992); the RSES		Grade Point Average (self reported)

	(Rosenberg, 1965)	
Zoller Booth et., al., 2014	Semi-structured and open-response Interviews; Rosenberg Self-Esteem Scale (Rosenberg, 1989); Marjoribanks' Perceived Social Capital Scale (PSCS; Marjoribanks, 2002)	School Attitude Scale (Marjoribanks, 2002)

RQ3. ***This studies' final research question asks: What is the nature of the relationship(s) among the languages and racial/ethnic identity(ies) and academic learning of Black students?***

Based on the frameworks guiding this literature review, t students' FoK are viewed as highly intricate and multifaceted. Articles within this literature review measure a non-standard(-ized) FoK resource in relation to a standardized achievement measure (table above). Articles included in this literature review were majority quantitative studies that utilized a standardized measure of FoK (e.g. survey) and achievement (e.g. student reported, GPA, teacher reported). Findings across studies suggest that a relationship between the two forms of FoK (language and identity) is present. This research question will discuss identity and language articles in relation to academic achievement separately since there are several patterns and themes within each FoK resource type. However, across both language and identity articles, the following general themes were identified. The nature of the relationship varies (e.g. positive vs. negatively significant or null significance) with many articles reporting non-significant findings. The final theme in this section discusses articles that also measured lived experience which was a FoK resource also included in the study. This is because lived experiences are important aspects of students FoK and even though this study only includes articles that analyze language or racial/ethnic identity, lived experiences was often mentioned in discussion of both FoK variables (i.e. lived experiences relate to identity and language).

RQ3 Theme 1: Relationship BetweenStudents' Racial Ethnic Identity and Academic Achievement

The identity articles reviewed here each measure racial and/or ethnic identity in relation to an achievement measure. The majority of these articles used quantitative measures (n = 8), some use mixed methods (n = 4), and fewer use only qualitative measures (n = 3). There were many qualitative and mixed methods articles that were excluded because they only examined identity, but not achievement. All identity articles within this study measured racial and or ethnic identity, many also studied **sex** (Butler-Barnes, et. al., 2018; Zoller Both et. al., 2014; Adelabu, 2008; Kerpelman & Mosher, 2004) or other markers of identity as well.

The majority of the articles that measured racial ethnic identity had **mixed results** especially in relation to academic achievement. For instance, several articles suggest that

historically marginalized students have stronger racial/ethnic identities and connectedness than their non-marginalized peers; however, findings also present null or negative relationships between strong racial/ethnic identity and academic achievement. One article suggested that students' who managed academic and social lives were the 'cultural straddlers'; they defined cultural straddlers as students who navigate multicultural capital practices and accept multiple ways of living (such as dominant and non-dominant cultures; Carter, 2006).

RQ3. Theme 1.1 Identity Articles that look at mixed racial/ethnic participants. The majority of the included identity articles examined populations that were 100% Black (n = 12) or 100% Historically marginalized (n = 1) student samples and only two of the included identity articles included White student samples (n = 2; Zoller Both et. al., 2014; Worrell, 2007). Frank Worrell's research suggests that historically marginalized students had stronger ethnic identity yet lower other group orientation scores than their White peers. Zoller Booth and colleagues found that White students in their study typically do not give much consideration to their ethnic or racial background, leading them to also overlook how this identity may affect their experiences in the classroom (2014; Phinney, 1989). Their mixed methods findings also suggest that Black students have intricate connections between their ethnic identity, self-esteem, and school perceptions in comparison to the other students within the study; Black students within the study showed a strong attachment to their ethnicity, similar to Hispanic students, but this attachment was not always positive, particularly for Black male students. For instance, Black male students were often advised by parents/guardians not to overtly 'act Black' (Zoller Both et. al., 2014).

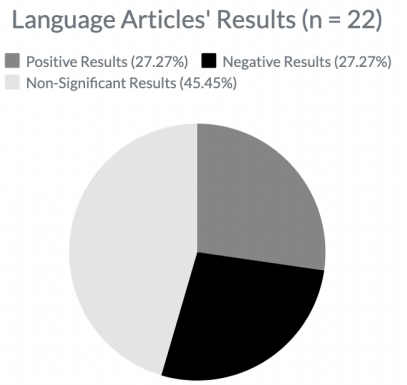
RQ3. Theme 1.3 Identity Articles that look within/across homogeneously Black participants. Several studies examined racial/ethnic identity within a majority or all Black U.S. student population. Some of these articles suggest variation in racial/ethnic identity and achievement by **sex** (Kerpelman & Mosher, 2004). For instance, Kerpelman and Mosher's research (2004) found that "African American girls are more future oriented in their thinking and behavior pertaining to education and career"; they also mention that this finding is in line with previous research (Sanders, 1998; Brown, 1997; Johnson and Engelhard, 1992). Some authors discussed to what extent Black students' **centering of White mainstream values** in relation to academic achievement. For instance, Spencer et al. (2001) measured racial identity in a middle school sample (n = 562); in a previous article, Spencer measured racial identity in a young sample (n = 384; aged 3-9; 1982). Initially, Spencer's findings suggest that the relationship between Black students is more intricate than previous research suggests and that more needed to be done with a wider age sample (1982). Later, Spencer's research found that for their sample of Black middle school students, lower levels of achievement were linked to a high focus on Eurocentric values and perspectives (Spencer, et. 2001). They found that African American students who were classified as 'high-achieving' could not uphold 'acting White values' and recognized that they should not be assessed on White mainstream standards (Spencer, et. al., 2001). This means that African American students within this student who achieved higher scores had lower Eurocentric values. This is a unique finding that in a homogeneously Black sample, students with high Eurocentric values achieve lower than students with low Eurocentric values; this finding is different than literature that measures Black students who are the minority in their school (e.g. Spencer's 2001 finding is contrary to Carter's 2006 finding that students' who are cultural straddlers are higher achievers).

Many of the articles with 100% Black student samples had **positive findings** in relation to achievement. Adelabu's research found that higher grade point averages were associated with

positive futuristic outlook, higher grade levels were associated with higher GPA's, and finally ethnic identity and achievement were found to have a positive relationship through correlation statistics (2008). Two articles were **qualitative analyses** of identity and achievement (Legette, 2018; Compton-Lilly, 2006). Compton-Lilly conducted a case study on an African American male first grader in an urban midwestern context ($N = 1$) focused on literacy, identity, media, and resources in relation to childhood (2006). She found that cultural resources such as media references (e.g. favorite superhero) or relationships (e.g., classroom peers, family) were beneficial tools for the student's academic development (Compton-Lilly, 2006). The work of Legette suggested that 'tracking' Black seventh grade students ($N = 20$) as either 'honors' or 'non-honors' related to the variation of students' self-awareness of academic achievement and opportunities; for instance, they found that their were negative stereotypes of non-honors students and some of the honors students believed that the 'underachievement' of their non-honors peers created negative connotations for Black people as a society (2018). Overall, these articles that focus on Black samples show that Black students' have unique identities from White/non-marginalized populations that needs further analysis; articles also suggest that FoK are assistive resources that support academic achievement.

RQ3 Theme 2: Relationship Between Students' Languages and Standard American English (SAE)

Figure 2. Proportion of studies that showed positive versus negative versus non-significant/mixed relationships between language and academic achievement.



The language articles included in this review examined registers in both a standardized and nonstandardized language; many articles included samples of student oral language that were transcribed, and quantitatively coded for linguistic patterns associated with specific languages. Results across these studies were mixed with the majority of articles having non-significant or inconclusive results (n = 10); and the remaining articles finding significantly positive (n = 6) or negative (n = 6) results (see table). Some articles with **negative or neutral results** still show that Black students have a dialectical difference as opposed to deficit that affects their abilities in a standard language (Baratz, 1969; Genshaft & Hirt, 1974; Grill & Bartel, 1977; Washington, et. al., 2018). For instance, Washington, et. al.'s cross-sectional study analyzed "the relationships between dialect density, general oral language skills, and reading" in first through fifth grade (n = 835; 2018, p. 235); they find that students who used higher AAE dialect density had

significantly lower SAE reading and language scores. Results such as these accurately report the statistical achievement gap between AAE and SAE students. These articles provide systematic patterns of AAE showing how the dialect is different from that of SAE; however, these articles limit their investigations to students' existing achievement scores in a curriculum that values SAE and does not integrate the use of AAE. Therefore, deficit views of African American students' linguistic ability may be perpetuated and the opportunity gap that these dual-dialectical learners face is ignored.

Several articles had **mixed** results about Black students' language usage in relation to achievement, meaning that the usage of non-SAE dialects and languages may have positive and negative relationships to standard language usage. However, of these articles many had **positive results** specific to speaking multiple languages. For instance, Mido Chang conducted a quantitative comparison study of English Language Learners (ELL), dual-language learners (DLL), and English-only speaking k-5 students within racial groups (White, Black, Latinx, and Asian students) across the U.S. ($N < 21{,}399$; 2012). This study defines both ELL and DLL students as multilingual but ELL students referred to English as a Second Language (ESL) programs whereas DLL are not reported to struggle in English classes (Chang, 2012). This study does have a smaller sample of Black students whose home language is Dual-Language (1.7%) and ELL (1.4%) than English-Only (96.9%). The findings are mixed yet **positive for Black DLL**. A non-significant finding from this study is that ELL students had lower scores. A negative finding is that "English-only students from the Black group who attended all-day kindergarten displayed a significantly lower growth rate in both mathematics and reading" (Chang, 2012, p. 31). However, the study found that for Black DL students, the all-day kindergarten had a positive increase in math and reading (Chang, 2012, p. 32).

One study analyzed emergent bilingual second and fifth grade students' linguistic usages within a Standard Spanish classroom (Morales & Hartman, 2019); this article suggests that it is valuable to recognize the multilingual and multi-dialectical contributions of historically marginalized students by acknowledging and accommodating different forms of English, Spanish, and other nonstandard languages. Furthermore, they found that the Spanish teacher used AAE as an exemplar to the entire classroom which validated this dialect as a positive resource for any language (Morales & Hartman, 2019). Another study analyzed students' language within a Mandarin Immersion classroom (Bucknam & Hood, 2020). There were two African American students within this study: one a female who spoke creole at home and the other a male who had prior Mandarin instruction and often spoke Mandarin with a sibling at home; for these two students they found that the female student with the least Mandarin exposure "spoke more Mandarin than her two native English-speaking peers" whereas the the male student who had the most Mandarin exposure utilized Mandarin less than others (Bucknam & Hood, 2020). Although this study had overall positive results (i.e. 61% of classroom talk in Mandarin) it underscores the mixed nature of results as well particularly with the very different language usage outcomes of the two Black students and likely there could be further reasoning as to why students felt more or less capable of Mandarin usage (Bucknam & Hood, 2020).

Two studies analyzed the effect of a **linguistic intervention** (Lee, et. al., 2007; Ball, 1995). Lee et. al., described in a previous section, had mixed results; however, they found little to no significant results for their Black sample (African American and Haitian; 2007). Arnetha Ball conducted a replication of a /-s/ suffix intervention with second grade AAE speakers in the midwest (n = 31; Torrey, 1972; 1995 p. 31). She found that students receiving the explicit intervention had a positively significantly higher pre-test post-test increase than students

receiving 'literature-based instruction' suggesting that SAE should be taught to AAE speaking students only after understanding and explicitly incorporating their unique speech in instruction.

Overall, it is clear from these articles that Black students are exposed to numerous languages and dialects and this exposure and usage may have both positive and negative consequences on their usage of a standardized language; however, it seems that when these students home languages/dialects are explicitly embraced and or intentional interventions are created that are mindful of who students are, these multilingual resources become more beneficial.

RQ3 Theme 3: Relationship Between Language and/or Identity with Students' Lived Experiences

Although none of the articles included in this study measured both language and racial/ethnic identity, four articles (Gholson & Martin, 2014; Chavous et. al., 2008; Lee et. al., 2007; Miller & McIntosh, 1999) measured students' lived experiences which is another important aspect of students' FoK not focused on within this literature review (Lived experience mentioned in methodology section).

Lee and colleagues (2007) conducted a science classroom intervention-based study aiming to intentionally incorporate the cultural and experiential understanding of students with the goal of creating scientific curricula that is readily available, useful, and purposeful for any student (Lee, et. al, 2007; Lee, 2004; Lee and Fradd, 1998). Although this study did not find significant improvement in African American nor Haitian students, they did find that Latinx (race/ethnicity) and English/Spanish bilingual students' (languages) showed the most significant improvement after undergoing the intervention.

The other three articles that analyzed students' lived experiences overlapped with students' identity. One study measures racial identity, perceived discrimination, and academic performance amongst other variables on an entirely Black/African American sample ($N = 410$) using mixed methodology; their findings suggest sex variation and a small negative relationship between discrimination and achievement for males specifically (Chavous et., al., 2008). Miller & McIntosh (1999) examined racial socialization and ethnic identity on an entirely Black/African American sample ($N = 131$). They found that a positive racial identity can be used as a tool to cope with discrimination and that a positive ethnic identity correlated with higher academic achievement (Miller & McIntosh, 1999).

Finally, one qualitative ethnographic case study examined several intersecting variables (i.e Black identity, Black girlhood, social networks, mathematics identity, lived experiences, mean, bully, etc.) at an Elementary school within a homogeneously Black neighborhood (Gholson & Martin, 2014). Several types of data (i.e., video recordings, student documents, interviews) were collected from one teachers' classroom, and a further examination was taken on the group and individual identities of the female students (n = 10). The others found that students racial identity, socio-political constructions of their racial identities such as colorism, and social positions within the classroom affected their academic performance and ability to participate in classroom discussions; students' academic achievements were measured in this study through mathematics interviews, standardized tests, and grade point averages (Gholson & Martin, 2014).

Conclusion

In this systematic literature review of 37 articles, K-8 Black students' FoK (i.e. racial/ethnic identities and languages/dialects) were analyzed in relation to academic

achievement. Findings are presented in order of the three research questions and major themes found within these questions. These articles included analysis of both a non-standardized resource (i.e. language or identity) and standardized achievement measures. Terminology and conceptualization of variables varied across studies. Studies were majority quantitative, but also qualitative and mixed methodology were represented. Finally, several articles took an asset approach and recognized the importance of leveraging students' FoK through their literature framework and or pedagogical approach. In terms of identity, results found that Black students' racial/ethnic identity matters to them and that positive appreciation of their own identity often leads to positive academic outcomes. Racial/ethnic identity is often found to have varied consequences and results by sex. Studies with mixed samples that included non-marginalized samples found that students who embraced multi-cultures were most academically successful whereas articles with homogeneously Black student samples often found a positive relationship between centering Black/African identity and achievement and one study even found a negative relationship between centering Eurocentric ideologies and academic achievement. In terms of language, articles that compared Black students with other student samples often found negative results (e.g. usage of AAE deters usage of SAE) yet these articles still prove that AAE is a standardized dialect that is unique to SAE. Language articles that incorporated specific pedagogical approaches or interventions that recognized students' home languages/dialects as an asset often found positive results. It is clear that Black students racial/ethnic identity and languages/dialects are unique from that of mainstream classroom standards and that intentionally incorporating who these students are into the curriculum often leads to more positive effects on their academic achievement.

Discussion

In the majority of classrooms, Black and Brown students are not told how to use the knowledge that they possess if it is not the same knowledge of the dominant culture. In most classrooms, and even in some of the research reviewed above, BIPOC students are told that they are deficient and need additional intervention in order to have a chance in academia; however, these students should be intentionally taught that because their culture is different from the culture of the majority, they have to use more effort than other students to code switch and navigate through two or more cultures. Although both explanations tell students they need additional intervention to perform similarly to White peers, the former explanation says it is because BIPOC students are less intelligent whereas the second explanation empowers Black students by allowing them to realize they are intelligent and recognize how rich their cultural knowledge is.

It may be impossible to decide one single way to change this reality because there are numerous factors at play. For example, both Black and non-Black individuals have misperceptions of the importance of languages and dialects that are different from SAE. Since each Black person, Black community, and Black student is unique, school curriculum would require an increase of variability of text, materials, and real world examples in order to become inclusive and relatable for all students in the United States. A similar classroom curriculum, scope, and goals across the nation is important to formulate similar foundational conceptualization for all American students, but how this information is exemplified should be dependent on the needs in the classroom. These needs should be evaluated by recognizing the ecological systems influencing the community and further communicative investigation with each student and parental guardians. Even though teachers have the honorable and crucial task of teaching students required material, teachers should also give students the tools and confidence

to use their knowledge and experiences alongside the knowledge learned in the classroom. How this occurs could differ across nations, regions, schools, and ultimately the classrooms as it should. Each classroom is a system of individuals.

The experience in one classroom could never be exact to the experience of another. So, why should the material used for each classroom be exactly the same? Alongside examining classical literature or literature using SAE, teachers can utilize modern literature as well, or literature written in various dialects. Music is an example of engaging literature that students may relate to and be motivated to lead discussions. For instance, all teachers should start by asking students about their interests. If many students listen to a similar hip hop artist, the teacher could print the lyrics and discuss with students the meaning of different phrases or practice writing the phrases in SAE and discuss why each language type is useful in different ways. Classes could compare lyrics across genres and brainstorm why these differences occur. Students should be encouraged to find examples of various languages on their own and have more authority in what is discussed in the classroom.

When teaching multicultural classrooms, it is very essential for teachers to realize the difference between incorporating student culture and appropriating student culture. For instance, if a White Female teacher wants to teach her class of majority Black students how cornrowed hair styles were used as maps by slaves or how Negro spirituals were used as a linguistic code, she should not cornrow her own hair or sing Negro spirituals to represent this. Instead, she can use resources to assist the lesson, or have a Black guest lecturer who is more familiar with the cultural reference. If students speak in a dialect that the teacher is unfamiliar with, teachers should ask students what they mean when they use a word or phrase, but they should not mock the students by attempting to converse in the students' home dialect themselves. When teachers represent student culture but are cognizant not to appropriate that culture, they show their students that they respect them and appreciate them. If Black students are told that they are important members of society, if they are listened to, encouraged, and respected for who they are and the culture they possess, they may have a higher chance of success even within a system that is not designed for their success. African-Centered (or Afrocentric) Psychology is useful philosophy when aiming to understand the culture of Black students in the U.S. and reforming their educational experiences (Awosogba, et. al., 2023). This philosophy centers culture when conceptualizing how African descent individuals make sense of their environment.

Implications and Limitations

Asset-based research on historically marginalized students, specifically Black students is essential for increased academic achievement, belonging, and motivation. This systematic literature review addresses gaps in literature regarding Black multilingualism and culture. The context of U.S. education research continues to evolve and become more representative; however, more needs to be done connecting education theory to practice. Future researchers, including my own research, can refer to this systematic literature review to have a comprehensive understanding of what has been done in the class and novel interventions that would be useful. This systematic research will be especially beneficial collected directly in classrooms. As this is a literature review, this research does not directly draw from a specific sample and themes and patterns may not be as impactful as empirical research itself. As explained early on, education research is an evolving entity; this research has not always highlighted the strength with Black populations and can contain systematic racism that may continue to perpetuate classroom realities. That is why it is important that this review critically

examines previous work with a modern lens. Modern research cannot transform without learning from what has or has not worked previously. Another limitation is that not every aspect of funds of knowledge is described or detailed and with this, many researchers who work with Black populations may discuss funds of knowledge and language, but may be using other terminologies (i.e. vernacular, Ebonics, slang, hip hop, rap, hood, ghetto, etc.). That means that the key terms used for this research have a researcher bias and may neglect viable findings that do not use educational psychology findings. However, this review can evaluate what terms are used in each of the articles and learn which key terms are most important to addressing the issue. Future research should expand upon this review to be inclusive of other racial/ethnic marginalized groups and expand to early childhood, high school, and higher education.

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II. SECOND MANUSCRIPT.....

ABSTRACT

This qualitative case study analyzed examples of students' funds of knowledge (FoK) and teacher incorporation of FoK into classroom lessons through the interviews of seven science middle school teachers in diverse and urban classrooms. This study used asset-based and culturally inclusive pedagogies that recognize students' diverse identities, languages, and lived experiences (funds of knowledge, FoK) as valuable resources for learning (Moll et al., 1992). The goal of this study was to 1) explore teachers' recognition of marginalized students' diverse FoK, 2) examine teachers' FoK and its relation to students' FoK, as well as 3) investigate to what degree teachers integrate students FoK into their pedagogical approaches.

1. Integration of Historically Marginalized Students' and Teachers' Identities, Languages, and Lived Worlds in Urban Middle School Classrooms

For historically marginalized youth (i.e., racially minoritized or [BIPOC] Black Indigenous Persons of Color) social inequities create systemic barriers including access to high-quality learning experiences (Harper, 2013). Culturally responsive and relevant education (CRRE; Barrio, et. al., 2017; Kugler & West-Burns, 2010) aims to address these inequities by taking approaches to creating classroom environments that invite and value students' cultural practices and experiences (cultural competence), create ongoing opportunities for students to have the agency to choose academic excellence (academic success), and develop an understanding of socio-political and -historical issues that are rooted in societal and communal goals (critical consciousness; Ladson-Billings, 2014; Paris, 2012). This approach counters traditional "deficit models" of historically marginalized students and instead operates from the stance that marginalized students can prosper within an educational system that recognizes the academic value of their home and cultural resources that may not fit with Eurocentric norms and values in mainstream schooling (Esteban-Guitart et al., 2019; Moll, et. al. 1992; Oughton, 2010; Vélez-Ibáñez & Greenberg, 1992). Specifically in science education, disciplinary ways of talking and knowing are often foreign to marginalized youth (Brown & Spang, 2008; Brown & Ryoo, 2018; Calabrese-Barton et al., 2008; Emdin, 2011). A large body of scholarship shows that students' out-of-school experiences, languages, and cultural practices exemplify science, but may not be represented within standardized school science curriculum (Bang & Medin, 2010; Moje et al., 2004; Warren et al., 2001). These home and cultural resources that students bring to bear have been referred to as their *funds of knowledge* (FoK, Moll et al., 1992). Importantly, teachers play a crucial role in meaningfully integrating students' FoK within or beyond standard classroom materials (Emdin, 2011; Esteban-Guitart et al., 2019). Further, identifying and integrating representative elements of student FoK in their classrooms often transcend mainstream curriculum and instructional practices (Esteban-Guitart et al., 2019; Moje et al., 2004; Rodriguez, 2013; Warren et al., 2001). One aim of this study is to describe the ways middle school science teachers engage in this particular CRRE approach to identify, value, and leverage their students' FoK in their science classrooms.

Additionally, there is a gap in the literature on the FoK that *teachers* bring to bear, and how this influences the ways in which they identify and incorporate their students' FoK in their science classrooms. However, emerging literature in this area indicates that the personal experiences and associated beliefs, values, and identities that teachers bring to their classrooms plays a strong influence in their pedagogical decision-making practices (Hedges, 2012). That is,

teachers' FoK is the filter through which they make instructional decisions (Hammersley, 2005). Thus, another major aim of this study is to better understand the FoK of teachers, and how this relates to their ability to identify and integrate their students' FoK in science classrooms.

Taken together, the purposes of this study are twofold: 1) To identify and describe middle school science teachers' FoK, and 2) to describe how teachers' FoK relate to how they identify and integrate their students' FoK in their science classrooms. The CRRE framework and concept of FoK are described next, as well as review of empirical studies focused on integrating students' and teachers' FoK in science classrooms.

2. Asset-Based Pedagogy: Elevating Student's Funds of Knowledge

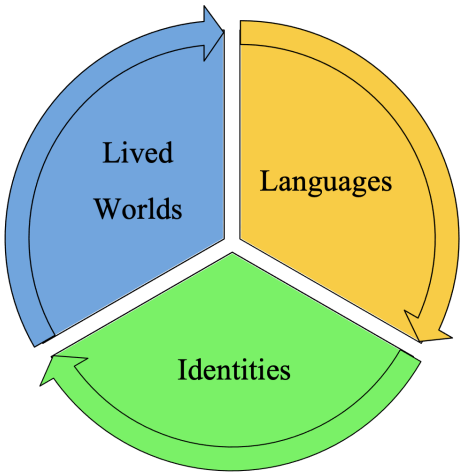
Our research draws upon asset based theoretical frameworks that recognize cultural variations as beneficial to learning when implemented intentionally. Deficit based approaches often label marginalized and/or low-SES communities as at-risk, only emphasizing how these communities are unequipped for U.S. classrooms rather than asking how U.S. classrooms could become more adept at supporting these student populations (Anastasiow & Hanes, 1974; Cole & Bruner, 1971). Asset approaches recognize the diverse cultural resources students bring to classrooms as valuable for learning. The importance of CRRE (Gay, 2002; Ladson-Billings, 1995, 2014; Paris, 2012) for making science learning relevant and accessible to historically marginalized students is well-established in the literature (Ladson Billings, 1994; Paris et al., 2012). Several case studies and literature syntheses demonstrate the positive effects of CRRE on student learning, including desirable outcomes such as positive ethnic identity, higher standardized test scores, and higher graduation rates (Aronson & Laughter, 2016; Howard & Rodriguez-Minkoff, 2017). Our study draws from core principles of CRRE, which views each new generation of students as holding evolving FoK that are influenced by national policies, historical events, home lives and local communities, as well as popular and youth cultures of their time, which have academic value for classroom discourse (Ladson-Billings, 2014; Paris, 2012).

A core facet of CRRE that is particularly relevant to this study is identifying and inviting students' diverse FoK into science learning activities in meaningful ways (Moje et al., 2004; Moll et al., 1992). Funds of knowledge refer to culturally developed knowledge and practices (e.g., native dialect) of students' households and communities (Gonzalez & Moll, 2002; Moll et al., 1992). For instance, students' native dialect as well as racial and ethnic identities are elements of their FoK. González and colleagues (2005) argued that, "The concept of funds of knowledge . . . is based on a simple premise: People are competent, they have knowledge, and their life experiences have given them that knowledge." (González, Moll, & Amanti, 2005b). However, people's competences–their knowledge– are not often acknowledged or valued in classroom curricula.

Funds of knowledge have been considered a (1) a theoretical and methodological framework to conceptualize formal education and the resources of historically marginalized students' home and cultural resources and (2) an approach to transforming educational activities by integrating traditional or mainstream curriculum with students' FoK (Llopart et al., 2018). In this study, we primarily use the concept of FoK as a framework to systematically identify teachers' FoK as well as to document the student FoK teachers identify in their science classrooms. However, we also apply the concept of FoK as a pedagogical approach by documenting and describing the ways that science teachers integrate students' FoK with the science curriculum. Specifically, we delineate three major sources of teacher *and* student FoK

established in the literature, including: 1) **lived worlds** (e.g., experiences from home, social activism within communities), 2) **identities** (e.g., membership to geographic, social, cultural, institutional groups), and 3) **language practices** (e.g., non-English native language, dialects, youth genres, Jovés et al., 2015; Brown, 2006; Emdin, 2011; Hedges et al., 2011; Love, 2014; Petrone, 2013). We next describe each of these sources of teacher and student FoK and how teachers leverage them within their instruction before presenting research specifically related to teacher FoK.

Figure 1.



2.1. Students' Funds of Knowledge

A review by Bae and colleagues (2021) provides a synthesis of studies that illustrate the various aspects of historically marginalized students' FoK and how they are integrated into mainstream science curricula. These studies are briefly summarized below.

2.1.1 Lived Worlds. Lived worlds refers to the various contexts that students engage in both inside and outside of school, including: (a) family, (b) community, (c) peer groups, and (d) popular culture. The concept of 'lived worlds' was explicated by several ethnographic case studies of middle school science classrooms (Calabrese Barton & Tan, 2009; Irish & Kang, 2018; Moje et al., 2001; Calabrese Barton & Tan, 2009). These case studies also revealed the ways in which teachers brought students' lived worlds into the science classrooms in an effort to make science content more relatable and engaging to students. Efforts included encouraging storytelling (e.g., experiencing a hurricane in the Dominican Republic) and connecting to family experiences (e.g., family salad recipes as examples of nutrition).

2.1.2 Identities. Students' identities are formed through their membership in various social and/or cultural groups. Identities are stories constructed by self and others within a given way of believing, acting, and interacting (Gee, 2001). The development of identities is conceptualized as a process (not product); rooted in culture and culturally-based language (rather than individual language), dynamic (not constant), and interrelated with others' identities and actions in the world (rather than individualistic; Gee, 2001). Within this frame, personal actions are understood in the context of how one's identities are negotiated through language, through one's social context, and through one's current and historical interactions with others. However, critical scholars (e.g., Brickhouse et al., 2000) stress the oppressive structures historically marginalized students often find when attempting to connect their

identities to science curriculum and instruction, as teachers of the discipline often position marginalized students as outsiders due to perceived disconnects between the cultures of the school and students.

Studies have empirically investigated the ways in which teachers can create contexts within the science classroom for students to both connect their identities to science instruction and curriculum as well as to develop their identities as scientists. For example, Thompson (2014) conducted a 4-week intervention called "lunchtime science" where girls from an underserved high school who were failing science collectively built their science identities through discourse. Through activities that helped the students ask and answer questions relevant to their lives, the girls came to see themselves as having the authority to solve problems and built a sense of belonging within the science classroom. Additionally, O'Connor (2015) and Reveles et al. (2004; 2007) described the discursive moves teachers used to position students as scientists. Phrases inviting students to think like scientists (e.g., 'we are going to be thinking like scientists' or 'your questions are the same questions astronauts try to answer') and act like scientists (e.g., 'scientists observe carefully. You can too' or 'scientists are able to defend their claims. You can be an expert and defend your claims as well') can forge connections between students' various identities and those of scientists.

2.1.3 Languages. Languages are the words, both spoken and written, used for communication. They refer to languages and dialects students use at home, to communicate with peers, as well as those used within the science classroom and are accordingly representative of particular cultures and values (Bayne, 2009; Emdin, 2009; Gee, 2004; Gumpertz & Hymes, 1986). Language of the science classroom is frequently characterized as highly academic because it possesses technical vocabulary and uses complex sentence structures. This academic language often poses barriers to marginalized students' participation in the science classroom in two ways: 1) by describing intelligible concepts in esoteric and confusing ways; and 2) through linguistic hegemony that requires students supplant their languages and dialects with formal discourse of the science curriculum (Brown, 2004; Kachchaf et al., 2016; Lee et al., 2013).

To mitigate the hegemonic effects of science discourse, teachers can engage in a process of linking students' languages and dialects with the formal academic language of the science curriculum. For example, the fifth-grade science teachers studied by Brown and Spang (2008) used "double-talk" to connect students' vocabulary with the scientific equivalent (e.g., "backbone…skeleton in your back" was connected to "invertebrate"). When teachers engaged in this double talk, they promoted students' vocabulary and conceptual understandings. Additionally, Varelas et al. (2002) described how student-created rap songs built their conceptual understanding of scientific theories of buoyancy and gravity while related work by Emdin (2011) argued that teachers could use rap battles to both connect to and validate urban students' language while promoting 'co-generative' dialogue where students build scientific understandings together in the classroom.

2.2 Teachers' Funds of Knowledge

Although a much smaller literature base compared to the work focused on students' FoK in science classrooms, there is emerging evidence showing that teachers' FoK play a crucial role in how they implement CRRE (Hedges, 2012). Teachers are shaped by the contexts of their personal and professional experiences, and in turn, their practice is filtered through the personal

and professional lenses that teachers bring to their classrooms (Hammersley, 2005). Through a case study of two elementary math teachers, Andrew et al. (2005) demonstrated how teachers' FoK related to their personal experiences of being a parent, sharing ethnic and/or religious backgrounds with their students, and being part of their local community influenced their pedagogical decisions in their daily professional practice. For example, shared ethnic and religious backgrounds gave one teacher an "insider" perspective that supported her ability to build relationships with the parents towards a shared goal of supporting the students' academic achievement. As another example, the experience of being a parent allowed another teacher to understand the lack of time at home for parents and children to engage in math-related activities . Similarly, another study documented teacher candidates' FoK through a collection of narratives from their childhood experiences (e.g., cross-cultural experiences, multilingual experiences), and showed how the diverse personal challenges and lessons learned in their own schooling experiences influenced their beliefs and values about the goals bridging informal and formal knowledge in their teaching (Gupta, 2006).

The presence of this small, but growing body of work suggests the need for an empirical examination of how teachers' FoK (Hedges, 2012) co-exist and interact with student FoK in school classrooms. We aim to take a first step in this work by analyzing teacher interviews to identify and draw comparisons (e.g., similarities and differences) between teachers and their students' FoK, and also to examine how teachers speak about applying CRRE approaches that leverage their students' FoK in their science classrooms. Additionally, research also shows that the occurrences of FoK integration occur sporadically and are often absent in formal learning settings (Authors, 2022; Calabrese Barton & Tan, 2009; Emdin, 2011; Moje et al., 2004). The existing literature provides several explanations for this, including the time and effort required for teachers to implement a FoK approach in their classrooms (e.g., meeting their students' families and learning about their home lives, Llopart et al., 2018), differences between teachers and their students' ethnic, cultural, and language backgrounds (Redding, 2019), variation in the degree of teachers' awareness around issues of power and marginalization in education that impact their students of color (Matthews & Lopez, 2019; Rodriguez, 2013), and structural barriers and accountability systems that limit teachers' ability to flexibility adapt and expand the curriculum (Haverly et al., 2020; Parkhouse et al., 2022). Therefore, we acknowledge these complex confluence of factors that can support or constrain teachers' use of CCRE.

2.3. Leveraging Student Funds of Knowledge with mainstream curriculum. Scholars have documented three prominent ways in which FoK is integrated into education spaces: 1) the ***presence*** of FoK in canonical, academic spaces (i.e., students' FoK is mentioned but not connected to subject matter in a meaningful way); 2) the ***bridging*** of FoK with academic or mainstream curriculum (i.e., superficial connections between students' FoK and subject matter that privileges the latter); and 3) the ***transformation*** of academic knowledge/practices and FoK to create new, equitable ways of knowing (i.e., norms and what counts as knowledge related to subject matter is transformed to include students' FoK; Gutiérrez et al., 1999; Moje et al., 2001, 2004). We also draw from studies that underscore how students' diverse languages create opportunities for ***crossing*** or ***navigating*** between dominant and diverse discursive resources of youth and minority cultures (e.g., Emdin, 2011; Lee, 1993; Varelas et al., 2002).

Importantly, research shows that teachers' level of critical consciousness influences their ability to identify and integrate their students' diverse FoK in mainstream curriculum. Critical consciousness in a frame of mind that guides educators in engaging with 'liberating' pedagogical

practices that not only support students of color in succeeding within current education systems, but also empowers them with critical knowledge of societal structures rooted in U.S. and global history such as capitalism, racism, and segregation (Watts et. al., 2011; Freire, 1970). Teachers who recognize the negative impact of social inequities are more likely to support students in becoming adept at interrogating oppressive educational norms and practices (Ladson-Billings, 1995, 2014). A key principle of this critical pedagogy involves elevating historically marginalized students' FoK into mainstream curriculum to expand ideas about *who* belongs in classrooms and *what* counts as knowledge towards more inclusive learning environments (Ladson-Billings, 1995; 2014). Scholars call for the importance of integrating students' diverse FoK in the science curriculum (e.g., Authors, 2022; Calabrese Barton & Tan, 2009; Emdin et al., 2021; Haverly et al., 2020; Moje et al., 2004), but translating these goals to practice is complex and information to guide this approach to teaching is lacking. Specifically, there is a gap in the literature regarding *when* and *how* to productively integrate students' FoK in classrooms, and the variation in the degree to which this integration occurs. Therefore, in addition to documenting the student FoK that teachers identify and integrate in their science classrooms, we will examine the degree to which this integration is occurring with illustrative examples.

3. PURPOSE OF THE STUDY

The literature presented above clearly demonstrates that both teachers' and students' FoK play important roles in teachers' pedagogical decisions. In this study, we aim to contribute to the literature regarding CRRE approaches that identify and elevate students' FoK in science classrooms, with close attention to how teachers' FoK plays a role in this process. The following research questions guided this study:

1. What FoK (lived worlds, identities, languages) do teachers bring into their science classroom?
1. What student FoK (lived worlds, identities, languages) do teachers identify?
2. To what degree (present, bridge/navigate, transform) do teachers describe leveraging their students' FoK with science content in their classrooms?

4. METHODOLOGY

4.1. Design and Sample

We used a multiple case study methodology for explanatory purposes (Yin, 2014), as this method best answers our questions regarding how teachers' FoK, and their recognition of their students' FoK influence their science pedagogy. A case study refers to a thorough investigation focusing on an individual, a group of individuals, or a particular segment, with the purpose of drawing general conclusions that can apply to multiple segments (Gustafsson, 2017). Unlike single case studies, the multiple case study examines multiple cases to comprehend their distinctions and commonalities (Gustafsson, 2017; Baxter & Jack, 2008; Stake, 1995); additionally, multiple case studies analyze data within each case and as well as across cases (Gustafsson, 2017; Yin, 2003).

This study of six middle school science teachers was part of a larger research project that examined science discourse within an urban Mid-Atlantic public school context that served historically marginalized student populations (Authors, 2022). The sample of teachers included 1 male and 5 females, with an average of 12.71 (SD = 5.79) years of teaching experience (see table 1 for additional teacher and school district demographic information). We present singular

case findings for each teacher by code themes; therefore, there is a case detailed for each teacher that is organized in three sections (i.e. their description of their own FoK, their students' FoK, and their integration of students' FoK). Additionally, a cross-case analysis of thematic patterns between all six teachers is discussed in terms of major convergences and divergences across their discussions of their student populations.

Table 1
Description of participating teachers at year of data collection

Teacher	Sex	Age	Race	Grade	Total # years teaching	School Division	Educational and professional history
Mr. T	M	41	White	8	13	A	Bachelors (Biology Education)
Ms. R	F	44	Black	6	19	B	Bachelors (Biology), Masters
Ms. Y	F	29	Black	6	7	B	Bachelors (Athletic Training), Masters
Ms. H	F	47	White	7	9	A	Bachelors (Education)
Ms. C	F	35	White	8	5	A	Bachelors (Earth & Environmental Science)
Ms. L	F	39	Black	7	15	B	Bachelors (Biology), Masters

Note. School divisions A and B serves a student population who identify as male (51%, 50%), female (49%, 50%), and White (50%, 12%), and Black (26%, 69%), Hispanic/Latinx (16%, 15%), Two or more races (5%, 2%), Asian/Pacific Islander (4%, 2%), and Native American (< 1%, < 1%), respectively.

4.2. Data Collection

Prior to data collection, approval to conduct the study was obtained from the university Institutional Review Board as well as the research and assessment office in the participating school divisions. After receiving written and verbal consent from each teacher, zoom interviews were conducted and recorded. A semi-structured interview protocol was used, which consisted of five sections (i.e. introduction/consent, distance learning, discourse/FoK, language usage, and conclusion), focused on teachers' awareness of their students' culture and language usage, their own FoK in relation to their students, as well as their science and CRRE pedagogical practices with urban marginalized youth (Appendix A). The semi-structure provided a consistent structure while also allowing the interviewer to probe teachers' responses for additional detail and context. The interview protocol also included showing teachers a short video clip from a video-recorded science lesson that was identified as a hybrid discourse space (i.e. includes representation of student FoK) within the larger project (Authors, 2022). This video clip was intended to anchor teachers' reflections of their pedagogical decisions in actual classroom events, rather than general retrospective reports (Fishman et al., 2017). Each teacher received a copy of the questions prior to the interview, and the interviews lasted between 45 to 60 minutes in length. All interviews were video-recorded on zoom and transcribed verbatim for coding in *Dedoose.*

4.3. Analyses

4.3.1. Familiarization and segmenting. First, all three coders listened to the interviews prior to coding to familiarize themselves with the data. The six transcripts were divided into 146 distinct segments by the first author (approximately 24 segments per interview, 5 sentences per segment) for coding purposes. We created segments using guidelines from previous qualitative that define a segment as a unique 'unit of talk' with distinct talk turns and or subject from the next segment (Authors, 2022; Hogan et al., 1999; Murphy et al., 2018).

4.3.2. Coding. Based on findings from a prior systematic literature (Authors, 2021), we developed a codebook. Parent codes directly related to the research questions (teacher FoK, student FoK, and FoK integration). Child codes were then developed within the broader parent codes to systematically distinguish among the three distinct types of teacher and student FoK (i.e., *lived worlds, identities, languages*) as well as three distinct levels of FoK integration (i.e., present, bridged or navigated, and transformed). The full codebook with code definitions and illustrative excerpts is presented in Appendix B. All references to teachers' or students' identities, languages, and lived worlds were coded as a type of FoK. As defined within the theoretical framework reviewed, we consider FoK as any out-of-school resource that an individual brings to the classroom from their homes, communities, and cultures (Moll et al., 1992). We also acknowledge that these knowledge are often excluded from mainstream textbooks and curriculums, thus, teachers' ability to identify, understand, and/or leverage students' FoK are likely to vary. To account for this variation, we also coded the degree of integration whenever a teacher referenced their students' FoK.

Specifically in coding for the degree of FoK integration, at the most basic level, when teachers identified students' FoK without connecting it to their classroom in any way, we coded the segment as *present*. On the second level, surface level references to students' FoK (identities or lived worlds) in relation to the classroom or subject matter, but without expanding mainstream ways of teaching science were coded as *bridged* (e.g., Gutiérrez et al., 1999; Moje et al., 2001, 2004). Also on the second level, references to students' diverse linguistic backgrounds within the classroom without explicit connection to a science lesson was coded as *navigated*. Because of the importance of languages when 'talking science' and how this looks for non-SAE speakers (Lee & Fradd, 1998; Lemke, 1990), the interview protocol was intentionally structured to prompt teachers to reflect on discourse patterns in the recorded lesson (i.e. non-SAE and SAE was defined to teachers and a video clip from their classroom in which students used non-SAE or a non-English language was played for each teacher prior to their responses). We thus analyzed language separately and in our findings, discussed navigational spaces in reference to the work of Carol D. Lee (1993) as a specific, linguistic form of bridging students' FoK in classrooms. For the final and third level of integration, only student FoK examples that were meaningfully tied to their science curricula in ways that expand or fundamentally shift traditional science teaching approaches were coded as *transform*ing students' science learning (Moje et al., 2004).

The first author coded all of the interviews, and the second and third authors double-anonymous coded approximately 50% of the segments (coders analyzed the interview individually blind to the analysis of the other coders). The coders met regularly to discuss and resolve discrepancies in code applications. Once all interviews were coded, the proportion of teacher FoK type, student FoK type, and integration level was calculated for each teacher. In order to account for variations in interview length, code percentages represent the code count out of the teachers' total segments (tables 2 to 7). This data transformation variant (Creswell & Plano Clark, 2017) of the qualitative codes provides general descriptive patterns regarding the types of

teacher FoK, student FoK, and FoK integration levels each teacher reported in their interviews. These descriptive patterns also allow us to examine general similarities and differences across teacher cases.

4.3.3. Theme Development. In fitting with multiple case study analysis, we first examined each teacher's experiences individually and then conducted cross-case analysis to investigate patterns of experiences and notable discrepancies from these patterns across all teacher cases (Merriam, 1998). In individual case analyses, we considered descriptive patterns of teacher FoK, student FoK identification, and student FoK integration across both parent and child codes (Huberman & Miles, 2002; Saldaña, 2014). We then wrote a summary memos (Corbin & Strauss, 2014) for each teacher that described each FoK as well as links between what the teacher identified as their own FoK, and what connections were present between these teacher FoKs. We also wrote summary memos for the student FoKs teachers identified, and the ways in which teachers integrated student FoKs within their science instruction. Finally, we used these summary memos to compare patterns across cases, paying particular attention to commonalities and notable discrepancies in the relationships among teacher FoK, student FoK identification, and student FoK integration. Throughout this process, researchers met to discuss emergent themes using a constant comparative method, in which cases representing similar patterns were examined and grouped in thematic clusters (Huberman & Miles, 2002; Saldana, 2004).

5. Findings

For each of the research questions, we first present a table of the code percentages as well as a summary of the major qualitative themes that represent how teachers spoke of their own and their students' FoK, and the integration of their students' FoK with science. Code types overlap meaning that there could be multiple types of codes within one excerpt; therefore, the percentages do not evenly total to 100%. These descriptive patterns are then followed by in-depth qualitative case descriptions for each teacher, illustrating how teachers discuss FoK in relation to their and their students' identities, languages, and lived worlds (RQ1 and RQ2) and how teachers discuss integrating their students' FoK to curriculum and activities in their science classrooms (RQ3). We then conclude with a cross case analysis that synthesizes notable similarities and differences across teachers.

5.1. Teachers FoK

Table 2 presents code percentages related to teachers' FoK (identities, languages, lived worlds) and table 3 presents a summary of major qualitative themes related to teacher FoK.

Table 2
Teachers' FoK: Code percentages

Teacher	Total # of Excerpts	Teacher FoK	Identities	Languages	Lived Worlds
Ms. R	30	70%	37%	33%	40%
Mr. T	34	35%	12%	24%	24%
Ms. Y	26	35%	23%	4%	35%
Ms. H	21	52%	24%	19%	33%

Ms. C	14	13%	21%	14%	21%
Ms. L	21	24%	10%	14%	5%

Note. Percentages are code frequencies divided by each teachers' total excerpts.

Table 3
Summary of teacher FoK qualitative themes

Teacher	Teacher FoK Qualitative Themes
Ms. R	Black woman, mother, and grandparent (*identities*), multilingual knowledge (English, AAE, Spanish, Indian, French, Creole, etc.; *languages*), raised in melting pot (NY); multicultural knowledge (*lived worlds*)
Mr. T	'Hillbilly' (*identities*); SAE, 'Pittsburghese/Yinzer' dialect, learning Spanish (*languages*); raised to appreciate different cultures (*lived worlds*)
Ms. Y	'Only Black female science teacher' at her school (*identities*); multilingual (SAE, AAE, French, Spanish, Creole; *languages*); growing up in District A (as the 'token Black girl') and teaching majority Black/Brown students in District B, neighbor to some students (*lived worlds*)
Ms. H	'White female' (*identities*); English only (SAE and Southern English dialect; *languages*); raised and living in the same district as students (*lived worlds*)
Ms. C	White female (*identities*); SAE (*languages*); grew up 'lower-middle class', attended similar school as students and was the 'minority' in her school *(lived worlds)*
Ms. L	'Black woman'/ 'science nerd' (*identities*), SAE (*languages*), recognizes students' economic disadvantages as different from her upbringing (*lived worlds*)

5.1.1. Ms. R's FoK

Ms. R, a Black female teacher, had 19 years of teaching experience at the time of the interview. She shared how growing up in a large metropolitan city and having exposure to various cultural groups (*lived words*) gave her access to developing a rich *language* background:

> "I grew up speaking other languages. I did grow up knowing bad words in other languages. In, in Indian, in Spanish, in French, we had all learned because in New York, I grew up in New York, so it's a melting pot. So I had Haitian people around, I had Jamaican people around. I had Indian people around. I had black people around. I had different cultures from different Latino communities around."

Ms. R also said that even though she shares the majority of her students' racial background (*identities*), popular slang (or youth genres, Varelas et al., 2002) develops generationally and she is aware that the *languages* of her generation are different from that of her students. For instance, she referenced a more outdated slang term 'bad' (e.g. Michael Jackson's hit song *Bad* from 1987) which equates to other slang such as 'cool' or 'dope' saying, "um 20 years ago, everybody knew what I was talking about. But now if I say it's bad, they're like, [Ms. R], what's wrong with it (laughs)? "

Notably, Ms. R spoke about her experience teaching in different cities and schooling contexts (e.g., a private versus public school in the northeastern versus southeastern region of the U.S., *lived worlds*) which shaped her political viewpoints and perspectives as a Black female science educator (*identities*). For instance, she shared how she is able to implement critically conscious pedagogy that celebrates Black people and the contributions of Black scientists and engineers in her private school, but not in her public school classrooms:

> "... because not everybody is in that mindset where we [Black people] are powerful, and it takes a little bit of time for you to get the mindset that okay, a lot of the thinking that we have, has been, you know, implemented through years and years and years of… indoctrination… it's okay to feel like you're powerful, it's okay to feel like…you do have power, you know, as a people. And, you know, we got through a lot and enjoy those victories, and you celebrate the fact that we have it, and celebrate the fact that we were engineers, and celebrate the fact that we were doctors and celebrate the fact that we were all these things at one time."

5.1.2. Mr. T's FoK

Mr. T, a white male teacher, had 13 years of teaching experience as well as a Bachelors and Masters degree in Biology. Mr. T was a notable case in our study in that he did not express having any similarities in identities, lived worlds, or languages with his students. For example, in the following excerpt, he describes the cultural gap between his and his students' backgrounds, making a joke about how the majority of this students' perception of his midwestern background (referring to himself as a "hillbilly," *identities*) is based on a popular horror film:

> "So I'm a hillbilly. So my identity is vastly different from all the lowlanders down here, the flatlanders. So it is a bit hard for students to relate where their only experience with hillbillies…is the movie The Hills Have Eyes (laughs). And so they said why aren't all hillbillies cannibals? Well, no (laughs)."

Furthermore, he juxtaposed his upbringing and the backgrounds of his friends and family in the midwest to the backgrounds of his students in the mid-Atlantic region of the United States, stating that these are vastly different cultural backgrounds that come together in his classrooms (*identities*, *lived worlds*) :

> "So my group of friends, everybody has such a vastly different cultural identity for my friends who are hippies, my friends who are like river rats… my friends who are like diehard Baptist, you know, Southern Protestant..But in some ways being brought up in a home where yes, I was a hillbilly…They [his students] have a hard time relating to part of me, but that's where me learning Spanish and becoming culturally aware has changed my perspective…So coming to [southeastern region of U.S.], and working in schools with a very different racial makeup, I put an effort into learning my students cultural identity, and explaining to them how my cultural [and ethnic] identity is so vastly different from theirs."

He also described linguistic differences between him and his students, and how these *language* variations have created opportunities for students to ask about and learn more about his background:

> "...when I when I say something in Pittsburghease, people don't understand what I'm saying (using accent, laughs). But when the yinzer accent from Northwestern Pennsylvania comes out, they just go, what are you saying? Yeah. And I said, well, we're gonna do this yant to? Do you want to? And it's difficult for them. But at the same time being different makes some kind of go, Wow, you're weird. You're so strange. Why do you do this? If the kids who asked those questions, they obviously want to understand and having that difference, if you're open to them, they'll be open to you."

Mr. T however, also described how he was exposed to different groups of people throughout his life, supported both by his parents who valued exposure to different cultures, as well as his openness to learn Spanish (*languages*) and the cuisine familiar to his students (*lived worlds*):

> "My parents value travel, my parents value different experiences, and they value us trying new foods…Okay, my white friends are like, Oh, I would never eat chitlins, that's disgusting. But I'm like, I'll try anything out here. I don't care. And I try it. And I'm like, Oh, that's really good. And so I talk to my students, and they say, Do you eat chitlins? Oh, yeah, I eat chitlins and they're like, oh, wow, white person eating Chitlins like, Oh, my God. And so, you know, and then talking about eating tacos, tripe, which is the stomach tacos. It's tripe. And so you talk about these things. And if you just go out there and experience…you can align with the students."

5.1.3 Ms. Y's FoK

Ms. Y, a Black female teacher, had over 7 years of teaching experience as well as a Bachelors and Masters degree in athletic training. Ms. Y spoke about the importance of her racial/ethnic *identity* as well as being a native of the city where she is currently teaching (*lived worlds*). Specifically, she spoke of being the only Black student in her school during her formal K12 educational experiences in school district A, and feeling the pressure to assimilate to a culture that was not her own (*identities, lived experiences*). Ms. Y contrasted this by discussing the school in district B that she is currently teaching in, which serves a majority Black student population with whom she shares community roots. Having witnessed disparities in educational opportunities between these two school districts firsthand, as a student and now as an educator, Ms. Y described a deep commitment to and need for Black and Brown educators to speak up for their students:

> "I do think that there's a place for like Black educators, or Brown educators to speak up for those kids who are overlooked. I'd rather work here. And that's just my preference…And I let them know [Black and Brown educators] when I meet them. Like you're needed because I needed that. And I didn't have it. So like, based off of that experience…I don't even know what that was until I went to grad school…my culture was different and nobody cared. So I had to assimilate. Everybody's not like that. And that's a skill that you have to learn."

Ms. Y also shared how she was raised in a household with college educated parents and how she was exposed to both standard and non-standard American English (*languages, lived experiences*). In her description of language use, she spoke of both her participation in diverse linguistic practices (e.g., speaking a different dialect or language) as well as her awareness of the norms in formal (academic) versus informal settings that influenced how she communicated and interacted with others:

> "...there's always been slang around like…I also had to learn that you can't, you know, in academic settings, you can't like, write how you talk. So I feel like, yes, standardized…my parents are like educated...So I feel like it was like a mixture. Like, you have to be able to turn it off and turn it on. And like no one has the appropriate time. And so…my family, I have…Spanish speakers in my family and French. And I know, a little Spanish, like probably more French than, you know, like people who speak Creole."

5.1.4 Ms. H's FoK

Ms. H, a white female teacher, had 9 years of teaching experience and a Bachelor's degree in Education. Ms. H spoke about growing up in the same community as her students, and how this supported her ability to make connections to their local contexts (*lived worlds,* discussed in more detail in the student FoK section). She acknowledged her Whiteness, and when prompted shared that the way she speaks is influenced by a southern dialect (*languages*);

> "Which is hard, it's very hard for a child of a different culture and a different race to, you know, to trust really an adult that isn't their same race, so…Oh yeah, oh I'm Southern [referring to having a Southern accent and speaking Southern American English. I will say I'm Southern all the way. So yeah, I guess I'm- you know, um, and I, you know I'm honey, darlin', baby, sweetheart."

However, she spoke mostly about sex/gender and age as her identity markers, referring frequently to generational gaps as the most salient differentiator of her and her students (*identities*).

> "So you know I try to let them know 'ayy I might be older than dirt, but I know where all of this is, these are my stomping grounds', so hopefully they realize that, you know. I know where they're coming from and I know their background kind of sort of…their culture, it's totally different than mine and it's only because of generation, it has nothing to do with anything else other than that generational gap".

She also spoke frequently about her experiences of marginalization as a woman in science, and in turn, she was cognizant to intentionally incorporate females and people of color as science role models into the classroom (*identities*).

> "You know, and correct culture, like 'cause they're so many things that are, have been in history just washed up under the rug or you know or changed for the benefit of whoever's teaching it… like Rosalind Franklin. She had her stuff stolen from white men, you know, because they felt like they were better than her and we need to show them, hey this is not the way we do things or not the way we-this shouldn't be the way we do things. So, I'm hoping as the years go one, we bring more and more things and, that are culturally

> relevant to the students and have them understand, hey I can do this, even though I'm might be black, or might be hispanic, or you know asian, I can still do these things because there was somebody who did it."

5.1.5 Ms. C's FoK

Ms. C, a white female teacher, had 5 years of teaching experience and a Bachelor's degree in Earth & Environmental Science. Ms. C shared how she grew up in the same state as her students, and spoke about growing up lower to middle class, and her schooling experience as a White student in a predominantly Black school [*identities, lived worlds*]. She described the shared socioeconomic background and experience of being a white student in a predominantly Black school as something that helps her relate to her students:

> "I…grew up kind of more lower-middle class and I can kind of relate with them there. You know, some of the blue collar work. Most of my students are African American or Hispanic, a few Asian and Indians mixed in, so they probably don't relate to me on that front. I do understand where they are coming from. Because…I did grow up in a school where I was the minority, despite the fact that I'm not the minority in our country, like, I was the minority in my highschool and so I can kind of relate to that…I try to share parts of myself with them, so that they realize that they can talk to me and I do understand, kind of, where they are coming from…so even though it wasn't necessarily my story, it was kind of the stories I walked along, if that makes sense."

Ms. C also shared that she only spoke English and that SAE was her native dialect (*languages*). However, she also shared navigating between academic language and her students' native and/or vernacular everyday language in her science classroom to make science terms more accessible. This is discussed in more detail in the student FoK and pedagogy sections below.

5.1.6 Ms. L's FoK

Ms. L (pseudonym), a Black female teacher, had 15 years of teaching experience as well as a Bachelors and Masters degree in Biology. Ms. L shared that she and the majority of her students were from the same racial background, and that she was raised speaking different African American English (AAE) dialects similar to many of her students (*identities, language*). Ms. L specifically underscored how this racial and cultural match between her and her students supports her in understanding the norms, communication styles, and language expressions of her Black students. This in turn, influenced her asset-based approach to interpreting and responding to her students' classroom behaviors in culturally relevant ways; that is, not taking offense and rather, determining the underlying reasons for students' behaviors:

> "Um and whereas some people might be offended, and they have behavior concerns. Whereas…I can, you know, have a side conversation with them and talk them down, or figure out what's really going on, like, if it's like a attitude or something weird…I can recognize it for what it is oftentimes, and the students and I will be fine after that moment. And I think I know I recognize that because of who I am."

Ms. L also recognized that there are differences between herself and her students' home lives and the neighborhoods (*lived worlds, languages*). For instance, she discussed how her

parents prioritized her usage of SAE, yet she recognized the cultural importance of AAE for building a classroom community:

> "What Ebonics? No, not really. My parents were kind of against that [non-standard AE]. Uh, but you didn't talk about all the code switching situation. So, of course, I noticed like I've always noticed, like, but I think there's always been like a place for it."

She also spoke about socioeconomic differences between her and her students that influenced the kinds of access and exposure her students have to natural phenomena that she can anchor her science activities in (*lived worlds*). This is discussed next in more detail in the student FoK section.

5.2 Identification of Students' FoK

Table 4 presents code percentages related to teachers' identification of students' FoK (identities, languages, lived worlds) and table 5 presents a summary of major qualitative themes related to student FoK.

Table 4

Students' FoK: Coding frequencies and percentages

Teacher	Total # of Excerpts	Student FoK	Student Identity	Student Language	Student Lived Worlds
Ms. R	30	80%	47%	40%	43%
Mr. T	34	53%	27%	29%	27%
Ms. Y	26	58%	19%	4%	46%
Ms. H	21	57%	24%	24%	33%
Ms. C	14	79%	36%	36%	57%
Ms. L	21	57%	19%	24%	29%

Note. Percentages are code frequencies divided by each teachers' total excerpts

Table 5

Summary of student FoK qualitative themes

Teacher	Student FoK Qualitative Themes
Ms.. R	Black cultural pride (e.g Black Power), diversity within Latinx community (e.g. Mexican, Costa Rican, Cuban, Brazilian, Venezualen; *identities*); Multilingual (e.g. Spanish and AAE), generational differences in slang (*languages*); northeast private vs. southeast public school contexts, hobbies (e.g. music; *lived worlds*)
Mr. T	Diverse population, science versus cultural or religious identity mismatch, adolescence and peer groups (*identities*); Multilingual (e.g., Spanish, Chinese, Mayan dialects, AAE; *languages*); 'lowlanders/flatlanders', Southern culture, hobbies (e.g. video games; *lived worlds)*
Ms. Y	Majority Black and Latinx, adolescence and peer groups (*identities*); students allowed to use AAE in classroom (*languages*); Inequalities (e.g. lack of computer skills, lower reading levels), hobbies (e.g. Netflix, Umbrella Academy, music; *lived worlds*)

Ms. H	Diverse populations (*identities*); Multilingual (e.g., Spanish, Dutch, French), shorthand writing/generational miscommunication (e.g., texting language like 'brb'or 'bc'; *languages*); science hobbies (e.g. space; *lived worlds*)
Ms. C	Majority 'African American or Hispanic, a few Asian and Indians mixed in' (*identities*); Multilingual (e.g. Spanish, AAE; *languages*); Lower-class/'blue-color', some parents work in construction, hobbies (e.g. soccer, basketball; *lived worlds*)
Ms. L	Majority Black, diverse (*identities*); Multilingual (e.g., AAE and Spanish; *languages*); Famous female Black scientist attended their school and came to talk to them,'large percentage are extremely economically disadvantaged'(*lived worlds*)

5.2.1 Ms. R's Student's FoK

Ms. R, a Black female teacher from a metropolitan city in the northeastern region of the U.S., shared the diverse ethnicities of Latin American origin (Latinx) represented in her classrooms. Further, in discussing her Latinx and Black students, she shared the cultural nuances that she perceives her Latinx students (compared to her Black students) have in their schooling experiences (*identities, lived worlds*):

> "And so far, you know…this child might be Colombian while this child is from Costa Rica, Costa Rica and this child is from Mexico…they're so diverse as a unit, at least the Latinx population, while black Americans are kind of less diverse. As a unit, we kind of have the same sort of mindsets and mind controls, you know, because of things that we have a common experience here in the United States. So a Cuban is much different than a, you know, Brazilian or Venezualen."

She also recognized the generational differences in everyday language and discussed how youth genres she used when growing up in a northeastern private school and with her students earlier on in her teaching career is different from the how her students speak presently in her southeastern public school contexts (*languages, lived worlds*):

> "You know, I might have said, 'Oh, that's dope'. And the kids all knew what I said. Nobody knows that [now]. If I say, 'that's bad'. Um 20 years ago, everybody knew what I was talking about. But now if I say it's 'bad', they're like, Miss R, what's wrong with it (laughs)?"

She also discussed the rich connections she sees between her students' racial and cultural backgrounds and innovations in science and engineering throughout history (*identities, languages*). In the following excerpt, she highlights the importance of showing her students how professionals of color have led great achievements in STEM fields, and her hope that students will see themselves in these professional roles:

> "Reading articles that are relevant to them…and you write your journal entries, and you have all this and understand that somebody is going out and reading things that are scientifically based by people who look like them, is going to make all the difference in the world with those kids making connections…I show them all these neuroscientists, all

> these doctors, all these lawyers, all these people who were engineers, from all different times in history, so they can go ahead and understand that they can take ownership over their, not only their language, but…engineering feats…if they want to build or create something, or be an entrepreneur…all these things are in their pocket, but until they see people who look like them doing it, or people who look like them writing about it, or using a language that they're familiar with…"

5.2.2 Mr. T's Student's FoK

Mr. T discussed his students' FoK in relation to the scientific curriculum, their academic achievement, and their preparedness for the workforce and adulthood. He discussed his perceived tensions between students' cultural backgrounds (*identities*) and science curricula that he believes influences their attitudes, beliefs, and behaviors in his science classroom:

> "So a lot of students come in with a combative attitude towards science because of their cultural identity… they tend to gravitate away. And so the only way to bring them back is to make it as fun as possible and relatable to their culture as possible."

Mr. T continues to explain how he navigated this combativeness by respecting students' cultural and religious beliefs while also teaching about the nature of science:

> "And get them to understand that science is…Well, it's just a theory. Well, let's talk about what a theory is, and how much evidence you need to have to be a theory…I'm still using their language to introduce a topic because otherwise they're not gonna even want to approach what I'm talking about."

Mr. T also spoke in great detail about his students' diverse linguistic and dialectical backgrounds including AAE, Spanish, Mayan dialects, Vietnamese, Chinese, and Mandarin (*languages*). He described how his view on dialectical variations in his science classrooms was influenced by his childhood, but has evolved over his time teaching. Whereas he once believed he needed to correct his students' way of speaking (similar to how he was corrected as a child), he describes now creating space for students to speak 'their way', and building on his students' language backgrounds to support their learning of scientific language:

> "...And if we [his siblings or himself] spoke with non-standardized English, my mother corrected us because she didn't want us having the hillbilly twang in our talk. So when I first started teaching, I would try to correct my students. And I began to realize everybody has a dialect...And by letting them speak…their way, and then I can speak it back to them in a natural way…if you don't come down to the kids' level, you'll never reach them. And so you have to talk to them at their level, and then work through the whole year, to bring them up to a higher level."

5.2.3. Ms. Y's Student's FoK

When discussing students' *identities*, Ms. Y explains that her school "service mostly…Black and… Latinx children". She discusses the hardships she has faced attempting to leverage students' identities into the classroom because the standard curriculum doesn't reflect her students' *identities* and *lived worlds*:

> " It's, it's just hard, like, you have to be more creative in teaching them. Because everything is made for the standardized, and the standardized is not them. The standard is not them. So they have to…find tricks and tips to be able to navigate in a world that was not created with them in mind. And so I think that it can be like, it's hard".

Ms. Y went on to share how she viewed students' minoritized *languages***,** specifically African-American English Vernacular (AAEV) as assets, which she also speaks and welcomes in her classroom:

> "I think…it's important to meet children where they are…when I'm talking to them, or when they're talking to me, like, it's perfectly fine, it's perfectly okay [to use AAE]. I think it's good to like, I feel like, my kids have to code switch a lot."

She also shared the diverse sex/gender identities that are openly represented in her classrooms; for example, in the case of her non-binary student, the class used they/them pronouns:

> "I have a child who's…non binary, which is, to me like that, that's very different from what my other children are, like, some I don't even know what that means…we use they, them pronouns, you know, so I find, I'll find a way to, like, relate and make everybody feel comfortable."

Ms. Y discussed having similar *lived worlds* as her students, including living in the same neighborhood and going to a local theme park that she and many of her students have visited, which she uses to teach about different forms of energy:

> "I've had kids who are like, my neighbors, you know, so I think that, like, it's definitely helpful for them to not see me, like to see me as a human and to be like, I can relate to this person…We talked about energy, I was talking about Kings Dominion like... potential and kinetic energy, because that's close. And most kids have gone on at least a school field trip to Kings Dominion."

5.2.4. Ms. H's Student's FoK

Ms. H shared the minorized racial and sex *identities* of her students, discussing how these identities that students bring into her classroom influence how they interact with her and with science. For example, she stated:

> "I don't expect that I'm gonna understand everything that they are going through, um, you know. …I don't have to deal with "Hey by the way, what is the teacher gonna say to me cause I am a different ethnicity or different race? Are they gonna treat me different?" I never had any of that. …which is hard, it's very hard for a child of a different culture and a different race to, you know, to trust really an adult that isn't their same race…"

Ms. H spoke about how she was familiar with landmarks from her and her students' neighborhoods that represent shared spaces (*lived worlds*), and how she uses these to create a sense of community in her classroom:

> "Right and so they will be like, Hey do you remember the [gas station] or do you know where the [gas station] is? I'm like yeah, I go by there three times a week, you know and so, and they're like, um when I was at [school name], there was um at the neighborhood across the street, they had, they had a little park with a lake in it…And they're like-you've been in my neighborhood?...So that, I think that helps them realize that you know, I'm not as much of an outsider…So you know I try to let them know…I might be older than dirt, but I know where all of this is, these are my stomping grounds. So hopefully they realize that, you know, I know where they're coming from and I know their background… "

Finally, Ms. H discussed her students' diverse *language* backgrounds and how she sees opportunities to leverage her students' native languages for learning science. For example, in the following excerpt, she shares how she makes connections between students' native languages and scientific terms by pointing out the common origins and roots of science terms:

> "...How do you guys say this in Spanish or how do you say this in Dutch…French is another one…because a lot of words are similar because of you know it being a Latin, especially for science, being a Latin or German background…so it then translates into other languages as well. I try to have them tell me as well because then, if they were able to-again make that connection between their language and my language or scientific terms or, you know educational terms, it will help them again cross that gap of, I don't understand really what that means. So to put it in their perspective, in their native language is going to help them out."

5.2.5 Ms. C's Student's FoK

Ms. C spoke about various aspects of students' lives outside of school that she sees as resources to connect to science, including their parent's professions, their interests, and their native languages (*lived worlds, languages*). Specifically, she discussed the cultural and linguistic connections to science that exist, but that her students are often unaware of when they encounter scientific content:

> "You know a lot of their parents work construction..or they want to cook, they have that connection, they just don't necessarily realize it. So they tend to be really shy in talking science, because…I think a lot of times they see science as…these new words and this bigger vocab, particularly my ESL [English as a Second Language] students…so I try to bring that language to something that they can refer to and relate to…that kind of helps them kind of connect in. That's part of the reason I do try to add in…cultural references to help them feel more comfortable having that conversation…showing them that there are scientists that look like them also to kind of encourage them to relate and to have that connection…to feel like 'Oh I can talk science.'"

Ms. C discussed the rich linguistic context of her science classrooms (*languages*) sharing how her students regularly speak other languages or dialects. Similar to the others, Ms. C discussed deliberately building on students' everyday ways of speaking to integrate scientific ways of talking.

> "...You're calling it non-standardized language, but kind of in my classroom that's kind of the language we're always getting. I'm kind of using probably the more academic language and then kind of meeting them where their language is and kind of trying to kind of just keep exposing them and hoping, you know that kind of through the exposure and the interaction with me would kind of getting them from their non-standard language to more of the academic language."

5.2.6. Ms. L's Student's FoK

Ms. L. taught an urban, and mostly homogeneous African American, seventh grade student population. In her interview she shared multiple facets of students' FoK that related to their ways of speaking including high usage of slang and AAE (*languages*), stating explicitly that she prioritizes the ideas students communicate over the ways in which these ideas are communicated:

> "...if we know what they mean, we don't have to get all into the semantics of it all and that's okay."

Ms. L also discussed how she uses several science examples that her students could recognize at home or in their communities (*lived experiences*). For example, her awareness of the varying levels of safety in her students' neighborhoods, and access to abiotic (non-living) and biotic (living) organisms in their yards and neighborhoods allowed her to structure her science homework activities in ways that were accessible to all of her students:

> "So it's hard to…make sure I'm giving them references to look at. [For example] one of the things we did was a scavenger hunt for abiotic and biotic factors. And they were supposed to go outside, and, you know, do the scavenger hunt in their own yard. But I had to factor in the fact that some of the students it may not be safe for them to be outside, you know, to do that, especially on their own, and then they may not have enough things…So giving them an alternate like a virtual tour of…like Lewis Ginter Botanical Garden…giving them some seeds that they could visit electronically as well. I don't live in the best place but I have trees…plenty of things that I can see outside of my space. But, um, yeah, I just say the exposures are different."

Finally, as discussed in her teacher FoK section, Ms. L talked about her shared racial, ethnic, and cultural *identities* with her students, and how this shared background allows her to identify her students' assets and hold high expectations for their success:

> "I think that me being a black woman…and a science nerd, I think that that aids me in helping them, because I let them know that it's cool to be smart. And it's cool to like weird stuff. And it's cool, you know what I mean? And I'm also invested in them, not that you can't be invested, if you have a different ethnicity, I'm not saying that. But I just felt like I want them to be great. And I believe they can be great. And I also get, I get a lot of their personality, their quirks, and it doesn't bother me."

5.3 Student FoK Integration

Table 6 presents code percentages related to teachers' integration of students' FoK across three levels (present, bridged or navigated, and transformed) and table 7 presents major

qualitative themes related to FoK integration.

5.3.1. Ms. R's FoK Integration

We observed one of Ms. R's science lessons in which students made observations and inferences based on a series of photographs taken in various urban contexts and different time periods. They also watched a video and completed a worksheet related to the layers of the atmosphere. Throughout her interview, Ms. R demonstrated critical consciousness as she supported students' awareness of sociohistorical and systemic injustices, while also encouraging them to take advantage of the academic opportunities that are afforded to them to better their own lives and the lives of people in their communities. Here is an example:

> "...That's one of the instances where I talked about how the libraries were destroyed. And the engineering feats that we had in Africa were totally, like, amazing… But then at the end of the day, who gets all the credit? Kepler. Who gets all the credit? Copernicus. All the Europeans get the credit. And that's something that I could stress in a class that is a black power classroom that I could not necessarily stress in my regular public school classroom."

Ms. R went on to connect her own identity to her students in several ways. She described her Black identity as being similar to the majority of her students, but similar to others she also discussed several distinctions between her students and her own identity such as age. She continued to discuss how classroom context affects what she can or cannot teach her students which connects to her strong critical consciousness philosophical standpoint and pedagogical practices

> "Well, in my school, my public school, most of my kids look like me. But because it's the public school, as you know, in the public school does, it still indoctrinate children to believe, unfortunately, on sort of a white privilege, superiority basis, no matter what, because all our textbooks are written by Caucasians, not a whole lot of diversity is looked at, in that situation. When we're not coming up with real relevant worldwide history, or and we're not including indigenous people in that information. "

In her interview, Ms. R discussed examples of how she transformed science learning in her classroom to expand mainstream, canonical science curriculum through the full integration of students' FoK, including their discourses as they discussed science content. Ms. R also leveraged students' lived worlds including music and media within her instruction. Additionally, Ms. R foregrounded students' identities, especially their identities as Black, in her instruction. She often situated this identity within the context of ***socio historical*** scientific events. She said:

> "Well, in my school, my public school, most of my kids look like me. But because it's the public school, as you know, in the public school does, it still indoctrinate children to believe, unfortunately, on sort of a white privilege, superiority basis, no matter what, because all our textbooks are written by Caucasians, not a whole lot of diversity is looked at, in that situation. When we're not coming up with real relevant worldwide history, or and we're not including indigenous people in that information. "

Ms. R offered a specific example when she described how she highlighted Black scientific accomplishments, but also empowered students to see the importance of their own scientific writing. She said:

> "I do something really specific in Black History Month, is I show them all these neuroscientists, all these doctors, all these lawyers, all these people who were engineers, from all different times in history, so they can go ahead and understand that they can take ownership over their, not only their language, but all over, you know, engineering feats, you know, if they want to build or create something, or be an entrepreneur, you know, all these things are in their pocket, but until they see people who look like them doing it, or people who look like them writing about it, or using a language that they're familiar with… "

Taken together, Ms. R shared powerful examples of identifying and integrating her students' FoK in ways that celebrate and empower their racial and cultural identities related to science, through models of Black scientists and stories of their scientific achievements.

> "Reading articles that are relevant to them, reading articles, and as you all go through this, and you write your journal entries, and you have all this and understand that somebody is going out and reading things that are scientifically based by people who look like them, is going to make all the difference in the world with those kids making connections. I do something really specific in Black History Month, is I show them all these neuroscientists, all these doctors, all these lawyers, all these people who were engineers, from all different times in history, so they can go ahead and understand that they can take ownership over their, not only their language, but all over, you know, engineering feats, you know, if they want to build or create something, or be an entrepreneur, you know, all these things are in their pocket, but until they see people who look like them doing it, or people who look like them writing about it, or using a language that they're familiar with, you know, because they're just writing in a different way because we're used to this research and technical English writing, and that's cool and everything"

5.3.2 Mr. T- FoK Integration

The lesson we observed covered chemical and nuclear reactions, mutations, and historic scientific events such as the atomic bomb and agent orange; the lesson included an activity in which students created their own periodic table to represent the relationship between atomic mass and number using real-world examples (e.g., type of candy and price). In addition to integrating students' languages into his science instruction, Mr. T had the most instances of transforming students' scientific learning through their FoK. He did this work by supplementing the standard curriculum. For example,

> "And I try to bring in as much, much of that [studets' FoK] as possible, because the texts that were given like we have textbooks, none of us really use them anymore. They're, they're old. What the county gave us, it doesn't really address any specific culture. And so we have to bring in the cultural experiences…I tried to do it…So talking about the kidney stone belt, like with my Latinos, I talked about tacos. Well, in Mexico, traditional taco

> gets hit with onion, cilantro, and lime. So they eat a lot of lime juice, and a lot of orange juice and everything. So they're getting hit with acid. So they also don't have the kidney stone problems.." - Mr. T

5.3.3 Ms. Y- FoK Integration

In Ms. Y's lesson we observed the Earth's orbit, rotation, axis, gravity, day/night, and the seasons. She had the lowest level of FoK navigation within her own integration codes as well as across teachers. This was somewhat surprising, given that Ms. Y appeared knowledgeable about her student's non-SAE, for example AAE. Ms. Y made a distinction between students' oral language and their written language, differentiating between how they speak to one another and how she expects to communicate in their scientific writing:

> "I think…it's important to meet children where they are…when I'm talking to them, or when they're talking to me, like, it's perfectly fine, it's perfectly okay. I think it's good to like, I feel like, my kids have to code switch a lot."

> "So I try to let them know, like, we don't write how we talk…Because sometimes they want to have to write something [in AAE, which is oral not written], I'll be like, uh, I see what you're trying to say. But (laugh) let's, let's write it this way [in SAE]... I feel like [SAE] is , their second language…there might be words that you're like, I have no idea what that means. So, I mean, like, I wouldn't like learn Spanish, and then go to Puerto Rico and then just not even tried to learn their vernacular…I think you should respect the culture…that you're coming into."

When Ms. Y explicitly discussed transforming students' scientific learning opportunities, she discussed incorporating students' interests, hobbies, and pop cultural references. She transformed science concepts through students' cited pop-cultural knowledge. For instance, "we've talked about Netflix shows that have science concepts in them. And like, we talked about the Umbrella Academy, and how Number Seven, her power was resonance. " She later echoed, "when we talk about atoms and energy levels, I'll talk about how it's like VIP, the first energy level is like Jay-Z and Beyoncé. And then…the second energy level…it's some of their [Jay-Z's] close friends. They're not in, but they can be around."

Ms. Y, similar to Ms. R, references pop cultural influences, specifically music. These teachers clearly iterates that they are having constant conversations with students as well as keeping up with subcultural influences that highly relate to students' interests and engagement.

5.3.4 Ms. H- FoK Integration

Within our larger grant funded study, we observed one of Ms. H's science lessons in which small groups of students rotated through various stations to review a wide range of science topics, such as the characteristics of elements on the periodic table (e.g., proton, neutron, metals, gasses, and electrons) and well-known scientists (e.g. Dalton, Thomson, Rutherford, Bohr, Schrödinger).

Ms. H had multiple instances of FoK integration at the present, bridged, and navigated levels, but unlike the other teachers, did not have any explicit connections between FoK and

science content and therefore had no transformational quotes. It's important to recognize that this teacher acknowledges her students' FoK and is beginning to incorporate it into her teaching to some degree. Unlike other teachers, Ms. H made specific reference to students' sex identity and incorporated female scientists into their learning. Although she incorporated some critical thinking and sociohistorical references in this example, she does not explicitly discuss how she's incorporated this topic into a lesson for her students, therefore it was coded at the bridged level.

> "You know, and correct culture, like cause they're so many things that are, have been in history just washed up under the rug or you know or changed for the benefit of whoever's teaching it. Um I really hope that we, you know, um we bring in the relevant, the true information, and not sugar coat anything. I mean it's not , never easy, none of this is ever easy to talk about, especially when you know, if somebody's been put upon and so, but we need them to know like Rosalind Franklin. She had her stuff stolen from white men, you know, because they felt like they were better than her and we need to show them…it's not the way we do things or not the way we-this shouldn't be the way we do things. So, I'm hoping as the years go on, we bring more and more things and, that are culturally relevant to the students and have them understand, hey I can do this, even though I might be black, or might be hispanic, or you know asian, I can still do these things because there was somebody who did it."

We had several discussions about Ms. H's critical discussions because of some of the ideology and the way in which she discussed concepts. Although she recognized and discussed students' FoK, she still often does not show similar critical thinking as other teachers (e.g. Ms. R).

5.3.5 Ms. C- FoK Integration

We observed one of Ms. C's classroom lessons that took place in late 2019. During the class period, students worked in pairs on science experiments to apply principles related to developing hypotheses, isolating independent from dependent variables, recording observations, and representing data using graphs. Students worked in pairs to conduct their experiments. Ms. C had FoK present, bridged, and navigated examples throughout her interview as well as two instances in which her explicit FoK integration transformed students' scientific learning. In the following example, Ms. C references students' home lived experiences, such as parent occupation, and how she has been able to use this specific knowledge in her classroom. Home knowledge is a very traditional example of FoK as well (Moll et al., 1992). Ms. C utilizes *critical consciousness* in this example by helping students see how science is extremely relevant in their lives that scientists like them are needed.

> "You know a lot of their parents work construction, um, you know, or they want to cook, they have, they have, they kind of have that connection, they just don't necessarily realize it. So they tend to be really shy in talking to science, cause a lot of times I think a lot of times they see the science as, you know, these new words and this bigger vocab, particularly my ESL students and they're just not familiar with the langage. Um, and so I try to bring that language to something that they can refer to and relate to and I mean, that kind of helps them kind of connect in. And, you know, the language becomes a issue for those ESL students, and so they have a harder time with the discourse. And then we do

> try, uh, I mean that's part of the reason I do try to add in some of those, like, cultural references, um, to help them feel more comfortable having that conversation. And the, you know, showing them that are scientists that look like them also to kind of encourage them to relate and to have that connection and to feel like oh I can talk science." -Ms. C

In the following example, Ms. C connects science with socio-historical relevance and ties the unit with other *curricular learning* (e.g. history):

> "Um, I mean so far this year, like we've been trying to do scientist spotlights, to try to highlight current scientists, um, of all varieties, all cultural varieties. We did a big Hispanic focus for Hispanic Heritage month. Um, our library's been really good about providing Native American heritage resources for this month. And then like usually when I get into, so when like, when I teach nuclear energy, I usually try to pull articles in. Um, kind of about how, let me try to get, I don't have an exact resource in front of me, but they um, you know how the, I can't remember the, Nimbo, Nemo, not in my backyard. Um,and I try to pull in the economic in there as well. To kind of, you know, about how when they want to put in power plants and these different things, a lot of people will talk about, you know, don't put that waste in my backyard and, kind of. I mention a little bit, you know, the Aaron Brockovich story, those kinds of impacts and I try to pull in some of that policy, but then I also just ask the kids a lot, you know, like where they have reference."

Ms. C described creating opportunities for students to demonstrate their understanding through multimodal representations. In the following example, she shares how her English as a second language (ESL) students are given vocabulary sheets that allow them to write words in both English and Spanish, as well as represent the science words via images:

> " I mean for my ESL students I have in the past given almost like a vocab sheet, where like, I have them write out the vocab word and then they get a spanish english dictionary um and they will write the word in Spanish and in English and then write the definition in English and then draw me a picture…Um, so, use-I kind of lean on and kind of need more visuals. And kind of have to have alternative means of showing their understanding, so it's not always a written response."

As illustrated in this excerpt, Ms. C recognizes students' everyday ways of speaking in classroom conversations, and discusses intentionally integrating academic language into their lexicon.

> "Um, I mean so far this year, like we've been trying to do scientist spotlights, to try to highlight current scientists, um, of all varieties, all cultural varieties. We did a big Hispanic focus for Hispanic Heritage month. Um, our library's been really good about providing Native American heritage resources for this month. And then like usually when I get into, so when like, when I teach nuclear energy, I usually try to pull articles in. Um, kind of about how, let me try to get, I don't have an exact resource in front of me, but they um, you know how the, I can't remember the, Nimbo, Nemo, not in my backyard. Um,and I try to pull in the economic in there as well. To kind of, you know, about how

> when they want to put in power plants and these different things, a lot of people will talk about, you know, don't put that waste in my backyard and, kind of. I mention a little bit, you know, the Erin Brockovich story, those kinds of impacts and I try to pull in some of that policy, but then I also just ask the kids a lot, you know, like where they have reference."

5.3.6 Ms. L- FoK Integration

We observed one of Ms. L's classroom lessons that took place during Black History month in 2020, in which students worked in small groups to research and create a poster of a Black scientist to display in the classroom. In terms of the distribution of FoK integration, Ms. L spoke primarily of making students' FoK *present* (59%) and the least about *transforming* the science curriculum by integrating students' FoK (5%). Although Ms. L only had one instance of transformation in her interview, it is important to note that this example of transforming the traditional science curriculum by incorporating students' research about Black scientists was an approach used throughout multiple lessons. Specifically, this example illustrates how Ms. L integrated students' racial, ethnic backgrounds (*identity*) and their school context (*lived worlds*) to transform mainstream science curriculum by creating opportunities for students to learn about Black scientists, and incorporating students' new knowledge about these same-race science role models as a regular in-class activity:

> "We did African American scientist riddles of the day, they made videos, flip grids on an African American scientist or inventor…facts about the person. And then I use their videos to make the riddles for the class…we use those in class each day. And that was fun. Some of them wanted us to bring them back. And we even used one of the students who went to our school, [student name], who's like the first black nanoscientists. So she was one of the riddles that we did. So that was cool. Because I was like, she went to [school name]."

Ms. L elaborated on the social importance of supporting her students' pathway into science fields, demonstrating an awareness of the greater socio-political backdrop of inequitable and STEM education experiences and access for students of color:

> "We need scientists like them…to address the issues…not even just address issues that they face, but just to bring their own perspectives on to it, because they have a different background…we're doing this thing with… artificial intelligence. And it talks about the, like, the ethical concerns of it, and how it affects African American communities more. But the reason why there's so much bias, because there aren't enough African Americans who are working in that field. So just making sure that they are aware of the jobs that are out there."

Ms. L also demonstrated multiple instances of *bridging* her students' FoK with their lived worlds. Ms. L used her knowledge about her students' homes and communities to create accessible science activities. For example, she discussed connecting common household items with scientific phenomena, and notably, *celebrating* moments in which :

> "...And then just trying to use examples of stuff that they have in their um, community is also a thing. Um like we do, we did like, um, what do you call it watershed analogies, wetland analogies, and they get to use their own stuff. Which is very creative. Like some people had a washcloth and that's fine. Like, it was like, it could relate to them, you know, personally, so that's okay, that's good. And we celebrate those moments where, you know, they're being creative, and they come up with their own stuff that still applies. But it's like, specific to them. ..." -Ms. L

5.4 Cross-Case Thematic Findings

5.4.1 Teacher and Student FoK Codes

Looking across all six teachers, we see several patterns of their FoK, common and unique identification and understandings of student FoK, and varying degrees to pedagogical approaches that incorporated student FoK into the science curriculum (i.e., present, bridged/navigated, or transformed). In relation to RQ1, looking at the descriptive and qualitative patterns across cases showed that teachers referred to various sources of FoK both in reference to themselves as well as their students. More than half of Ms. R's (70%) and Ms. H's (52%) interviews described their own FoK; whereas Mr. T (35%), Ms. Y (35%), and Ms. C (13%) described their own FoK less than half the time (table 2). More than half of each teachers' excerpts referenced students' FoK, although Ms. R (80%) and Ms. C (79%) discussed their students' FoK more than Ms. Y (58%), Ms. H (57%), and Mr. T (53%) respectively (table 3).

Teacher FoK. When teachers described their own FoK throughout the interviews it was often in reference to leveraging their students' FoK which indicates that teachers' lived experiences shapes their pedagogical decision making (Hedges, 2012), including how they identify and understand their students' FoK.

For instance, Ms. R, Ms. Y, and Ms. L all discussed being Black women, or even Black women scientists (Ms. Y and Ms. L) and how it's important that their students in District B, which is homogeneously Black and Latinx, see that non-white and non-male identifying individuals have a place in science. Ms. R and Ms. L explicitly mentioned teaching their students about Black scientists throughout history because they recognize that their students would not learn this aspect of history in traditional textbooks. These Black female science teachers engaged in critically conscious pedagogy, by intentionally exposing their students to the knowledge of existing social inequalities and barriers faced by people of color in the United States, particularly as it relates to inequitable access to knowledge, occupations, and recognition in science. In their interviews, these teachers shared the importance of this knowledge for their students to prioritize their own education, feel a sense of pride and empowerment in their racial identities and history towards overall wellbeing, and be oriented towards pursuing STEM fields to be a contributor to their communities. Mr. T, Ms. H, and Ms. C explicitly shared that they do not share their students' racial, ethnic identities; however, they often described other aspects of their experiences and identities that allow them to relate to their students. Mr. T demonstrates his intentional research into socio-historical events specific to his students' racial and ethnic backgrounds and how he is able to use this knowledge to support students' in making real-world and personal connections to the science curriculum. Ms. H described her identity as a woman and making an effort to represent women in science, and how she is also able to build

relationships with students through conversations about common spaces that her and her students know from their shared communities. Similarly, Ms. C was raised in the same community as her students, and as one of the few white students in her schools; she observed the injustices her peers faced first hand and shared how this gave her insight to her present day students' schooling experiences.

All of the teachers were culturally cognizant to varying degrees. That is, the teachers recognized themselves as cultural beings along different social markers (e.g., race, sex, regional and/or cultural dialects) and shared various understandings of the impact of culture on their lives and the lives of their students. When asked, every teacher mentioned that the science curriculum at their schools did not incorporate CRRE approaches and that they were not expected to bridge this on their own. However, they each believed that culturally relevant approaches to teaching science, specific to their student populations, was needed to increase students' comprehension of and engagement with the material, and ultimately, academic success. To this end, every teacher mentioned a commitment and effort to incorporating CRRE approaches to teaching science on their own to different degrees. They all also identified structural obstacles that limited their ability to apply CRRE including lack of time and lack of instructional materials. Importantly, all teachers used their own cultural knowledge to connect with that of their students. Teachers' recognition of the diverse student FoK in their classrooms, as well as their commitment and willingness to support their students' science education with CRRE approaches that welcome and celebrate their students' FoK in science is a notable finding of our study. This finding is important given the current socio political climate in U.S. (particularly within this southeastern state), lack of CRRE curricular supports and instructional resources, as well as gaps (e.g. generational, racial, and cultural) that teachers are constantly trying to bridge with each new group/generation of students who bring with them unique identities, interests, etc. As discussed below, our findings have implications for how educational policy and practices need to be revolutionized to support teachers who are committed to learning about who their students are (FoK) and using CRRE approaches that often go against the grain of schooling.

Student FoK. The qualitative findings also demonstrate variations in the ways teachers identified, understood, and integrated their students' FoK (Gupta, 2006). When examining what student FoK the teachers identified and discussed, descriptive patterns of the distribution of code count percentages showed that teachers across cases all *identified* aspects of students' identities, lived worlds, and languages to some extent. These included references to students' intersectional identities along gender, racial/ethnic, and cultural lines, diverse language backgrounds (e.g., dialects, bilingualism), and multiple lived worlds (e.g., schooling experiences, peer groups, home lives, neighborhoods).. However, deeper qualitative analyses illuminated how teachers *understood* their students' FoK, and the *degree* to which teachers integrated their students' FoK in their science classrooms were quite variable and unique to each teachers' own FoK and pedagogical approaches. For example, while both Ms. R, Ms. L, and Ms. H identified and discussed the racial minority backgrounds of their students (*identities*), Ms. R and Ms. L spoke in-depth about creating a classroom culture in which their students can be empowered to succeed in science (e.g., by exposing students to Black scientists and celebrating their contributions to the field) whereas Ms. H didn't elaborate on how her students' diverse racial backgrounds can be connected to science, and instead shared other ways she integrates students' FoK in the classroom by focusing on their shared lived worlds (e.g., growing up in the same community).

Our qualitative findings also showed that each teacher often made connections between their own and their students' FoK. It seems that the aspects of students' FoK that teachers discussed most related to what they found most salient within their own FoK and/or what they identified with most within their student populations. For example, Mr. T identified as a "hillbilly" whose language (i.e., dialect) was not valued beyond his hometown. He shared stories of being reprimanded for speaking with a Yinzer dialect and in recalling these experiences he was able to understand the importance of valuing his students' dialects and languages while encouraging their encoding of SAE and scientific language. Similarly, three teachers shared that because they grew up in and/or lived in the same communities as their students, they were able to recognize communal resources and references to build relationships and bridge classroom lessons with shared lived experiences (Ms. Y, Ms. H, and Ms. C).

We also found that every teacher identified many distinctions between themselves and their student populations as well as injustices that interfere with student learning. Teachers spoke about the many ways in which these differences and disadvantages have made it difficult for them to leverage students' FoK in their science classrooms. For instance, several teachers discussed the generational gaps between themselves and their students as a barrier (Ms. Y, Ms. R, and Ms. H). Ms. R, a Black female science teacher who speaks AAE describes how even though she shares a dialect with her students, slang terminologies change over time there are still distinctions in word meaning which highlights the many variations within the dialect and suggests further research to support these students' linguistic code switching and comprehension. Ms. H also elaborated on language use in her classroom, describing how technological advancements, specifically cell phones and text communication, has caused students to speak and write using more shorthand that she is not as familiar with. Finally, Ms. Y discusses how even with having a similar racial/ethnic identity as her students and sharing similar lived experiences with her students, she has different interests in hobbies, such as music from her students. These teachers' nuanced understandings of their and their students' FoK align with the philosophy of CRRE; that is, CRRE is not a discrete practice (e.g., speaking AAE) but rather, a dynamic approach to teaching that requires educators to engage in an ongoing process of learning about each new group of students' youth culture, interests, and other unique FoK they bring to the learning environment (Ladson-Billings, 1995, 2014).

All of the teachers recognized to some degree the disadvantages that students faced related to socio-historical injustices, low SES, or distinctiveness from mainstream culture. Mr. T discussed difficulties navigating student language if scientific terms are not easily translatable to their native language or if they are only able to speak their native language/dialect and cannot use this FoK to learn scientific or SAE writing (e.g., Chinese versus English). He also discussed how some of his students' religious or cultural identities often contradict scientific theories. Ms. R emphasized how science curriculum highlights white male scientists and often ignores the stolen work of African scientists, and similarly Ms. H mentions women scientists whose work is not mentioned in science textbooks. Both Ms. Y and Ms. L discuss disadvantages students face because of their low SES (e.g., lack of resources in their schools and communities). Ms. Y mentions students being behind in grade level and unequipped in computer skills which affects their ability to learn grade level science and continue on a pathway towards professions in STEM fields. Ms. L mentions that she has to think critically about students' disadvantages before creating assignments; for example, she describes that a seemingly simple assignment for students to go on a scavenger hunt for scientific phenomenon in their neighborhood could potentially put

students' safety at risk and/or lead to students realizing that they have certain resources in their neighborhoods (e.g., variations in trees).

Although historically marginalized students described in this study may face grave difficulties and distintinctions in their classroom learning due to lack of FoK representation and lack of resources, teachers show both compassion and concern when earnestly attempting to bridge, navigate, and transform these gaps on their own. This finding suggests dire need for policy makers, researchers, and those with power to find novel, meaningful, intentional, and most importantly different ways to teach historically marginalized populations so that they have more resources, more explicit academic connections to their unique FoK, and so that these students feel uplifted and seen by their schools so that they have the tools to be successful without forfeiting who they are.

5.4.2.3 Pedagogy Codes

All teachers appeared to ascribe to the thesis advanced by Esteban-Guitart (2019) that "deep learning is facilitated when it stems from, and transforms, learners' identities" (p. 159). Accordingly, they leveraged student FoK in their teaching and used several common ways to do this work. First, most teachers (n = 5) described speaking non-Standardized dialects with their students. They used these dialects in support of relationship building and as a way of making space for students' language in the otherwise exclusionary science disciplinary language (Emdin, 2009; Kachchaf et al., 2016). For example, they recognized students' various languages and allowed its usage within classroom conversation. Two teachers–Ms. C. and Mr. T–explicitly prioritized the usage of SAE and scientific language but saw non-SAE and other languages as a means to scaffold in and support students' comprehension of SAE. A representative quote came from Mr. T who said "we have to start at their language, and slowly bring them up to a higher level of language. But still even up here, when I'm hitting that higher level. I'm still using their language to introduce a topic..." Ms. Y was unique in her lack of reference to language. This finding likely aligns with the low priority she ascribed to language as evidenced in her limited reference to her own language FoK and the students (4% of codes referred to language, see tables 1 and 2). The potential power of language to encourage minoritized students' participation in the science classroom is well documented. O'Connor (2015) found discursive moves effective in positioning marginalized students as scientists while Brown and Ryoo (2008) effectively used student's everyday language to 'translate' otherwise unfamiliar science concepts. Our findings align with this work.

Second, three teachers described using pop culture to leverage student learning;Ms. R, Ms. Y, and Ms. C utilized students' music in their teaching to help foster student engagement. Ms. R explained, "I'll use their music somehow...Like I might bring up some words because that's something that we all share." The power of music relevant to students is well-documented in the literature. Emdin (2009), Varelas and colleagues (2002), and Sprang (2008) all found rap music effective for engaging students with science concepts in ways that center the realities and cultures of youth, create collaborative learning spaces, and empower the voices of historically marginalized students. Ms. Y used music celebrities Beyonce and Jay Z in an explicit reference to atoms and energy levels and Ms. C discussed often finding rap music about science phenomena.

Furthermore, three teachers discussed incorporating students' hobbies and interests other than music into the curriculum. Mr. T (e.g. basketball), Ms. Y (Netflix), and Ms. H (space) explicitly discussed the importance of students' interest integration when transforming students' scientific learning opportunities.

Finally, all teachers leveraged student FoK in service of science learning through their instructional materials. All teachers stated that the standard school curriculum did not support CRRE, and therefore to varying degrees, supplemented the curriculum with their own materials to make science learning more relevant and inclusive for their students (Warren et al., 2020). For example, some teachers spoke directly about how the curriculum represents dominant narratives, and excludes the identities and stories of historically marginalized groups. Mr. T referenced this explaining, "What they've given us from the county is...basic text and it's, it's basically culturally neutral. They're not they're not bringing culture or history or relevance into it much at all. So I make my own". Two teachers, Ms. R and Ms. Y, both Black female teachers, went further. They explicitly described the effect of systematic inequalities on the marginalized students in the public k12 system. Ms. Y remarked that "If you have to take an eighth grade test... then you have that language there that they're not familiar with. And I [Ms. Y] personally, don't think that's fair." Ms. R described her socio-historical understanding of historically marginalized and marginalized people within science explaining that "it's okay to feel like...you do have power, you know, as a, as a people... and celebrate the fact that we were engineers...and celebrate the fact that we were all these things at one time, but this thing was taken away from us."

The interactions among teachers' FoK, critical consciousness, and educational structures. These pedagogical decisions are a manifestation of teachers' critical consciousness (Ladson-Billings, 2014; Paris, 2012). However, there was variation in teachers' critical consciousness and the three Black female teachers demonstrated the highest comprehension of this pedagogical approach. Ms. R and Ms. Y directly challenged exclusionary power structures in the science classroom related to socio-historical injustices (Ms. R) and socioeconomic injustices (Ms. Y); Ms. R and Ms. L shared resources with their students so that they could see positive science role models that they identify (Thompson, 2014), An asset-based approach to science instruction would *utilize* students' diverse FoK to support their learning, would privilege students' multiple ways of knowing, and would see ask teachers themselves to challenge hegemonic power structures and empower their students to do the same (Warren et al., 2020). Existing research (e.g., Matthews & Lopez, 2019) has found variation amongst teachers' awareness of the issues of power and marginalization that impact students of color that can lead to teachers incorrectly ascribing student performance to race or class rather than to exclusionary instructional practices (Bang & Medin, 2010; Calabrese-Barton et al., 2008).

Teachers highlighted several key points within interviews (i.e. awareness, political efficacy, and critical action). Firstly, to varying degrees all teachers were aware of the lack of cultural representation present in the curriculum and knew that students' had experiences and knowledge that could be more intentionally incorporated daily to positively affect their academic comprehension and achievement. Teachers each describe creating cultural opportunities for students despite structural barriers in public schools (e.g., lack of resources, accountability systems) and socio-political turmoil in their region (e.g. racial protests, police shootings, and confederate statue removals). The three Black female teachers specifically (Ms. R, Ms Y, and Ms. L) had richer discussions of political efficacy such. For instance, Ms. R detailed historic

injustices and described the importance of letting her Black students know that Africans lead in several scientific findings that are ignored and rejected in most curriculums. Ms. Y discussed district distinctions between where she went to middle school and where she teachers; her parents were teachers, and although they placed Ms. Y in a higher socioeconomic school district, knew the importance of working in the school district that needed higher Black teacher representation which is where Ms. Y herself was inspired to later choose to work. Lastly, Ms. L discussed awareness of students' communal safety and experiences and discussed virtual opportunities in which she can safely expose and teach students about the science within their own communities. Lastly, Ms. R especially as well as Ms. L discuss the importance of taking critical action and making changes. Ms. R especially does so by comparing her experiences teaching public school with teaching at a private institution that more deliberately gives Black students power through knowledge. Taken together, we documented variation in teachers' pedagogical approaches, which were influenced by a confluence of their own lived experiences, their experiences as identification as members of marginalized group(s), and understanding of their students' FoK.

5.4.2.3. FoK Integration Codes

In answer to RQ3, we used FoK integration codes to investigate patterns in teachers' approaches to connecting student FoK to the curriculum. The level of students FoK integration reported by teachers was coded on a scale from present, bridged/navigated, and/or transformed (table 4). Navigation, although at the same level as bridged, was coded specifically in relation to teachers' integration of students' language. Notably teacher interviews including broader, retrospective reflections of their teaching longitudinally over the course of the previous school year. A key finding from these interviews is that all teachers recognized what student funds of knowledge are and the importance of integrating that knowledge into the curriculum even if it is not a requirement. Roughly one third of the codes ('Student FoK present': 32%) indicated teachers simply referenced student FoK without any explicit incorporation into instruction. An additional 34% of coded instances (sum of 'student Fok bridged' and 'student FoK navigated': 34%) suggested teachers went beyond just referencing student FoK but meaningfully incorporated it into the science classroom, and fewer instances explicitly described transforming students' curricular experience by centrally situating student FoK into instruction (Student FoK transformed: 10%).

The proportion of FoK integration was higher in this teacher sample than previously noted in literature (Authors, 2022); however, in line with Emdin (2011), we noted the fewest instances of transformation. We believe the increased evidence of FoK integration is reflective of teachers' awareness of their own FoK (Hedges, 2012), their valuing of student FoK (Gupta, 2006), and their desire to create socially just science classrooms that meaningfully incorporate student FoK into instruction (Esteban-Guitart et al., 2019). There is also evidence that teachers' FoK informed their pedagogy and the ways in which they integrated student FoK. As described above, Mr. T clearly understood the role language played in his life, saw the importance of student language, and had one of the highest use of navigation (21%). Additionally, Ms. Y and Ms. R displayed critical consciousness and an awareness of power structures. They also had more instances of transformation while Ms. H, who displayed some deficit orientations had no instance of transformation. These findings suggest an intersectional relationship between teachers' FoK and pedagogical approaches that ultimately leverage students' FoK integration.

It is important to note that the frequency of their mentioning how they integrate students' FoK may not accurately reflect the frequency in which they do so in the classroom. For instance, many teachers described one or more powerful instances of how they transformed science lessons via students' FoK, yet this is not a reflection of how often this is done in their classrooms or how students perceive these instances.

6. Discussion

This study makes a significant contribution to the extant literature by using a theoretically grounded codebook to systematically analyze *both* teachers' and students' funds of knowledge (FoK). Further, we examine the degree to which teachers integrated students' FoK into their science teaching and thematically reflect on pedagogical approaches. Although there is wide consensus regarding the importance of asset-based approaches that value and leverage diverse students' FoK in the standard science curriculum, translating these goals to practice is complex. Additional research is needed to understand *when* and *how* teachers productively integrate students' FoK into science discourse activities. Finally, it is important to note that teachers' professional pedagogical decisions about how to meet their students' learning needs exist in a complex system of national and state-level policies, as well as the present, extremely politicized nature of K12 education.

Findings suggest a relationship between teachers' FoK and pedagogical approaches that ultimately lead to various degrees of leveraging students' FoK integration. This study provides multiple qualitative cases linking teachers' FoK, teacher perceptions of their students' FoK, and teachers' pedagogical decisions because as stated previously this literature base is extremely limited (Hedges, 2012). Hedges (2012) suggests that future research further explores the expertise and experiential knowledge that teachers bring to practice within diverse educational settings and cultures as well as delve further into how teachers effectively blend and harmonize formal and informal knowledge (p. 21). Our findings begin to address these gaps in the literature by highlighting six cases of experienced middle school teachers in urban settings who each claim to intentionally incorporate culturally relevant perspectives in their pedagogical approaches even though it is not a necessity of their schools' curriculum plans.

Findings also underscore the diverse FoK that *teachers* bring to bear when making these complex pedagogical decisions, and how their identities, lived experiences, and languages influence how they perceive and incorporate their students' FoK in their science classrooms. Teachers in this study recognized the importance of knowing the student populations they served and went beyond curriculum requirements to create student centered lessons. Results also have important implications for considering the unique ways teachers' approach CRRE in terms of their professional positioning and the students they serve, as well as for providing nuanced illustrations of the different ways teachers and students FoK operate in science classrooms.

In terms of RQ1, we found that teachers each shared unique combinations of FoK that related to their personal histories, lived experiences, and identities in and outside of the school.. Teachers come from unique and distinct upbringings and they are conscious of who they are when working with their students. For instance *(lived experiences)*, two teachers (Mr. T and Ms. R) were raised in different states than their student populations and spoke a lot about the distinctions between contextual environments; however, the other teachers (Ms. Y, Ms. H, Ms. C,

and Ms. L) were all raised in the same state as their students and discussed how, even if they have different socioeconomic statuses than their students and therefore different privileges, they believe it's important that they know about students' communal resources. Regarding teacher *identities*, one teacher was male (Mr. T), three teachers were white (Mr. T, Ms. H, and Ms. C), and the remaining three teachers were Black women (Ms. R, Ms. Y, and Ms. L). All teachers recognized that their identity did not exactly match that of their students and discussed ways in which they research students' culture and interests to make up for these differences. Finally, majority of teachers were raised speaking another dialect (Mr. T speaking Pittsburghese, Ms. R and Ms. Y's familiarity with AAE and Creole, as well as Ms. H speaking Southern American English) these teachers, as well as the others (Ms. C and Ms. L) felt that non-SAE dialects and other languages are present in the classroom and discussed strategies to scaffold student language.

These findings align with previous studies on teacher's funds of knowledge that similarly demonstrated that teachers often discuss themselves and their own experiences within and outside of their identity as a teacher when asked questions about their students' FoK (Andrew, et. al., 2005). Similar to the findings of a qualitative study conducted with teachers' in the United Kingdom, teachers drew upon their a.) childhood experiences and/or experiences raising their own children, b.) racial/ethnic, religious, and linguistic experiences, c.) communal experiences, as well as d.) teaching experiences all in comparison and contrast to how they interpret their students' experiences and identities (Andrew, et. al., 2005). For instance, several teachers in our study discussed the benefit of living and growing up in the same communities as their students and how knowing local landmarks and phenomenon is a way in which they felt bonded with students whereas two teachers specifically (Mr. T and Ms. R) discussed in detail their own unique uprising and how much they had to learn about the local community later in life as they moved to these locations to teach. The findings presented in our case study extend previous bodies of literature that have highlighted teachers' FoK in European countries that have a different cultural context than urban U.S. classrooms (Hedges, 2012; Andrew et. al., 2005).

With RQ2 we focused coding on student FoK specifically; however, because the nature of this case study is teacher interviews, discussions of students were often directly compared and discussed with teacher FoK. Teachers often discussed the severity of the injustices in the system that their student populations face such as low SES, lack of resources, and opportunity gaps in science due to parent illiteracy or students being behind grade levels; it seemed that the three Black female teachers (Ms. R, Ms. C, and Ms. L) recognized this problem the most and talked about leveraging the problem through critical consciousness *(lived experiences)*. Ms. R and Ms. L did this especially by highlighting Black and African scientists throughout history while also holding students to strong academic standards and teaching them that education is the tool that will allow them to positively impact and uplift their communities.

Interestingly, because teachers discussed students' FoK in conjunction with their own, the examples of students' FoK they recognized were often very similar to that of their own FoK. This finding makes sense, given the existing literature that shows that teachers' approaches to teaching, including how they see their students, is filtered through the personal and professional lenses that teachers bring to their classrooms (Hammersley, 2005). For example, only two teachers (Ms. R and Ms. Y) really discussed recognizing and utilizing music and similar popular culture references in their science discussions. Ms. R mentioned growing up in diverse New York which is how, even as a Black American woman, she recognizes the diversity within Latinx

populations and she detailed various musical genres overlapping between Black and Latinx cultures likely because it is what she was exposed to growing up. Ms. Y, who was the youngest interviewed teacher, discussed a science lesson where she incorporated a reference to Beyonce and Jay-Z and she further discussed an awareness yet distaste for her students' musical interests. Other teachers did not discuss music as an important form of students' FoK yet that does not mean that it is not. Mr. T was the only teacher who discussed cultural dishes as an important discussion point in his classroom. Because he had the most unique identity from his student population, he has a strong interest and passion for being open to various foods and sharing his knowledge about this with his students.

Therefore, the student FoK that teachers discussed and leveraged related to what they felt was most essential based on their own FoK. These findings align with current literature that suggest the need to allow students the autonomy to convey their own FoK within STEM classrooms because students' FoK is ever evolving based on their daily experiences and maturation overtime (Salac, et. al., 2023). Scholars suggest further that giving historically marginalized students opportunities to share in the knowledge building process within the classroom will allow them to be more autonomous in their learning (Miller et al., 2018). Examining opportunity structures to create hybrid spaces where students' FoK are bridged with curriculum over time warrants future study.

Finally, through RQ3 we analyzed to what extent teachers discussed leveraging students' science education using their FoK. We find that the majority of the discussion of student FoK were on the second level of integration (i.e. bridged or navigated). This suggests that teachers are going beyond that identification of student FoK and are making attempts to relate scientific knowledge to students' FoK; however, our results also suggest that teachers are having difficulties transforming students' education with their FoK suggesting the need for policies, resources, and training that explicitly incorporates CRRE for historically marginalized populations. However, there were several high-quality examples of FoK integration in teachers' descriptions of their science lessons. Specifically, FoK transformation which we defined as deliberate utilization of student's FoK within a classroom lesson. Each teacher was able to share who they were and how it related to students, positive examples of how they've created culturally relevant lessons, as well as difficulties they have experienced in doing so. Each teacher, even those with the highest quality of integration, knew that they were still limited and that there were parts of students' identities that they could not relate to or fit into the classroom. For instance, Mr. T discussed difficulties in teaching evolution when it is in discordance with students' religious beliefs and Ms. Y, even though the youngest teacher, recognized the generational gap between herself and her students' and described the lack of awareness and appreciation she had for her students' music. Several teachers discussed the difficulties of working with English Language Learners and wanting more permanent scientific linguistic interventions for the students beyond dictionaries and online translators that can still be inaccurate or not easily translatable into scientific phenomena or true understanding of scientific processes.

Previous literature suggests the importance for historically marginalized students, specifically Black students, in the U.S. to maintain strong racial/ethnic identities of themselves in order to become resilient in their educational endeavors despite the inequity that they face (Miller & MacIntosh, 1999). One particular exploratory qualitative case study found significant

results when a math teacher amplified existing classroom materials (i.e. worksheets) to create a hands-on as well as culturally inclusive lesson centering Black American popular culture (e.g. transformed a worksheet about distance through the imagery of physically traveling to these locations and references to the movie *Are We There Yet?*); the study also noted that the particular school incorporated positive Black cultural imagery across the entire student population (e.g. singing the Black National Anthem and references to modern Black music; Gholson & Martin, 2014). Our findings, as well as the findings of previous research, argue the need for structured hybrid discourse spaces (HDS) in which students' culturally diverse ways of being and knowing (i.e. culturally relevant languages, identities, and lived experiences) are explicitly sought after, celebrated, and incorporated specifically into STEM classrooms (Bae, et. al., 2022; Brown et al., 2005; Calabrese Barton et al., 2013; Gutiérrez et al., 1999). Future research should not only examine how teachers intervene with creative lessons inclusive of students' FoK, but also create and utilize evidence-based curriculum and inclusive pedagogies drawing from literature that reflect the assets of historically marginalized student samples.

Practical implications. Overall, teachers in this study believed that critical pedagogy, socio-historical connections, and encouraging student autonomy were imperative for historically marginalized students' motivation and learning in their science classrooms. Findings suggest that the science teachers within this study had varied levels of cultural awareness and critical consciousness based in their own FoK; however, these teachers all demonstrated the initiative of basing their classroom lessons in CRRE pedagogy by making references and connections to students' FoK which assists in scaffolding their overall science comprehension.

Some teachers go beyond CRRE by rooting their teaching pedagogies in critical consciousness which allows students to see and understand their social surroundings in order to take democratic initiatives in their learning and professional development. Findings about teachers within this qualitative case study do not have overarching implications for the general teacher population; however, findings do present examples of CRRE and FoK from scientific practitioner perspectives which can begin to address the gap in literature on historically marginalized students in STEM. Differences across cases could potentially relate to teachers' varied levels of critical consciousness (Bae et. al., 2022; Matthews and López, 2019). For instance, one Black female teacher who was the most experienced of all teachers had the highest frequency of critically conscious claims and it was clear that she believed reformation of the public school system, specifically for the empowerment of Black students, was necessary for their achievement whereas other teachers seemed to believe the a few additional curriculum references to marginalized peoples (i.e. sex and racial minorities) could benefit all students within the current system and did not further discuss a need for socio-political modifications to the entire structure of the education system.

Our findings suggest that teachers' languages, lived experiences, lived worlds, and level of critical consciousness interrelated to their pedagogical approaches in leveraging students' FoK; recognition of socio-historic politics that influence societies power dynamics is an essential aspect of creating HDS that aim to benefit students' long term academic and social development in a way that is beneficial to their community at large (Bae, et. al., 2022; Rodriguez, 2013). Our study examined three White and three Black teachers, all of whom mentioned working with English Language Learners as the most difficult aspect of FoK to integrate into lessons. Future studies should seek to interview teachers representative of more racial/ethnic groups,

non-English native speaking teachers, more sex/gender diverse, and or religious diverse teachers because in accordance with our findings, previous research emphasizes the importance for students' to share multiple FoK aspects with their teachers to benefit their achievement outcomes (Redding, 2019).

Limitations. This study recognizes several limitations. Firstly, we are bounded within teachers, students and classrooms. In order for transformation to occur in classrooms, policies need to be in place to maintain this systematically. Our research nods to this, but more work needs to be done with education policy makers and stakeholders. Next, due to their participation in the larger NSF study, the sampled teachers may be more likely to use multiculturalism than typical science teachers in the nation. This study makes sure not to generalize this sample's experiences to a national level, but rather suggests that the found patterns suggest similar research with a larger more representative sample. Additionally, it is essential that this research recognizes how validity of the findings could potentially be compromised due to various elements of data collection and explain how best to address these weaknesses in validity. For instance, convenient sampling methodologies were used to research the five teachers in this study. The sample is from a larger NSF project which has already introduced the concept of FOK to teachers over a year. Therefore, these teachers may already be more likely to use multiculturalism than typical science teachers across the nation. Additionally, the researchers' existing professional relationships with the teachers may have increased their willingness to volunteer for this project. This study makes sure not to generalize this sample's experiences to a national level, but rather suggests that the found patterns suggest similar research with a larger more representative sample. Lastly, member checking occurred simultaneously during interviews by asking teachers if researcher interpretation matched their response. Another limitation is that student data, and therefore student perspectives, are missing because of COVID-19 and the inability to collect student data. Future research could additionally interview students to determine 1. if teachers accurately recognized their FoK, 2. if and to what degree students' felt that their FoK were intertwined within the curriculum, and 3. if students' could name examples of FoK within science or rather or not they felt this incorporation were useful. With this, teachers in this study were conveniently sampled and may not accurately represent all teachers within this state or nationally. For instance, these teachers recognized students' knowledge as an asset and useful and felt reform was necessary to improve student learning; however, this is likely not a shared belief across teachers within the state with more conservative political views and/or teachers who view historically marginalized students' out of school knowledge as a deficit or distraction from the main curriculum. Future research should examine a multitude of teachers with varying perspectives to learn to determine if these teachers have another suggestion as to how to increase historically marginalized students' academic experiences and achievement. Lastly, due to COVID-19 interviews were conducted via zoom and both interviewer and each teacher met while at their homes. Therefore interviews varied in excerpts and lengths because of the various effects of COVID-19 on each teachers' lives at the time of data collection (e.g. having children at home, internet connection, and/or time availability). Because all teachers participated in interviews from their home they may have been affected by various external factors contributing to their discussion reflections as well as discussion lengths (e.g. extraneous stressors, other priorities, time crunches, etc.).

Future Directions. Future researchers should aim to conduct larger studies with a more representative sample of the U.S. teacher population nationally. Additionally, future research

should discuss further the relationship between FoK integration mentioned in interviews and actual classroom videos and could compare interview and classroom coding for convergence and/or divergence. Particularly, it would be useful to conduct a longitudinal study that examines FoK integration in lessons overtime to determine the effects on student achievement and academic motivation. Further, nuanced and culturally rooted approaches (Gray, et. al. 2022) are necessary to create systematic examples of integration that can be replicable. For policy makers, further investigation and creation of communal learning based classroom contexts could be beneficial for Historically Marginalized, and especially, for Black students. For researchers, using "empowering methodologies" (p. 9) and framing would be essential to create critical research that acknowledges more variables that influence Historically Marginalized students' academic outcomes (e.g. QuantCrit, mixed methods, photovoice, cognitive interviewing, equity focused research inquiry). Lastly for teachers, continuing to allow student voices and agency to have a place in the classroom is essential in particular when working with students whose FoK are different from one's own. Students' ownership in co-creating academic experiences will assist their decision-making, leadership, and ultimately communal give back (Cook-Sather, 2006; Cook-Sather et al., 2014; Duncan-Andrade & Mor- rell, 2008; Ginwright et al., 2006; Mitra, 2004).

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Appendix A

Semi-Structured Interview Protocol

Intro

Thank you so much for agreeing to do this interview with me. This interview will be analyzed within the NSF CAREER research project. Your interview responses will be anonymous and will only be reviewed by myself and fellow researchers. A major goal of this interview is to understand how your distance learning has been so far and understand your views regarding student funds of knowledge. The FoK that this interview is focused on is student cultural references/language in relation to science discourse. Before we start, do I have permission to record your responses?

Distance learning and discourse questions [5 min]

1. How is distance learning going?
    - Probe: what is going well? What is challenging?
2. How has the nature of classroom discourse (teacher to student, student to student) changed from in-person vs. distance learning?

Discourse and Funds of Knowledge questions [30 minutes, 5 minutes each]

3. A major focus of this project is to integrate students' funds of knowledge with science talk activities. We believe that students bring valuable experiences and knowledge from their homes and communities that can be integrated to make science more accessible and meaningful to them.
    - Does the required science material or text from your school/county incorporate culturally relevant material? No required textbooks, classroom textbooks, older books. Most of what is provided isn't. Our PLC does try to pull cultural influences. Lots of ESL students and even across economic levels
    - Can you describe an instance when you've incorporated additional culturally relevant material within your lessons that may not have been within the required text?
    - How do you think students' identity influences how they approach science talk?
4. How would you compare your students' cultural, racial, and ethnic identity with your own identity?
    - Do you think the aspects of your identity aid or deter your ability to support your students' engagement in science talk? If yes, how?

Language Questions

Preface

Before asking you the next set of qs, I will play an excerpt from your classroom that shows an example of students' making connections between their everyday lives and science talk activity, such as using non-standardized American English dialects.

- ***Non-standardized language*** *can also be described as student usage of a home or informal dialect rather than scientific language (also referred to as African American English, slang, vernacular, etc.).*
- ***Standardized language*** *can be described as classroom or academic language (i.e Standard American English). I will play an excerpt from your classroom*

that demonstrates student use of non-standardized dialects prior to the interview.

This clip is just to have you thinking about your classroom context and the students you teach when answering the questions. Before I play the clip from your classroom, do you have any questions?

[SHOW VIDEO CLIP]

- Now that I played an example of non-standardized student dialect within your class, what are your general reactions or thoughts?
- Did you grow up speaking any other language or dialect?
- Do you feel that Standard American English was your native dialect?
- How have you incorporated non-SAE in your science classroom? Why or why not?

5. What do you think is the most beneficial way for students to learn scientific language and communicate in scientific ways?
    - What are some unique needs of your multilingual/dialectical students, compared to students whose first language is standardized/academic, in science talk activities?
    - How do you support these students in acquiring the scientific vocabulary and ways of communicating in your class?

<u>Conclusion</u>

6. What are some challenges related to teaching science discourse you'd like to learn more about or troubleshoot with your colleagues on this project?
7. This is the end of our interview. Before I end the recording, do you have additional thoughts related to the subject of student language?

Appendix B

Qualitative Codebook

Parent Code	Child Code	Definition	Exemplar Quote
Student FoK	Student Identity	Statements that reflect aspects of student identity related to social and/or cultural groups (Gee, 2001).	"Even our black kids, they listen to Reggaeton, you know, I'm saying so, you know, I'll use the music titles to try to bring there but if you're a Mexican, I'm probably not listening to the bachata and that's what y'all like, you know, I'm sayin? Um, if you're Puerto Rican, you're probably not listening to you're probably listening to reggaeton" - Ms. R
	Student Lived Worlds	References to the various contexts that students engage in including academic and non-academic: (a) family, (b) community, (c) peer groups, (d) popular culture, and (e) school. (Mantei & Kervin 2014).	"And then like, energy is cool, because like, you know, electrical energy, everybody, you know, hopefully has electricity in they house and can turn on the light. And if they haven't seen it at school, they've seen it out in the community" - Ms. Y
	Student Language	Use of Standard American English (SAE), non-SAE, home language, different dialects, code-switching; communication can be oral, written, through text (Lee & Fradd, 1998; Lemke, 1990).	"I mean I try really hard, I try really hard because I ha-I am in school and I'm dealing with teenagers, to keep up with stuff, but you know like BRB I have to go look that up at first…you know, the texting also is the other thing, that shorthand" - Ms. H
Teacher FoK	Teacher Identity	[same as above but in relation to teachers] (Feldman, 2016)	"So I'm a hillbilly. So my identity is vastly different from all the lowlanders down here the flatlanders" - Mr. T
	Teacher Lived Worlds	[same as above but in relation to teachers] (Nasir, 2013.)	"I did grow up in a school where I was the minority, despite the fact that I'm not the minority in our country" - Ms. C
	Teacher Language	[same as above but in relation to teachers] (Chen, et. al., 2017)	"And what I see sometimes is, especially with my Latino students, I speak Spanish, so I try to talk to them in Spanish, and I try to keep them proud of their cultural heritage" - Mr. T

Parent Code	Child Code	Definition	Exemplar Quote
FoK Integration	Present	Student FoK is mentioned, but not connected to science content in a meaningful way.	"Few white students, most black and Hispanic; students probably don't relate on that front. [I] Can relate with some economically, blue collar work" - Ms. C
	Bridged	Student FoK is connected to science content, even if implicitly (Gutierrez, Baquedano-Lopez, & Tajeda, 1999)	"Every time I do a long lesson, the next day, I do a bitmoji recap. So I have talking bitmojis to basically go over what we talked about, I get like a three to five minute lesson through the talking bitmoji" - Ms. R
	Navigated	Student language is specifically integrated into science content so students see a way of crossing and succeeding in different discourse communities (Lee, 1993)	"I try to use, like standardized language. I would like not put slang in there. But when I'm talking to them, or when they're talking to me, like, it's perfectly fine, it's perfectly okay. I think it's good to like, I feel like, my kids have to code switch a lot. So I try to let them know, like, we don't write how we talk" - Ms. Y
	Transformed	Student FoK is compared and contrasted to science context and/or teacher asks students to think metacognitively about their FoK. Boundaries and norms of dominant discourses are pushed to include discursive resources from diverse cultures. (Moje et. al. 2001; 2004)	"I do something really specific in Black History Month, is I show them all these neuroscientists, all these doctors, all these lawyers, all these people who were engineers, from all different times in history, so they can go ahead and understand that they can take ownership over their, not only their language, but all over, you know...but until they see people who look like them doing it, or people who look like them writing about it, or using a language that they're familiar with, you know, because they're just writing in a different way because we're used to this research and technical English writing, and that's cool and everything, but sometimes you just need to break it down and almost feel like it needs to be like a YouTube channel where they break it down on different things" - Ms. R

Parent Code	Child Code	Definition	Exemplar Quote
Pedagogy	General	General strategies for teaching activities, formative and summative assessments,	"I was doing different styles of presentations, I was doing games, like when we did the notes, I was writing my own textbook chapters, I was making really great infographics that they would use using videos" - Mr. T

	classroom management	
Cross-curricular	Explicit connections between science ideas/content and practices to other subject areas (e. g. math, social studies, language arts).	"I like to talk about Agent Orange, and I bring in from the Vietnam War, and I talk about how that affected a lot of soldiers. If I'm talking about Native Americans, you know, I'll bring in talking about the pollution like how when we're talking about ecosystems" - Mr. T
Science content v. practices	Specific scientific topic/content or phenomena. Content: disciplinary ideas; practices: asking questions, developing models, investigations	"During cells, we talk about Rosalind Franklin. Um, when we talk about space, um, we talk about the, um, first women that go into space or that are, um, responsible for, you know, for being able to put any of the stuff together" - Ms. H
Sociohistorical	Presenting science in the context of relevant social and historical events (positive and or negative) that pertain to the specific environmental contexts that engulf students.	"And like, I am the only black female science teacher, like I'm the only one. So when they think of a scientist, they don't always think of me because this is not I'm not the norm where I'm at. And so, um, and then like, like. I'm, like, second generation American, and I have like, a lot of kids who are like, first generation, it's like, you know, second generation" - Ms. Y
Agency	Flow of power/dissemination of class material; student engagement	"Usually you have instantaneous recognition of who's actually being a passive learner or an active learner in a classroom. Now, you're kind of re.., you're kind of like responsible for really doing a whole lot more" - Ms. R
Critical consciousness	Teacher describes how oppressed or marginalized people learn to critically analyze their social conditions and act to change them; instruction becomes a tool for liberation (Freire, 1970; 2021).	"When I bring up a concept and I tell you, you know, well, they built all, they burned all our libraries down in Africa. So we probably came up with this knowledge, but they claimed this knowledge for their own use, and, you know...we've [Black people] been building structures and engineering structures that are very astronomically aware for eons compared to the colonizers, which have just kind of picked up the skill in modern day times." - Ms. R

III. THIRD MANUSCRIPT.....

Abstract

Critical Race Theory (CRT) posits that racism is so entrenched in the United States (U.S.) society that it is commonplace; therefore, historically marginalized, Black Indigenous and People of Color (BIPOC) within the U.S. experience heightened and systematic inequalities starting from an early age (Levinson, & Kumasi, 2011; Duncan, 2002; Delgado & Stefancic, 2000). Racial/ethnic marginalized students may face invisibility, hypervisibility, and/or social exclusion in the classroom, which may negatively impact perceptions of their student-teacher relationships, temperament, and academic achievement (DeCuir & Dixson, 2004). The goal of this *QuantCrit* case study was to quantitatively evaluate the experiences of historically marginalized student populations within a rural Midwestern kindergarten sample within the CRT framework (Garcia, et. al., 2018). The study drew upon multiple resistance frameworks (i.e. Critical Race Theory [Delgado & Stefancic, 2000], Critical Race Pedagogy [Curenton & Iruka, 2020; Yoo, 2010; Lynn, 1999], and Quant Crit [Garcia et. al., 2018; Garcia, & Mayorga, 2018]) aiming to promote equitable and positive culturally relevant pedagogies (Barrio, et. al., 2017; Kugler & West-Burns, 2010).

I. INTRODUCTION .....

A *QuantCrit* Analysis of Historically Marginalized Students' Interactions, Behaviors, Social Emotional Development, and Academic Achievement in Rural Midwestern Classroom Contexts

Although race and ethnicity are often treated as surface, nominal attributes, racial ethnic inequality exists in U.S. classrooms with unintended consequences such as disproportionate discipline and stereotypes (Iceland, & Sakamoto, 2022; Sanders-Phillips et. al. 2009; Calhoun, 1993). It is important to recognize resistance frameworks such as Critical Race Theory (CRT; Delgado, et. al., 2017) and latcrit theory (Solorzano & Bernal, 2001) perspectives when analyzing diverse historically marginalized populations within this country. Race was originally constructed as a man-made rationalization for authority, dominance, and financial oppression and is not a biological explanation of cognitive traits or characteristics (Stanfield, 1999). Race often groups individuals based on physical characteristics whereas ethnicity groups individuals based on shared culture, ancestry, and/or heritage; however, the line between race and ethnicity in the U.S. today is blurred because of the country's increasing heterogeneity (e.g. increase of immigration and interracial marriages) and in addition there is still debates rather certain groups (i.e. Latinx and Middle Eastern) should be considered a racial or ethnic identity group (Iceland, 2017).Thinking about racial/ethnic identity critically means to think about its ramifications within the contexts of society. Historical views and actions in the U.S. towards racial and ethnic minority groups lead to permanent social disparity and injustices for many individuals (Iceland, & Sakamoto, 2022; Sáenz & Morales, 2019). When capitalist societies are created, the dominant group becomes the most benefited and tiered distribution of responsibilities and wealth emerge in the form of a hierarchy (Levinson, 2011; Fanon, 2007; Robinson, 2005; Gramsci, Hoare, & Nowell-Smith, 1971).Today within the U.S., racial tensions remain and envelop societal beliefs

and stereotypes even though race and ethnicity continue to intersect, overlap, and interrelate over time (Shields et. al., 2002).

The purpose of this *QuantCrit* case study is to evaluate the learning environment of racial/ethnic historically marginalized kindergarten students in a geographic context where white Americans are the majority (Panos, 2021; Census, 2020). Ten teachers' survey ratings of a.) their historically marginalized students individually as well as b.) their entire classrooms are descriptively analyzed and discussed. Specifically, this study assesses teachers' perspectives of their relationships with students, their students' temperament, and their students' academic achievement. **The research questions guiding this study ask: 1. What are the average ratings of each historically marginalized student's relationships with their teacher, temperament, and academic achievement?, 2. What are the average ratings of the entire class' temperament, student-teacher relationships, and academic achievement?, 3. What are the relationships among student-teacher relationships, temperament, and academic achievement variables for the historically marginalized students?, 4. What are the relationships among the temperament, student-teacher relationships, and academic achievement variables for the whole class?, and 5. Are there differences in the distribution (upwards vs. downward slope, clusters, outliers) of teacher-reported ratings for the relationships between temperament (task persistence and negative reactivity), student-teacher relationship (closeness and conflict), and academic achievement (math and reading) for the white versus historically marginalized students?** Using the first tenet of CRT, we suggest that racial discrimination is the reality for the historically marginalized students in this sample; we aim to critically evaluate the students' classroom experiences in a way that is beneficial for the rural Midwestern education system in the future. In this study, teacher surveys regarding students' relationships with teachers, temperament, and academic achievement will be analyzed. Maintaining positive student-teacher relationships, social-emotional well-being, and on or above grade level academic performance are crucial aspects of a positive classroom environment that could affect a student's long-term success.

Student-Teacher Relationships. Creating positive classroom relationships between teachers and their students affects students long and short term social navigation and educational achievement (Rudasill, et. al., 2023; Pianta, 1999; Roorda et al., 2011). According to previous literature, historically marginalized and/or students' with lower incomes are less likely to experience positive relationships with teachers than their white and/or higher income peers (Hughes & Kwok, 2007; Entwisle & Alexander, 1988; Hamre & Pianta, 2001; Hill et al., 2004; Kohl, Weissberg, Reynolds, & Kasprow, 1994; Ladd et al., 1999; Rudasill et al., 2023). Other researchers propose that this lack of rapport and positive relationships between students and teachers based on race and income could potentially yield insufficient academic performance (Hughes & Kwok, 2007; Pianta, Rimm-Kauffman, & Cox, 1999; Pianta & Walsh, 1996). A recent study that examined teachers' perceptions of student-teacher relationships in kindergarten through second grade with Black and White children found that teachers reported the highest level of closeness and lowest level of conflict with their White female students and the highest level of conflict whereas they reported the lowest level of closeness with Black male students; additionally, they found that teachers reported more positive relationships with female students (both White and Black) than with male students (Rudasill, et. al., 2023). The authors' findings exhibited a racial prejudice against Black individuals that reflects the deep-rooted structural and systemic racism prevalent in the United States (Rudasill, et. al., 2023).

Student Temperament. Temperament refers to individual genetic and personality differences in tendencies or dispositions that affect emotional reactivity and self-regulation representing affect, activity, and attention (McClowry, 2014; Rothbart, 1981; Rothbart & Bates, 1998, 2006). Research has demonstrated that childrens' temperament has a relationship to their academic achievement (Sealy, et. al., 2021; Rudasill, et. al., 2016; Martin & Holbrook, 1985), development of interpersonal relationships (Sealy, et. al., 2021; Corapci, 2008; Gleason, et. al., 2005; Rudasill, et. al., 2010), and emotional wellbeing (Sealy, et. al., 2021; Degnan, et. al., 2010) which is why early childhood social-emotional development is crucial (Sealy, et. al., 2021). *Emotional reactivity* is an individual's response to environmental stimuli or changes, both positive and negative, and is measured by the duration and intensity of affective, activational, and attentional reactions (Damon et. al., 2006; Rothbart & Bates, 1998, 2006). Self-regulation is the ability to adapt or control ones' 'temperamental reactivity' (Damon et. al., 2006) and refers to an individual's ability to modulate emotional and behavioral reactions to environmental stimuli or changes (Rothbart & Bates, 1998, 2006).

Temperament varies and reflects differences in biology, emotion, and behavior. Although temperament develops with an individual overtime, it is often "resistant to change" and continuously characterizes a person (McClowry, 2014). Therefore, it is essential for young children to learn how to manage their temperament through social emotional competence (Blair, et. al., 2004). Students are still measured according to the 'goodness-of-fit' standards first proposed by Thomas and Chess (1970); however, CRT scholars would suggest that temperament varies across cultural practices and children may be negatively affected by racism. Temperament has been analyzed in terms of global cross-contextual variations; however, limited research has specifically analyzed subcultural variation such as temperament variation across racial/ethnic identities (Lee & Doan, 2020; Woroby & Islas-Lopez, 2009). Further investigation is warranted to examine the temperamental disparities and perspectives within diverse U.S. subpopulations because current research suggests that marginalized students are disproportionately chastised by teachers and characterized as negatively reacting to classroom climate compared to their white peers (Sanders-Phillips., Settles-Reaves, Walker, & Brownlow, 2009). For instance, marginalized students perceived to have high-maintenance temperament may be viewed as exhibiting negative behaviors and potentially could be disciplined in school more than non-marginalized students (Taylor, 1991). Other research suggests that this disproportionality intersects with sex as well as other social constructions, such as the cultural milieu of the geographic area (e.g. Black male students in rural settings suffer from various unjust discriminatory circumstances: Gallagher et. at., 2013).

Specifically, this study looks at measures of task persistence and negative reactivity as example positive and negative variables of temperament. ***Negative reactivity*** is a form of emotional reactivity and is defined as an inclination towards adverse emotions; it is imperative that a child is able to react to classroom stimuli positively for positive emotional development long term (Rudasill, et. al., 2020; Justice, et. al., 2008). Young children who demonstrate difficulties in rage management are often unsuccessful in controlling their affective responses in the classroom and often, when their lack of affective control is evident prior to starting school, teachers may perceive and perpetuate labels in regard to the child such as disobedient or confrontational (Justice, et. al., 2008; Denham, et. al, 2002) as well as difficulties in creating and maintaining meaningful interpersonal connections (Justice, et. al., 2008; Eisenberg et al., 1998). On the other hand, children exhibiting strong task persistence demonstrate the capacity to disregard interruptions, maintain concentration on particular goals, as well as effectively finish

those goals (Sealy, et. al., 2021). ***Task persistence*** can be described as the attentiveness and duration a child persists in working on a task despite encountering challenges; task persistence is a particularly essential skill for a child to develop as classroom and lifelong goals, particularly the difficulty level as well as length of time required to complete those goals, continuously increase (Varadi, 1973; Battle, 1963).

By critically examining teacher perspectives of racial/ethnic marginalized students' student-teacher relationships, temperament, and academic achievement, this research will determine if marginalized students are in sustainable classroom environments that allow them to achieve on average like their peers. Although temperament is widely defined as biological, it is hypothesized that historically marginalized students will be perceived as more reactive (i.e. exhibiting higher motor activity and conflict); additionally, because of their low demographic population within rural Midwestern contexts and because of systemic injustices, we hypothesize that historically marginalized students may exhibit lower academic achievement than the average of their classroom. This proposal aims to critically analyze teacher surveys to understand historically marginalized children's experiences (i.e. student-teacher relationships, temperament, and academic achievement) in a rural midwestern setting. This article takes a *QuantCrit* perspective because quantitative statistics are biased and do not favor the cultural and experiential richness historically marginalized students bring into a Eurocentric-based classroom (Urban, 2018); in other words, 'numbers are not neutral' and implications of quantitative results need to be carefully disseminated (Castillo & Gillborn, 2022; Garcia et. al., 2018; Garcia & Mayorga, 2017).

Positionality Statement

I am an African American, Caribbean American woman. I am an educational psychology doctoral student at Virginia Commonwealth University. My individual experiences as a Black student and teacher drive my research of the academic achievement gap between White American and a vast majority of historically marginalized American students. I have witnessed striking classroom injustices in the United States and abroad. At a young age I had the privilege of traveling, because of my father's non-profit work, to various international schools. I've sat in New Delhi, Indian classrooms where young girls sat on the floor at the far back while their male peers sat in chairs with learning supplies. I've visited rug manufacturing shops in Cairo, Egypt where school-age children work in sweatshops rather than classrooms. I later taught within Southeastern public schools where Black boys learn criminal hypermasculinity as a means of survival, a trait that often leads to dire disciplinary consequences throughout their lifetime. The heart of my research is to strive for a socially just education system by analyzing existing classroom practices and creating critically reflective interventions that could benefit all marginalized students as well as increase classroom multi-cultural relevance and belongingness. I believe that my current research of rural, suburban, and urban contexts across various U.S. states will greatly enhance and complement my perceptions as a Black woman, student, and teacher. For this specific study, I have been working virtually with data collectors and researchers who have met teachers and students in person. Because these co-workers live in the rural Midwestern context, every aspect of the study is discussed with them. In particular, the lead data collector who has met the teachers and students is a part of manuscript discussions because as stated earlier, the goal of this research is not to reprimand teachers' practices, but to highlight systemic classroom practices and critically examine how it may affect the student sample.

Background or Literature Review

This literature review focused not only on rural and midwestern contexts, but also marginalized populations that are represented within the research sample (i.e Black or African American, Latinx, American Indian, Samoan, as well as Pacific Islander). It is so essential to examine the experiences of historically marginalized youth in this specific U.S. context. Firstly because rurality can relate to less access to resources (e.g. education, technology, employment, and health), higher poverty rates, and or social isolation (Wilson et. al., 2022; Turrini et al., 2021; Cromartie et al., 2020; Farrigan, 2019; Anderson, 2018; Showalter et al., 2017; Farrigan & Parker, 2012.) Secondly, the geographic location of this study is centered because the racial political context of the Midwest has heightened in the past decade as well. For instance, one study interviewed police officers from the Midwest Police Academy and found a pattern of color-blind racist perspectives likely related to the limitation within the academy's diversity training and many argue that the relationship between police and historically marginalized citizens has become more prevalent since the 1940's (Schlosser, 2013; Haberfield, 2002). Since contexts, race, and ethnicity are major themes of this paper, it is hypothesized that the relationships between these variables greatly influence student outcomes.

Rural Contexts

Rurality and Midwestern contexts are each very distinct and therefore will be reviewed separately as well as jointly to describe the geographic political climate that surrounds the population. Families and educational systems in rural settings in particular encounter obstacles distinct from that of suburban and urban contexts such as lack of educational resources (e.g. technology and finances), low socioeconomic status, and less availability to reasonably priced medical services (Oudghiri, 2022; Wilson, et. al., 2022). These difficulties are especially evident for bilingual immigrant students (Oudghiri, 2022). One study utilized the first tenet of Critical Race Theory (e.g. racism is a regular occurance) to examine how a White female second grade teacher in a rural geographic community approached educating immigrant students and determined that this teachers' negative ideologies contributed to a continuation of blatant and internalized discrimination that ultimately limited her ability to teach these students with a critical and culturally asset-based approach (Oudghiri, 2022). Another study suggested that black boys in rural classrooms are likely to have poor relationships with teachers, regardless of their behavior or academic skills (Gallagher et. al. 2013).

One article includes several of the ethnicities represented in this study (Smokowski et. al., 2014). This was a quantitative research study in which the authors analyzed internalizing and self-esteem variables within a diverse sample ($N = 5000$) of low-income rural middle school students (2014). The sample of students were described as American Indian (n = 28.4%), White (n = 26.7%), African American (n = 23.3%), and Latinx (8%). The researchers suggest that there are numerous stressors that may result in students internalizing rather than coping which in turn could decrease student self-esteem or belief in one's own achievement and success (Smokowski et. al., 2014). They found that this community was a "minority-majority" community which allowed for historically marginalized (i.e. minority) students to have communal and cultural support and identity (Smokowski et. al., 2014). In contrast to previous literature, they found that Native American students did not experience high levels of internalizing stress. Although Latinx and Biracial students reported having high levels of internalizing stress, all historically marginalized students reported higher levels of self-esteem than White peers. The researchers felt that within this community, White students did not hold the majority status typical in the U.S., and in turn, may have experienced low self-esteem as well as high levels of internalizing stress

(Smokowski et. al., 2014). Based on their findings', it can be hypothesized that the historically marginalized students in this current study are at risk because of the lack of cultural representation in their community and classrooms; finally, the article highlights that context and situation affect students' experience and beliefs of belonging yet suggests that positive outcomes are related to the specific community context surrounding the sample (Smokowski et. al., 2014). However, this is not the case for all research in rural contexts as the majority discuss the negative outcomes for racial/ethnic minorities (Gallagher et. al. 2013; Jones et. al, 2013; Hardré, et. al., 2010; Wilson-Jones et. al, 2004). Perhaps with further research on racial/ethnic minorities communal safe space, a higher understanding of resiliency and ways to leverage this can form.

Midwestern Contexts

It is important to note the socio-historical political context of the Midwest, particularly the historically rooted negative stereotypes and discrimination of Black, Latinx, and other historically marginalized populations which has affected their academic achievement. There is a rich literature base of research within the Midwest yet considered urban and or suburban settings (Shadlow et. al., 2014; Walls, 2012; Moore, et. al., 2008; Long, et. al., 2007). For instance, Moore et. al. conducted a qualitative research study in order to address the disparity within urban Midwestern low-income communities for African American male student populations (2008). For instance, they discuss that an alarming number of Black males are viewed as mentally deficient in comparison to White males (Moore et. al., 2008). This study examined Black high school males, the majority of whom qualified for free or reduced lunch and more than half of whom were from single parent households. Through student interviews, they found that some students had negative student-counselor relationships within their special education classrooms (Moore et. al., 2008). This finding is beneficial because student-teacher relationships relate to belongingness as well as academic success.

One ethnographic study examined Latinx youths and was inclusive of documented and undocumented youths, all of whom had mixed status family members, in Midwest context (Casanova, 2019). The article describes the influx of Latinx population within the Midwest and in response an influx of racialized policies and other attacks. For instance, government regulations both locally and nationally affect the lives of Latinx youths and/or their families specifically in this Midwest region; this includes, but is not limited to: Immigration and Customs Enforcement (ICE) and other racialized raids, laws to revoke and constraints Deferred Action for Childhood Arrivals (DACA), politically/racialized phrasing (e.g. *Build the wall, Go back to where you came from*), as well as education level policies that disallow the schooling undocumented youth, and linguistic programs that center Standard American English while rejecting native languages/cultures (Casanova, 2019). After interviewing Latinx youths in what is described as a context of *Racist Nativism*, the researcher found that the various racialized immigration and educational policies related to youths' assimilation of White supremacy and hegemony (Casanova, 2019; Gramsci, 1995).

Rural and Midwestern Contexts

Very limited research about historically marginalized students' academic experiences in rural midwestern contexts is available. One study that examined pre-service teachers' funds of knowledge and how it affected their pedagogical practices with diverse elementary school-aged children specifically within a rural midwestern setting found that the pre-service teachers' FoK, specifically their childhood education experiences as well as status quo understanding of how

teachers and schooling *should* be affected their practices and inability to innovate lessons entirely novel from traditional expectations (Karabon, 2021). Further, results found that even if pre-service teachers are able to successfully *identify* students' funds of knowledge and social inequity, they may not know how to successfully implement this knowledge into their classroom suggesting that effective teacher training for device learners should increase in culturally rooted and evidence based tools and strategies (Karabon, 2021).

Ali and colleagues' study describes a large influx of Latinx immigrants within rural midwestern states because of the demand for agricultural laborers; with the fulfillment of this agriculture demand arose the demand for medical personnel (2015). This research describes assisting Latinx youth with STEM courses and health occupation courses to augment the academic performance of these students as well as maintain a diverse self-sustaining society in which the Latinx population can thrive in multiple occupations. Their first quasi-experimental mixed methods study focused on eighth-grade rural midwestern students; more than half of the participants were Latinx and the remaining students were White (Ali et. al. 2015). Students were involved within several group sessions that described various health care occupations as well as their cultural and communal impacts. Next students were both surveyed as well as interviewed in order to determine what aspects of STEM and medical employment they were most interested in (Ali et. al., 2015). Results found that the group sessions increased all of the students' interest in STEM and healthcare; however, there were no significant differences discovered between the aspirations of White students in comparison to their Latinx peers (Ali et. al., 2015). After reviewing feedback from the first study about what students liked or wanted more of regarding the sessions, a second quasi-experimental mixed methods study was conducted using a similar sample (rural midwestern eighth grade students, Latinx, as well as White) (Ali et. al., 2015). Unlike the first study, results found that the sessions did not increase students' STEM or healthcare interests. In terms of racial distinctions, they did find a significant distinction about student interest within the "physician domain" in that as the sessions were conducted, White students decreased interest within the field whereas Latinx students increased interest. The researchers believed that their intervention did not prove to be significant in the goal of increasing Latinx student interest in the medical field. Although the researchers did not find all aspects of their study to be significant, it was important that they recognized a need for academic intervention for Latinx rural midwestern youth. They suggest future research continues to find interventions that can support Latinx youth engagement as well as achievement. Ali and colleagues (2015) suggested that Latinx students in rural midwestern contexts are more motivated academically when there are extrinsic factors, such as a need within their own community that could assist in the maintenance of their growing population.

Another article that discusses the educational experiences of students in this context is a personal recollection of the authors' experience within a rural midwestern community (Jackson, 1999). This article, although not empirical, is interesting to current analysis because it critically describes historic discriminatory views of Black youth in this geographic context. Jackson's qualitative narrative was intended to describe his experience with racial discrimination to inform the research of "helping professionals" (1999). The article is important to the current study because it brings to life what statistical values and survey responses suggest without explanation: which is that racism exists within the United States and that it detrimentally affects historically marginalized students' educational and lifelong experiences. The author grew up in what is described as rural and suburban midwestern contexts. He then describes that he continuously experienced racism from an early age, even throughout his academic career. In addition, the

author describes that Black people within the United States experience racism systematically from a young age and must cope and exist with this reality throughout a lifetime. The horrific title of this article, "Mommy, There's a Nigger at the Door", is more than intended to trigger the reader; the quote was screamed at the eleven year old Black author by a five year old White boy (Jackson, 1999). It was a quote that the author says he will never forget (Jackson, 1999). The author summarizes by reminding professionals who work with human subjects that racism is more than ignorance, but results in a cycle of discrimination, hate, and attacks towards marginalized people. Although this research acknowledges that this article is outdated and that racial discrimination may now be subdued; the cyclical passing down of culture and discrimination has not vanished.

These studies suggest that there is an influx of historically marginalized students in rural, midwestern, as well as rural midwestern regions of the United States and therefore continued research is needed to ensure that these marginalized populations can flourish in White majority contexts.

Ecological Systems Theory

Bronfenbrenner (1977) proposed the ecological systems theory that he initially termed *the ecology of human development* (p. 514). The theory posits that students grow and learn within four overlapping and overarching systems that navigate their academic opportunities (Bae, & Lai, 2019; Bronfenbrenner, 1977). The first and most directly influential level is the microsystem; the level includes an individual's immediate and daily environment. For most students this comprises their home and classroom. Next, the mesosystem includes both daily environments as well as all environments that an evolving individual interacts with within their lifetime. For a student, this could extend beyond the school and home to include extracurriculars, a community, or extended family. The third level, the exosystem, includes the previous systems as well as all governing agencies that both indirectly and directly determine an individual's *local, state, and national* regulations (Bronfenbrenner, 1977). Finally, the macrosystem entails the direct and indirect influence on an individual by "overarching institutional patterns of the culture or subculture, such as the economic, social, educational, legal, and political systems, of which micro-, meso-, and exo- systems are the concrete manifestations" (Bronfenbrenner, 1977, p. 515). The complexity of these systems results in highly variable and individual student outcomes, trends, and patterns. The various external factors within these systems affect student language exposure and usage and ultimately may be beneficial or detrimental for each student's academic progress.

At the macrosystem level, racial discrimination in the United States has shaped, and continues to influence, the policies and practices in our education system. Historically, White Americans of European descent immigrated to the United States. They became the dominant power and maintained racial dominance by physically dismissing Native American inhabitants, creating governmental laws to enforce their status, and compiling wealth through enforced African enslavement (Urban, 2009; Duncan, 2002; Delgado & Stefancic, 2000). Laws were eventually passed in order to decimate this coerced hegemony; however, using the ecological systems theory, evidence suggests that this initial hierarchy continues to influence how individuals communicate within the society, current American academic achievement outcomes, and ultimately socio-economic status (Gramsci, Hoare, & Nowell-Smith, 1971).

Critical Theories

CRT, a theory that first arose in the 1970s, recognizes that injustice remains embedded in the United States due to systematic racial discrimination. One major premise of CRT asserts that within the United States' capitalist economy, "social meanings connect our faces to our souls" (Delgado & Stefancic, 2000). The historical facts about the United States have led to the nuanced intersection of race, ethnicity, and socioeconomic status in the United States. This theory is in line with the notion of hegemony proposed by the Italian philosopher Gramsci, who suggests that academic achievement, or intellectualism, within capitalist societies is embedded with social capital (i.e., race, wealth, and other social attributes) (Gramsci, Hoare, & Nowell-Smith, 1971, p. 131). Critical Race Pedagogy (CRP) is an educational approach that is firmly grounded in the principles and foundations of CRT (Lynn, 1999). The goal of CRP is to examine and question the systemic presence of race and racism within educational systems, with the goal of promoting racial justice and equality in education. While there isn't a rigid set of principles for CRP, there are several fundamental ideas and concepts commonly linked to this approach. Here are some fundamental elements of CRP/CRT (Bell, 2018; Dixon & Rousseau Anderson, 2018; Crenshaw, 2010; Delgado & Stefancic, 2000; Ladson-Billings & Tate, 1995):

1. Racism is an everyday and ordinary reality of U.S. society.
2. Racism is beneficial for the majority and upper class of society (i.e White supremacy and elitism)
3. Race is a manmade concept that is not a scientifically proven biological variation, but instead a grouping by physical attributes.
4. Racial discrimination varies per group and the narrative of an individuals' race relates to changing demands, such as those in the job market (e.g. Black men are strong athletes for sports yet also criminalized for appearing threatening).
5. Race groupings has historical origins and therefore varied cultural practices and additionally, race intersects with other identities (i.e. each person has intersecting identities)
6. Storytelling (aka counter storytelling, legal storytelling) recognizes that the voices of historically marginalized individuals contribute to necessary reform in a way that non-marginalized individuals could not contribute due to experience differences related to race.

The main tenets of CRT and CRP that this study draws upon are 1. the acknowledgment that racial grouping and therefore racism is a normal day to day reality in the U.S., 2. intersectionality between race, ethnicity, and geographic location are particularly essential in this study, and 3. there needs to be a greater increase of counter storytelling; historically marginalized individuals' voices need to be centered and asset frameworks such as FoK will allow for these individuals' cultural knowledge bases to be legitimized in their educational experiences. In addition to CRT and CRP, we also draw upon latcrit theory which acknowledges CRT tenets and extends the critical analysis of race to include ethnicity (Solorzano & Bernal, 2001).

Creating Socially Just Classrooms Through Students' Funds of Knowledge

To create socially just classrooms for historically marginalized students (i.e., minority, multilingual, and low-income students), it is important to incorporate those students' funds of knowledge, FoK (Esteban-Guitart, et. al., 2019; Oughton, 2010; Vélez-Ibáñez & Greenberg,1990). Funds of Knowledge, FoK, is a concept first proposed in the 1990's (Oughton,

2010; Moll, et. al. 1992; Vélez-Ibáñez & Greenberg,1990). FoK recognizes that out of classroom experiences, such as home settings, encompass "ample cultural and cognitive resources with great, potential utility for classroom instruction" (Moll, et. al. 1992). For instance, student native dialect/language as well as student racial and ethnic identity are major aspects of FoK that are not often utilized or expressed in classroom settings. The notion of FoK is extremely important in highlighting the intelligence of low income and historically marginalized students, confronting "deficit models' ' that suggest that these students are less than White students and delegitimize their unique experiences and knowledge bases and deems them irrelevant to standardized curricula (Oughton, 2010). Many Black and African American students in the United States, U.S. experience dissonance between school curriculum and their FoK. For instance, one study suggested that African American children may be seen as demonstrating increased levels of physical movement, greater inclination towards expressive social interactions and interpersonal styles, as well as the utilization of nonstandard language variations (e.g. African American English) in comparison to their white peers; however, through culturally relevant and responsive education (CRRE; Barrio, et. al., 2017; Kugler & West-Burns, 2010) teachers could better appreciate the cultural differences of these students without the need for higher disciplinary actions (Taylor, 1991). FoK suggests that these marginalized students can prosper within a system that recognizes their existing expertise and experiences rather than impel their assimilation into White culture. It is essential that teachers use representative symbols and demonstrations of student FoK although it requires effort beyond typical class requirements (Esteban-Guitart et. al., 2019). FoK is also important in classrooms that aspire to create socially just platforms for a diversity of student populations (Esteban-Guitart et. al., 2019; Vélez-Ibáñez & Greenberg,1990).

Gaps in the Literature

As stated above, this research study extends the current literature in several ways. Firstly, temperament literature that examines subpopulations within the United States is extremely limited and outdated. If White teachers systematically believe that their historically marginalized students exhibit negative temperamental traits, it may be a sign of cultural differences. Secondly, research on historically marginalized elementary students in rural Midwestern contexts is also limited. Finally, this study intends to use a critical lens by acknowledging the innateness of racial injustice. Rather intentionally or not, discriminatory teacher perceptions perpetuate the cycle of educational injustice in the United States. By using *QuantCrit* we recognize the limitations in the data analyses (Garcia et. al., 2018).

The Present Study

The overarching goal of this *QuantCrit* research is to evaluate the learning experience of a small sample of rural and Midwestern marginalized youth. We define a positive classroom environment to include above average student-teacher closeness as well as opportunities for academic achievement. Currently, critical analysis of student-teacher relationships, temperamental, and academic experience of early childhood learners in a rural Midwestern setting does not exist and this research is the first addressing this gap. We draw upon previous *QuantCrit* (Zimmermann & Cannady, 2023; Garcia et. al., 2018), CRT mixed methods (Garcia, & Mayorga, 2018), as well as empirical research (DeCuir-Gunby & Walker-DeVose, 2021).

***QuantCrit* case study design** of **teachers' perceptions of** 12 historically marginalized students' teacher-reported T-S relationship, temperament, and academic achievement will be conducted to center and deeply understand the experiences of students of color as unique cases. Highlighting variability that exists in group of HM students

The research questions:

1. What are the average ratings of each historically marginalized students' temperament, student-teacher relationships, and academic achievement? (descriptive statistics, quant)
2. What are the average ratings of the entire class' temperament, student-teacher relationships, and academic achievement? (descriptive statistics, quant)
3. What are the relationships among the temperament, student-teacher relationships, and academic achievement variables for the historically marginalized students? (correlations, quant)
4. What are the relationships among the temperament, student-teacher relationships, and academic achievement variables for the whole class? (correlations, quant)
5. Are there differences in the distribution (upwards vs. downward slope, clusters, outliers) of teacher-reported ratings for the relationships between temperament (task persistence and negative reactivity), student-teacher relationship (closeness and conflict), and academic achievement (math and reading) for the white versus historically marginalized students?

Method

This research proposes a *QuantCrit* case study design that acknowledges tenets of CRT, specifically the first tenet that recognizes that racism is an ordinary everyday reality of this society. Articles that abide by a *QuantCrit* design are generally characterized by the following paraphrased principles (Garcia, et. al., 2022; Gillborn et al., 2018):

a.) Placing race and racism at the core of research analyses is both complex and arduous,
b.) Statistical quantities are not objective and can perpetuate White supremacy,
c.) Quantitative classifications are human determined and require *critical* examination,
d.) Statistical findings lack inherent meaning and should be shaped by the lived, experiences and cultural knowledges of marginalized communities, and
e.) Quantitative conclusions hold no inherent significance, but can be used to support efforts for social equity.

QuantCrit does not aim to replace the value of qualitative measures that more intricately capture the various societal practices that perpetuate racial disparities; however, critical statistical analyses can map out patterns from a broader lens that accentuates more systematic obstacles and disparities that different racial groups encounter (Gillborn et al., 2018). The complexity in analyzing race statistically arises because race is a societal descriptor based on interpersonal connections and is not a fixed classification; race often does not reflect heterogeneity within and across racialized groups (Gillborn et al., 2018; Apple, 2001). Further, historic origins of quantitative statistics includes intentional contextual neglect to delegitimize historically marginalized individuals' ways of being and knowing and maintenance of Eurocentric/White supremacy (Garcia, et. al., 2018; Zuberi, 2001). The potential for racialized assumptions to

influence the outcomes of statistical analyses is possible at every phase and it is essential that critical theorists transparently recognize that quantitative processes are not accurate interpretations of societal experiences and phenomenon (Gillborn et al., 2018). Even with these limitations, *QuantCrit* theorists believe that intentionality, contextualization, and recognition of Critical Race Theory can be useful in conducting quantitative analyses that are in fact liberatory for historically marginalized individuals (Garcia, et. al., 2018; Zuberi, 2001).

Sample

This study examines subpopulations of student participants within a larger grant funded study that was approved by the Institutional Review Board . The larger study's intervention is a ten-week intervention that teaches social emotional skills to young children, their teachers, and their parents to promote long-term positive effects (Sealy, et.al., 2021; McCormick et. al., 2018; 2015; McClowry, 2014; 2003; 2002; O'Connor et. al., 2014); it is implemented in kindergarten and first grade classrooms with puppets that teach students about their individual temperaments and how to cope with day-to-day issues that occur in the classroom. This study does not measure the intervention effects on students.

This case study focuses specifically on kindergarten teachers (n = 10; white women = 100%) and the historically marginalized students within their classrooms who have opted into the intervention of the larger study (n = 12; 50% female). Students racial/ethnic identity and sex were reported by their parents in a separate demographic survey. The racial ethnicities of these students include Black/African American, Latinx, Native American, Samoan, and Pacific Islander (see table 1). However teachers are also examined in terms of their perceptions of all of their students to determine stronger correlations between their survey responses (n = 68). .

Table 1. Sample of historically marginalized kindergarteners (n = 12)

Historically Marginalized Kindergarteners

Student ID	**Racial/Ethnic Identity**	**Sex**
1	African American & Caucasian	Male
2	Latinx, Caucasian	Female
3	African American & Caucasian	Male
4	Pacific Islander	Male
5	Latinx, Caucasian	Female
6	American Indian and Caucasian	Female
7	African American and Caucasian	Male
8	Samoan and Caucasian	Male
9	Latinx, Guatemala/Mexico	Female

10	African American	Female
11	African American & Caucasian	Female
12	American Indian & Alaska Native	Male

Table 2. Teacher sample race/ethnicity and sex (n = 10)

Teachers (N = 10)	
Race/Ethnic Identity	**Sex**
White, Caucasian, non-Hispanic	female

Data Collection

The larger intervention recruited both control and intervention schools through emailed invitations. Schools, teachers, and parents were incentivized to participate. All rural schools in Lincoln, as well as in surrounding cities, were invited. Prior to data collection, approval to conduct the study was obtained from the university institutional review board as well as the research and assessment office in the participating school divisions. Permission was obtained both from the elementary schools, and because of the sensitive age group of the sample, permission was obtained from parents as well. Only data from students with parental permission is included and analyzed within this study.

Kindergarten teachers (n = 10) with participating historically marginalized students within the larger grant funded study were chosen for this research. Data utilized for this study is from both cohort 1 wave 1 (n = 8; 4 teachers and 4 students),cohort 2 wave 1 (n = 7; 3 teachers and 4 students), as well as cohort 3 wave 1 (n = 7; 3 teachers and 4 students) (see table 1). Data was collected during the fall semester of kindergarten (2018 and 2019 for cohorts 1 and 2, respectively). All data were collected by project members in person. Teachers were surveyed prior to their classroom recordings.

Teachers completed surveys for each student in their classroom as part of a larger social emotional intervention study. This study uses baseline data that assesteachers' perceptions at the start of the school year and before they fully engaged in the intervention; therefore, intervention effects were not examined within this study. This research chose teachers (from the larger studies' intervention) who had at least one historically marginalized student in their classroom; only historically marginalized students with parental permission to participate within the intervention were included (but as mentioned before, this study does not examine the effects of the intervention). The ten chosen kindergarten teachers each had at least one historically marginalized child within their classroom, two teachers had two historically marginalized children within their class.

Teacher-Student Relationship and Student Temperament Surveys. Teachers **completed various surveys** for each student within their kindergarten class; however, this study critically examines the survey scores of the marginalized students as well as in comparison with the class average. Therefore, teachers were not directly aware that their survey responses would be used to analyze their perceptions of historically marginalized students. We consider teacher perceptions through survey responses of students' academic achievement (ACES), temperament

(T-Sati), and social-emotional learning (STRS). Variables utilized for this study include negative reactivity, student teacher-relationships (i.e., closeness and conflict), motor activity, task persistence, reading, mathematics, and critical thinking.

Each variable ranges on a numeric Likert scale from 1- 5. To measure teachers' perceptions of the student temperament, the Teacher School-Age Temperament Inventory (T-SATI) was used (Lyons-Thomas & McClowry, 2012). The T-SATI consists of 33 items, and there are 4 temperament dimensions: (1) negative reactivity (e.g., "Gets upset when there is a change in plans"), (2) motor activity ("Runs when entering or leaving the building"), (3) task persistence ("Goes back to the task at hand after an interruption"), and (4) approach/withdrawal ("Seems nervous or anxious in new situations"). Teachers indicated how often their student's behavior is like the described behavior in each statement using a 5-point Likert scale (never = 1; always =5). In this study, Cronbach's alphas for T-SATI were .95 (negative reactivity), .90 (motor activity), and .94 (task persistence & approach/withdrawal).

To measure teachers' perceptions of their relationships with participating students, the Student-Teacher Relationship Scale – Short Form (STRS) was used (Pianta, 2001). The STRS consists of 15 items of the original 28 items, and there are 2 subscales: (1) closeness (e.g., "I share an affectionate, warm relationship with this child") and (2) conflict (e.g., "This child easily becomes angry with me"). Teachers indicated how much each statement applies to their relationship with each participating student using a 5-point Likert scale (definitely does not apply = 1; definitely applies = 5). In the current study, Cronbach's alpha for STRS were .82 (closeness) and .93 (conflict).

Teacher-Reported Student achievement. To measure teachers' perceptions of the student achievement, the Academic Competency Evaluation Scale (ACES) was used (DiPerna & Elliott, 1999). The ACES consists of 28 items, and there are 3 subscales: (1) reading/writing (e.g., "reading comprehension"), (2) mathematics (e.g., "computation"), and (3) critical thinking (e.g., "comparing similarities or differences among multiple objects or ideas"). Teachers rated students' academic skills, attitudes, and behaviors in comparison with the grade level expectations at their school using a Likert scale (no observation = 0; far below = 1; grade level = 3, far above =5). The ACES was based on teachers' judgments of each participating student's academic performance. In the current study, Cronbach's alphas for ACES were .90 (reading/writing), .85 (mathematics), and .93 (critical thinking).

Data Analysis

Teachers completed survey responses for every student in their class. This study aims to highlight teacher perceptions and the scoring outcomes of historically marginalized students individually; however, comparisons within the historically marginalized sample as well as between the historically marginalized students and White students are inevitable especially with this specific sample and context (n = 12 historically marginalized students; n = 56 White students). This study intentionally aims to limit the direct comparison of historically marginalized students to their White peers (which perpetuates the deficit narrative that historically marginalized students and the maintenance of Whiteness/White supremacy as the desirable norm). A critical approach is taken within this study to disaggregate the data and examine the constellation of teacher-student relationship, temperament, and academic achievement ratings for each historically marginalized student in the sample (n = 12). Specifically, this study analyzes the teachers' ratings of ***each*** historically marginalized student to highlight the unique ways in which these students' relationships with their teacher,

temperamental characteristics, and academic achievement manifest in classrooms. This approach moves away from coarsely aggregating the characteristics and learning experiences of historically marginalized students, and instead, highlights the uniqueness of each students' learning patterns by taking a case study approach. However, this study does discuss results for White students as well to add context and understanding of how teachers rated all students and further understand if there were interesting distinctions regarding how they perceive the various historically marginalized students. Because each historically marginalized student in this study is either the only or one of two historically marginalized persons in an entirely White class with a White teacher, it would be inaccurate to analyze their experience without discussion of how their experience varies from that of their White peers. Quantitative analyses of this data were run utilizing RStudio (version 2023.06.0+421). To ensure a comprehensive understanding of our process, we primarily concentrate on descriptive analyses, which serve as a crucial bridge between *epistemology* and method in quantitative research, offering in-depth insights into our procedures (Garcia, et. al. 2022). The descriptive statistics (i.e. means, minimums, maximums, and standard deviations) of teachers' reports across the 9 variables were reported and examined for the historically marginalized students (n = 12) in relation to each other to examine possible similarities and differences within this in-group (RQ1), and also in reference to the class average of all surveyed students (RQ2; n = 68; inclusive of historically marginalized students) to examine possible systematic patterns. Additionally, Zero-order correlations were run to determine the relationship between the 9 variables both across historically marginalized students (RQ3) as well as across the entire classroom (RQ4). Correlations were run using the RStudio corrplot package (version 0.92). Lastly, scatterplots were created using the R Graphics package (version 4.2.1) to visualize where historically marginalized students fell in reference to other members of the class for student-teacher relationships, temperament, and achievement (RQ5). A scatterplot is a visual depiction of data represented through the relationship between two variables (presented on the X and Y axis) presented on a Cartesian coordinate system (Friendly & Dennis, 2005). The primary objective of a scatterplot is to illustrate visually the interrelation between two variables in terms of trends, correlations, directions, distributions, clusters, and outliers (Friendly & Dennis, 2005). Further, this study will utilize color coding to distinguish historically marginalized from White students to discuss each racial group distinctively as well as homogeneously.

Results

Results of this study find that there are variations and patterns of teachers' perceptions and ratings 1. within each individual student, 2. across all historically marginalized students, 3. within subgroups of the historically marginalized sample according to race/ethnicity group, 4. as well as systematic differences between perspectives of historically marginalized students and all other students within a given teachers' classroom. Teachers reported unique results for each individual historically marginalized student regarding temperament, student-teacher relationships, and academic achievement (see table 3 and 4). Each survey utilized a likert scale ranging from 1 to 5 with 3 as a median: a.) the **student-teacher relationship variables**, closeness and conflict, ranged from 1 (*definitely does not apply*) to 5 (*definitely applies*) with 3 (neutral, not sure) as a median, b.) the **temperament variables**, negative reactivity and task persistence, ranged from 1 (*never*) to 5 (*always*) with 3 (half of the time) as a median, and c.) the **achievement variables**, math and reading, ranged from 1 (far below grade level) to 5 (far above grade level) with 3 (grade level) as the median. Results are discussed by research questions.

Research Question 1 Results. To answer the first research question, teachers' mean survey responses regarding historically marginalized students (n = 12) are discussed. Unlike previous literature, teachers perceived a.) closeness statements as *more applicable* (*M* = 4.29) and conflict statements as *less applicable* (*M* = 2.20), b) felt that these students *rarely* demonstrated negative reactivity (*M* = 2.04) and were more *frequently* task persistence (*M* = 3.27); however, these students' academic achievements were reportedly *below grade level* (math *M* = 2.39; reading *M* = 2.43).

RQ1 Student-Teacher Relationships (figure 2)**:** For one particular student (Student 9: Latinx female), her teacher perceived that the closeness statements *did not really apply* (*M* = 2.00) and that conflict applied more so than not (*M* = 3.43). This is particularly interesting because her specific teacher rated other students (n = 6) and felt that closeness applied somewhat or definitely applied for those other students (*minimum rating* = 3.38; *maximum rating* = 4.88). Additionally, student 9's teacher felt that conflict did not apply as much with the other students in her class (*minimum rating* = 1; *maximum rating* = 2.57). Besides student 9, student 12's teacher reported that conflict *definitely applied* between herself and student 12, an American Indian and Alaska Native biracial male, (*M* = 5) even though she also reported that closeness *definitely applied* between herself and student 12 (*M* = 5). Student 12's teacher did report that closeness applied more than somewhat for all of her students (n = 16; *minimum rating* = 4.13; *maximum rating* = 5); however, she perceived conflict to be less applicable for her White students (n = 15; *minimum rating* = 1; *maximum rating* = 5). Student 12's teacher reported conflict to be *definitely applicable* for one White student in her class (*M* = 5), reported conflict to *apply somewhat* for another student (*M* = 3.86), and reported that conflict *did not really or definitely did not apply* for the majority of her students (n = 13; *minimum rating* = 1; *maximum rating* = 2.86).

RQ1 Temperament (figure 1)**:** Student 12 was not only perceived to demonstrate the *highest frequency* of conflict (*M* = 5) amongst all of the historically marginalized students (n = 11; *minimum rating* = 1; *maximum rating* = 3.43) and all surveyed students (n = 67; *minimum rating* = 1; *maximum rating* = 4.57), but was also perceived to *more frequently* demonstrate negative reactivity (*M* = 4.73) than the other historically marginalized students (n = 11; *minimum rating* = 1; *maximum rating* = 2.64). However, student 12 did not demonstrate the *highest frequency* of negative reactivity out of all survey students n = 68; *minimum rating* = 1; *maximum rating* = 4.82). Although on average historically marginalized students were reportedly task persistent *more than half of the time* (n = 12; *M* = 3.27; *maximum range* = 4.89), half of the historically marginalized student sample were reportedly task persistent *less than half of the tim*e (n = 6; *minimum range* = 2.11).

RQ1 Achievement (figures 3-5)**:** On average, historically marginalized students were reportedly *below grade level* in both math (*M* = 2.39) and reading (*M* = 2.43). Student 2, a Latinx female, was reportedly *far below grade level* in both math (*M* = 1) and reading (*M* = 1). On average, surveyed students (n = 68) were *reportedly below grade level* in math (*M* = 2.81) and *above grade level in reading* (*M* = 3.85) although more students were reportedly far below grade level in reading (scored a '1'; n = 22) than in math (scored a '1'; n = 2).

Table 3. Descriptive statistics of the ratings for each HM student. Conflict and negative reactivity are reverse scored.

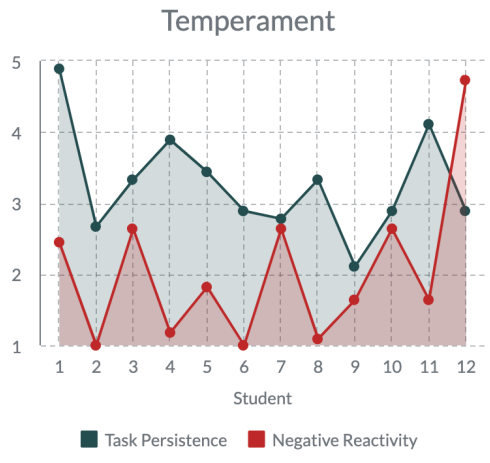
	Student-Teacher Relationships	**Temperament**	**Achievement**

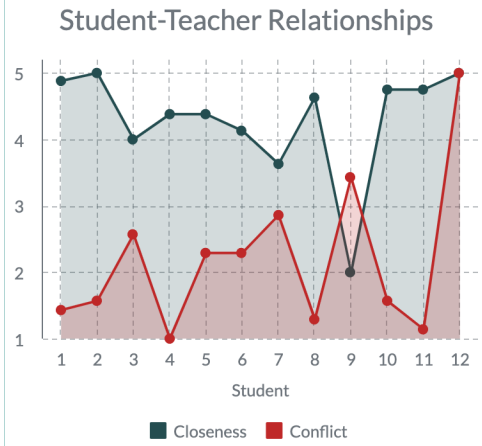
Student ID	Closeness *M*	Conflict *M*	Negative Reactivity *M*	Task Persistence *M*	Mathematics *M*	Reading *M*
1	4.88	1.43	2.45	4.89	1.25	3.27
2	5.00	1.57	1.00	2.67	1.00	1.00
3	4.00	2.57	2.64	3.33	3.00	2.09
4	4.38	1.00	1.18	3.89	3.13	3.00
5	4.38	2.29	1.82	3.44	2.50	1.91
6	4.13	2.29	1.00	2.89	1.38	1.82
7	3.63	2.86	2.64	2.78	2.00	1.91
8	4.63	1.29	1.09	3.33	2.13	1.73
9	2.00	3.43	1.64	2.11	3.00	2.91
10	4.75	1.57	2.64	2.89	3.25	3.00
11	4.75	1.14	1.64	4.11	3.00	3.55
12	5.00	5.00	4.73	2.89	3.00	3.00

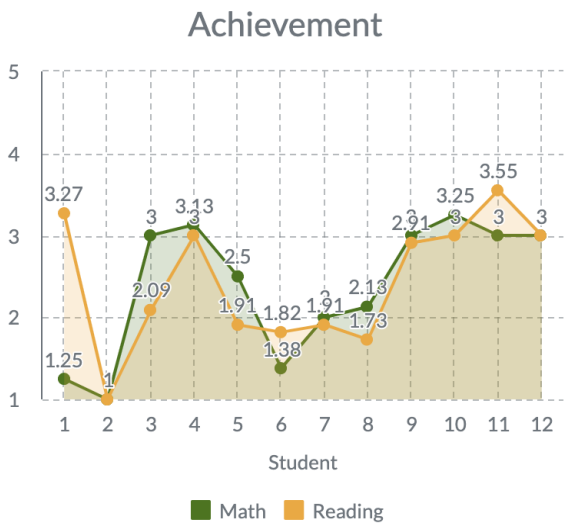
Table 4. Mean, minimum, and standard deviation of the variables for historically marginalized students (n = 12). Each variable was measured using a Likert scale ranging from 1 to 5. Student-teacher relationships ranged from 1 (*definitely does not apply*) to 5 (*definitely applies)*, temperament ranged from 1 (*never*) to 5 (*always*), and achievement ranged from 1 (*far below*) to 5 (*far above*). Conflict and negative reactivity are reverse scored.

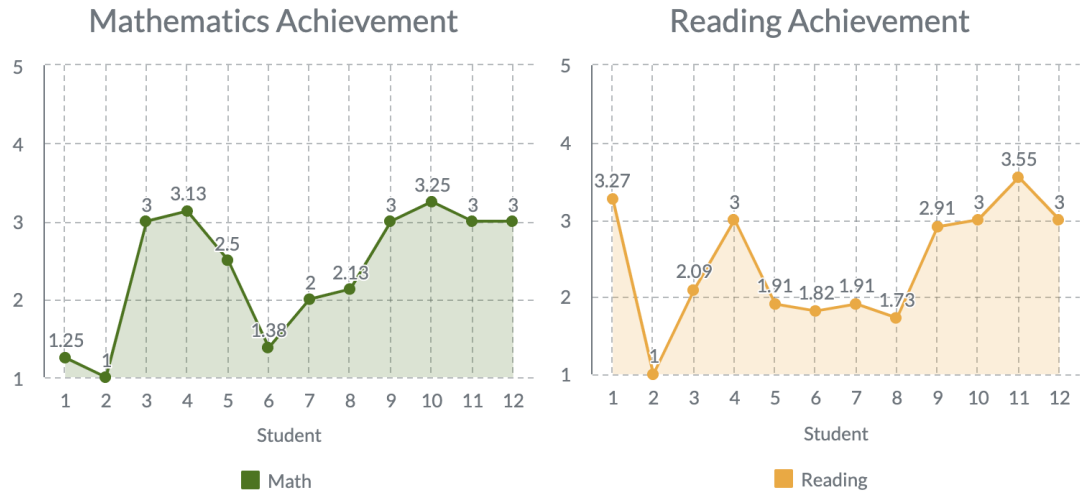
	Student-Teacher Relationships		**Temperament**		**Achievement**	
	Closeness	Conflict	Negative Reactivity	Task Persistence	Mathematics	Reading
M	4.29	2.20	2.04	3.27	2.39	2.43
Max	5.00	5.00	4.73	4.89	3.25	3.55
Min	2.00	1.00	1.00	2.11	1.00	1.00
SD	0.84	1.16	1.07	0.75	0.81	0.78

Figures 1-5. Area graphics for student-teacher relationships, temperament, and achievement for each of the historically marginalized students *(*n = 12*)* with reverse coded variables presented in red.









Research Question 2 Results. To answer the second research question, teachers' mean survey responses regarding all surveyed students (n = 68) are discussed (see appendix). The averages across all students created a better understanding of how each teacher, as well as all teachers, rated and viewed their students in general and if there are any significant variations in how they viewed all students in comparison to historically marginalized students specifically. Overall, teachers' perceptions of their class did not highly vary from their perceptions of historically marginalized students; however, teachers perceived their class to be above grade level in reading ($M = 3.85$) whereas the historically marginalized students were reportedly below grade level in both math and reading ($M = 2.39$; $M = 2.43$). Additionally, the maximum scores reported for the historically marginalized students in mathematics (*max* rating = 3.25) and reading (*max* rating = 3.55) were much lower than that of the overall class (*max* rating = 5; *max* rating = 5).

RQ2 Achievement: In terms of all surveyed White students' **math achievement** (n = 56), less than half were reportedly *below grade level* (i.e. scored below a 3; n= 24), several were reportedly right *at grade level* (i.e. scored 3; n = 19), and several were reportedly *above grade level* (i.e. scored above a 3; n = 13). Out of all historically marginalized students' **math achievement**, half were reportedly *below grade level* (i.e. scored below a 3; n = 6) and some were reportedly *at grade level* (i.e. scored 3; n = 4); Fewer were reportedly *above grade level* in math (i.e. scored above a 3; n = 2): Student 4, a Pacific Islander male ($M = 3.13$), and Student 10, an African American female ($M = 3.25$). In terms of all surveyed White students' **reading achievement** (n = 56), less than half were reportedly *below grade level* (i.e. scored below a 3; n= 21), several were reportedly right *at grade level* (i.e. scored 3; n = 16), and several were reportedly *above grade level* (i.e. scored above a 3; n = 19). Out of all historically marginalized students' **reading achievement**, more than half were reportedly *below grade level* (i.e. scored below a 3; n = 7) and some were reportedly *at grade level* (i.e. scored 3; n = 3); Fewer were reportedly *above grade level* in math (i.e. scored above a 3; n = 2): Student 1, An African American biracial male ($M = 3.27$), and Student 11, An African American biracial female ($M = 3.55$). These findings demonstrate that White students in this sample are on average on or above grade level in both math (57%) and reading (62.5%) whereas at least half of all Historically Marginalized students were reportedly below grade level in both subjects with few at grade level

in math (33.3%) and reading (25%) and even fewer above grade level in math (16.7%) and reading (16.7%).

Table 5. Mean, minimum, and standard deviation of the variables for all students (N = 68). Each variable was measured using a Likert scale ranging from 1 to 5. Student-teacher relationships ranged from 1 (*definitely does not apply*) to 5 (*definitely applies)*, temperament ranged from 1 (*never*) to 5 (*always*), and achievement ranged from 1 (*far below*) to 5 (*far above*). Conflict and negative reactivity are reverse scored.

	Student-Teacher Relationships		**Temperament**		**Achievement**	
	Closeness	Conflict	Negative Reactivity	Task Persistence	Mathematics	Reading
M	4.41	1.75	1.81	3.85	2.81	3.85
Max	5.00	5.00	4.82	5.00	5.00	5.00
Min	2.00	1.00	1.00	1.44	0.75	1.00
SD	0.66	0.98	0.84	0.86	0.79	0.76

Research Question 3 Results. Zero-order correlations were run to determine the relationship between the various variables that teachers reported on for historically marginalized students (table 6). Although there were several interesting relationships, only two were significant; this is likely due to the small sample size. Conflict and negative reactivity had a strong positively significant relationship ($r = 0.72$, $p \leq .01$) and mathematics and reading had a moderately strong positively significant relationship ($r = 0.57$, $p \leq .05$). There were several non-significant negative relationships. For instance, conflict had a negative and weak non-significant relationship with closeness ($r = -0.33$) as well as a negative and moderate non-significant relationship with task persistence ($r = -0.54$). Additionally task persistence and negative reactivity had a negative and weak non-significant relationship (-0.04). Interestingly, mathematics had a negative and weak relationship with both closeness ($r = -0.23$) and task persistence ($r = -0.10$); reading also had a negative and weak relationship with closeness ($r = -0.02$). Although non-significant and weak, these negative relationships suggest that historically marginalized students who were closer with teachers had lower reading and math scores and historically marginalized students who were task persistent had lower math scores. Findings from this analyses suggest that overall, teachers perceived that the marginalized students reacted more negatively ($M = 2.04$), were less close and more conflictive ($M = 4.29$, m= 2.20), and were less task persistent ($M = 3.40$) than the class overall ($M = 1.81$, 4.41, 1.75, 3.85 respectively; Tables 4 and 5). Additionally, marginalized students were perceived as having lower reading ($M = 2.43$) and math ($M = 2.39$) scores than the class overall ($M = 3.85$ and 2.81 respectively; Table 4 and 5). Majority of the variables that marginalized students are perceived higher in have negative connotations (i.e., higher conflict, higher negative reactivity and lower task persistence); further, in accordance with findings of previous research, marginalized students are receiving lower academic scores on average.

Table 6. Correlation matrix of teacher reported variables for historically marginalized students (n = 12).

	1	2	3	4	5	6
1. Closeness	1					
2. Conflict	- 0.33	1				
3. Negative Reactivity	0.16	**0.72****	1			
4. Task Persistence	0.52	-0.54	-0.04	1		
5. Mathematics	- 0.23	0.22	0.36	-0.10	1	
6. Reading	-0.02	0.03	0.38	0.45	**0.57***	1

$p \leq .05$, *$p \leq .01$**, $p \leq .001$***

Research Question 4 Results. Zero-order correlations were run to determine the relationship between the various variables that teachers reported on for the entire class (table 7). Several variables were statistically and significantly correlated with one another. Task persistence had a statistically significant relationship with every variable and reading had a statistically significant relationship with every variable except for negative reactivity. Closeness and conflict had a negative moderately significant relationship ($r = -.34$, $p \leq .01$) and conflict and negative reactivity had a strong positively significant relationship ($r = 0.75$, $p \leq .001$). There were a few negative non-significant relationships, but they were unsurprising. Negative reactivity and closeness had a negative and weak non-significant relationship ($r = -0.13$), mathematics had a negative and non-significant relationship with both conflict ($r = -0.16$) and negative reactivity ($r = -0.04$), and lastly reading had a negative non-significant relationship with negative reactivity ($r = -0.02$).

Table 7. Correlation matrix of teacher reported variables for all students (N = 68).

	1	2	3	4	5	6
1. Closeness	1					
2. Conflict	**-0.34****	1				
3. Negative Reactivity	-0.13	**0.75*****	1			
4. Task Persistence	**0.48*****	**-0.67*****	**-0.53*****	1		
5. Mathematics	0.09	-0.16	-0.04	**0.39*****	1	

6. Reading	**0.24***	**-0.25***	-0.02	**0.52*****	**0.79*****	1

$p \leq .05$, $^{*}p \leq .01$**, p ≤ .001***

Research Question 5 Results. Scatterplot matrices were created to visually examine differences in the distribution (e.g. slope steepness/direction, clusters, and outliers) of teacher-reported ratings for the relationships between temperament (task persistence and negative reactivity), student-teacher relationships (closeness and conflict), and academic achievement (math and reading) for the white versus historically marginalized students (figures 2-4). Each of the three scatterplots represent the relationship between two paired variables. Figure 2 demonstrates a relationship between closeness and conflict (teacher-student relationship), figure 3 demonstrates a relationship between negative reactivity and task persistence (temperament), and figure 4 represents a relationship between reading and math (academic achievement).

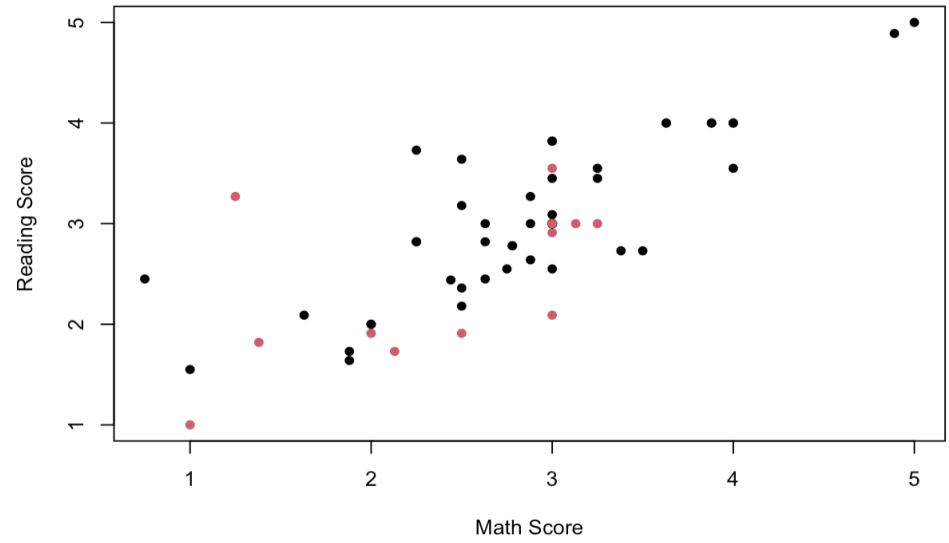
In terms of ***academic achievement*** (figure 6), there is a *generally linear upward slope* in the distribution of teachers' ratings for both groups which exemplifies the positive and statistically significant correlation between reading and mathematics within this study for both historically marginalized students as well as the entire student sample. However, when examining *clusters*, historically marginalized students are generally clustered around or below grade level for both classroom subjects; no historically marginalized student is presented above grade level in both subjects. One historically marginalized student, who received the lowest achievement rating of all students, appears at the very low end of the linear spectrum ($M = 1$ in both subjects). White students are more evenly distributed above and below grade level. Several White students are clearly represented above grade level in both subjects, particularly two White students (one who received a M of 5 in both subjects and one who received a M of 4.89 in both subjects). In terms of *potential outliers*, at least three students are represented above the linear trend. For instance, one historically marginalized student appears to be the greatest outlier with an above grade level rating in reading ($M = 3.27$) and significantly below grade level rating in math ($M = 1.25$).

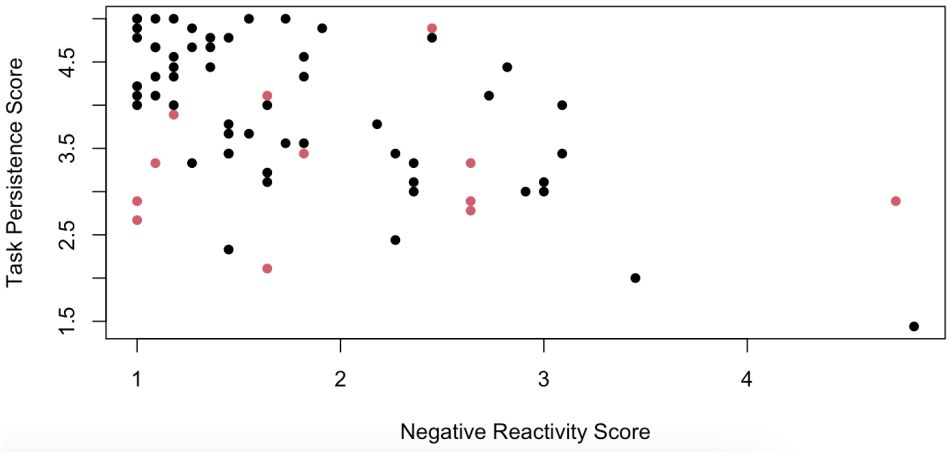
In terms of ***temperament*** (figure 7)**,** the relationship is *less linear* than that of academic achievement; however, there is clearly a downward slope representing *a negative relationship* between task persistence and negative reactivity. This aligns with the correlational results; task persistence and negative reactivity had a moderately negative and significant relationship for all students, but had a non-significant low negative relationship for historically marginalized students. All students are *heavily clustered* with negative reactivity ratings around or below a 3. One White student is represented with the highest negative reactivity score and the lowest task persistence score. A potential outlier is the historically marginalized student represented outside of the linear trend with reportedly high negative reactivity ($M = 4.73$), but moderate/nearly average task persistence ($M = 2.89$).

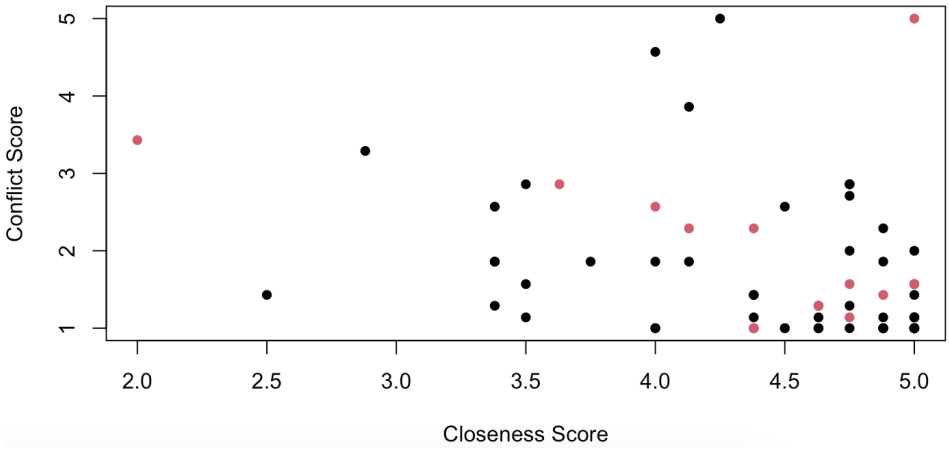
Finally, ***teacher-student relationship*** (figure 8), appears to have the flattest slope of the three scatterplot matrices. Closeness and conflict had a moderately negative, statistically significant relationship for all students, but a low and negative non-significant relationship for historically marginalized students. The largest cluster of students were reported with high closeness and low conflict. There are at least six students that teachers reportedly believed a conflictual relationship was more applicable than the neutral ($M = 3$) threshold. One historically marginalized student is at the opposing end of the linear pattern (opposite to the largest cluster); although this student fits within the trend, they have the lowest closeness rating across all

students (*M* = 2.00) with a more than neutral rating for conflict (*M* = 3.43). A noticeable outlier is the historically marginalized student with a maximum score of closeness and conflict (*M* = 5.00 for both variables).

Figures 6-8. Scatterplots of all students (N = 68) grouped by achievement, temperament, and student-teacher relationships. Historically Marginalized Students are distinguished by red (n = 12) and the White students are distinguished by black (n = 56).







Discussion

Overall, this research fills the gap within previous research regarding historically marginalized kindergarten students' experience, particularly their teachers' perceptions of them, within a rural and midwestern context. Previous literature does not focus on this age group which is problematic because rather or not these kindergarteners recognize social injustices, they are at a fundamental age where ramifications from divergent teacher perceptions could increase and have long lasting effects. This study quantitatively examined kindergarten teachers' perceptions of historically marginalized students within a rural midwestern regional context. This study explores White teachers' (n = 10) ratings of the historically marginalized students (n = 12) as well as their White peers (n = 56) with the lens of Critical Race Theory and in accordance with the tenets of CRT, recognize that racism is embedded within all U.S. societies and therefore integrated into every aspect of these students' lives (i.e. within the community, teacher training, school policies, classroom practices, etc.; Delgado & Stefancic, 2000). For instance, historically marginalized students within the U.S., particularly Black males, are chastised for behavior and labeled with a learning disability more so than their White peers and this phenomenon continues throughout and beyond schooling (Noguera, 2009). There is an abundance of statistical findings that support these claims and additionally note co-occurrences of negative school outcomes with socioeconomic disadvantages (Ladson-Billings, 2009). Whether or not these students are in fact displaying negative behavior and/or performing poorly, this belief phenomenon regarding racial minority students' classroom readiness and performance has become omnipresent and mundane (Noguera, 2009). Over half a century since Brown vs. the Board of Education passed in 1954, the equity of racial integration within the classroom remains highly debated as education leaders continue to question how to create quality educational platforms for diverse learners (Ladson-Billings, 2009; Bell, 1980).

In this quantitative analysis, ten teachers' survey ratings were examined across all of their students (n = 68), their White students (n = 56), and specifically also for individual historically marginalized students within each classroom (n = 12). Results revealed differences in teacher perceptions across the historically marginalized sample as well as between the historically marginalized students and the classroom overall. When analyzing average ratings of each historically marginalized students' temperament, student teacher-relationships, and academic achievement results determined that teachers' perceived close relationships with all of the historically marginalized students and perceived these students to be overall task persistent with

limited conflict and negative reactivity; however, half of historically marginalized students were reportedly below grade level in mathematics and more than half were reportedly below grade level in reading **(RQ1).** In contrast, when analyzing ratings for the entire classroom **(RQ2)** and even White students specifically, similar trends were found in teacher-student relationships and temperament; however, more than half of White students were reportedly on or above grade level in both reading (62.5%) and math (57%). Although previous literature suggest that student-teacher relationships are a significant proponent of students' temperament and achievement (Rudasill, et. al., 2023; Rudasill et al., 2013; Roorda et al., 2011; Liew et al., 2010; Hamre & Pianta, 2001), this study found that at least half of the historically marginalized student population were below grade level in both reading and mathematics regardless of having strong student-teacher relationships. This suggests that there are likely other factors besides student-teacher relationships that relate to historically marginalized youths' achievement (e.g. incorporation of culturally relevant teaching; Muhammad, 2020; Ladson-Billings, 2009).

Correlation analyses on historically marginalized students' ratings revealed mathematics as well as a strong positively significant relationship between negative reactivity and conflict and a moderately strong positively significant relationship between reading **(RQ3).** These correlations are in line with current literature that found strong positive correlations between reading and mathematics for both historically marginalized as well as multilingual youths implying that these assessment variables exhibit a significant degree of interrelation for racial/ethnic and linguistic minority elementary-school-aged children (Foster, et. al., 2022). One study examined preschool students from an urban northeastern population; the sample were reportedly majority White, but also included African American and Latinx children (Spritz, et. al., 2010). Their study, similar to this one, utilized the STRS to measure student-teacher relationships and their correlational analyses found that emotional lability/negativity (including negative reaction) was a mediator between social skills and student-teacher conflict (Spritz, et. al., 2010). The correlational results within our study address a gap in the literature mentioned by Spritz and colleagues to further analyze temperament and student-teacher relationships with racial/ethnic diverse child populations. Findings examining the relationship between student-teacher relationships, temperament, and achievement in early childhood, and particularly for historically marginalized youths, are limited and future research that utilizes larger samples of historically marginalized children regarding these variables would be highly beneficial.

Next, correlation analyses on the class at large revealed that task persistence had a statistically significant relationship with every variable and that reading had a statistically significant relationship with every variable except for negative reactivity; additionally, closeness and conflict had a negative moderately significant relationship and conflict and negative reactivity had a strong positively significant relationship **(RQ4)**. The discussion of the statistical significance of the relationship between task persistence, achievement, and temperament varies. Some studies find that task persistence does not actually statistically relate to student achievement and suggest that students' belief in their academic abilities is more related to their achievement (De La Cruz, 1999; Battle, 1965). For example, one study that examined Filipino fourth through sixth grade students found that task persistence and achievement had a low and non-significant relationship for this specific student sample; the author suggests that the low correlation between the two variables may relate to the relaxed nature of the students' classrooms (De La Cruz, 1999). This explanation is plausible for young children where lessons are more goal oriented and task persistence is not as necessary as it may be for older-aged students. Other studies however do suggest the significance of task persistence. For instance, one study on Black

fifth grade boys found that task persistence, achievement responsibility, and academic achievement had a strong relationship; specifically, results suggest that for these Black boys task persistence likely related to the administration of the task (i.e. students may persist longer in group projects than individually; Varadi, 1973). Other studies further suggest a relationship between task persistence and type of task and/or administration of task for young, specifically Black, children (e.g. indoor or outdoor task; Okoh, 2022).

Further research could not only survey teacher ratings of students' task persistence, but also observe and analyze how tasks are typically administered to those students. Additionally, more research is needed to examine the relationship between task persistence and student-teacher relationships as well as task persistence and other temperament variables for generally functioning early aged, and particularly historically marginalized, children. Further, it is not only essential to identify a students level of task persistence, but it is also useful for teachers to understand how to manage and work with students with various temperamental needs; for instance, students low in task persistence may have difficulties maintaining consistent energy on an assignment or may have difficulty processing a multi-stepped assignment at once and teacher training that provides knowledge on how to break down an assignment into smaller goals or provide students periodical intervals of rest may find ways for students to be successful at achieving goals even with low task persistence (Seal, et. al., 2021).

Lastly, scatterplot graphics were created to understand the visual distribution of paired ratings of student-teacher relationships (i.e. closeness and conflict), temperament (i.e. task persistence and negative reactivity), and achievement (i.e. math and reading) grouped by racial/ethnic identity (i.e. historically marginalized [red dots] and White [black dots]) **(RQ5)**. Scatterplots were created to examine patterns regarding the distribution of student ratings across two variables at a time (i.e. closeness and conflict, negative reactivity and task persistence, as well as math and reading).

Through a critical analysis of scatterplot matrices based on racial/ethnic marginalized or non-marginalized status, there are interesting patterns. Teachers reported having close relationships with all students, specifically, the majority of historically marginalized students are reported to have very close relationships with teachers. However, many historically marginalized students are also reported to have more than neutral negative reactive and some reportedly have less than neutral task persistence. The most striking finding evident through scatter plots is that the majority of historically marginalized students are reported as being on or below grade level in both reading math. None of the historically marginalized students are significantly above grade level in either reading or math. On the contrary, there are several White students who are clearly on or above average in both subjects. This finding is striking because although teachers report close relationships with historically marginalized students with generally low conflict, they still report many of these students to have below neutral task persistence or above neutral negative reactivity.

Additionally, more than half of historically marginalized students are reportedly below grade level in reading, half are reportedly below grade level in math, and none of the historically marginalized students are reported to be significantly above grade level. These results do not explain *why* teachers believe they are so close with their historically marginalized students especially when many are below grade level, but a possible scenario may be that teachers believe they are close with these students yet these students may not believe they are close with teachers. For example, a previous study examined fourth and fifth grade students' perceptions of their teachers' emotional socialization practices among historically marginalized students (Matejka,

2022). The study found that Latinx students reported teachers to utilize less support and care than did White and Black students and that Black students reported higher levels of unsupportiveness in teachers than did White or Latinx students; the author further discusses that previous research suggests null and mixed results regarding student-teacher relationships (Murray et al., 2008) whereas their study specifically found a negative relationship between race and student-teacher relationships (Matejka, 2022; Thompson & McDonald, 2016; Yeager et al., 2017). Future research should be conducted with larger samples of historically marginalized subgroups to determine if trends reported here are replicable, and to better understand the teacher-student closeness versus lower ratings of historically marginalized students' achievement discrepancy.

Another explanation may be that teachers may actually enjoy the personalities of historically marginalized students while still maintaining deficit beliefs about those students' academic performance capabilities. Specific to the Midwestern geographic context, which is generalized across multiple U.S. states, is the concept of *Midwest Nice* which references a general culture that often maintain White supremacy either intentionally or passively by not addressing racial/ethnic inequity simply by pretending racism is non-existent; this cultural phenomenon has been described in elementary school settings that are majority White (Cosier, 2019; Drake & Rodriguez, 2022; Lee, 2022). *Niceness* is referenced as a cultural normality and even aspect of cultural identity within this geographic region (Drake & Rodriguez, 2022). Although niceness is generally a benevolent trait, it can also refer to avoidance of more difficult and necessary equity reform (Lee, 2022). Further, *educational niceness* (Castagno, 2019) is also a phenomenon of avoiding politics and other more uncomfortable topics within school settings (Drake & Rodriguez, 2022).

Midwestern k-12 classrooms, although increasingly diversifies in student population, are majority taught by White (79%) and female (76%) teachers (report from 2017-2018 academic school year; Spiegelman, 2020) who, even if not overtly racist, may not feel a need to or know how to push against societal normalities even if they know that they are wrong (Drake & Rodriguez, 2022). Researchers argue that some teachers deliberately avoid *hot* political issues (e.g. racism or racial/ethnic inequality) through *warm* and *cool* neutrality (Drake & Rodriguez, 2022; Lee, 2022; Cosier, 2019). This phenomenon may be further exacerbated in a rural Midwestern context. Midwestern teachers may reject or feel a discomfort in the idea of reforming traditional ways of schooling to honor the cultural diversity of their, likely limited, population of historically marginalized youths especially when majority of students, especially White students, are successful within traditional formats (Cosier, 2019).

Research also suggests that rural Midwestern teachers refer to their own childhood educational experiences as well as their parenting experience (i.e. their funds of knowledge) when making pedagogical decisions (Karabon, 2021). Another theory is that teachers in this region may lack training on how to work with students with challenging temperament, ELL learners, and or non-White children. Research suggests that rural Midwestern teachers refer to their own childhood educational experiences as well as their parenting experience (i.e. their funds of knowledge) when making pedagogical decisions (Karabon, 2021). If teachers are referring to what they know from experience and are not given evidence-based training to work with diverse learners then they may unwillingly perpetuate unequal educational standards. Future research should examine both teacher and student perceptions of relationship closeness and conflict as well as examine the cultural relevance of teachers' pedagogical approaches within these geographic settings.

Limitations

This research has a very limited convenient sample (n = 68 students, n = 10 teachers, n = 12 historically marginalized students) which was not enough to make statistically significant claims or overall generalizations regarding all White teachers perceptions of historically marginalized students in rural midwestern regions. Specifically, there were not large enough samples of each racial/ethnic minority group. With larger samples of specific historically marginalized subgroups (e.g. Black, Latinx, etc.), perhaps statistically significant patterns within those subgroupings could have been found. In addition to increasing student sampling, a more qualitative or ethnographic approach may be useful in understanding each individual student further as well as teachers' pedagogical practices. Future studies could be more informative with the incorporation of mixed methodology to create more in depth case descriptions for each student individually. Lastly, this research, taken out of context, could perpetuate negative stereotypes about historically marginalized students' temperament and academic abilities. It is important that practitioners and researchers recognize the variation across contexts and samples when applying or examining evidence-based practices.

Future Research

Researchers of historically marginalized student populations continue to emphasize the importance of culturally relevant teaching. This article took a critical approach to analyzing White teachers' perspectives of historically marginalized students in a rural midwestern geographic context. By descriptively unpacking the results of teacher surveys we shed light on racial-ethnic differences that may relate to implicit or explicit bias, varied cultural norms, Eurocentric survey questions/standards, and or Eurocentric ways of knowing and being in the classroom. We hope that this research particularly inspires pre-service teachers to critically reflect on their positionality in teaching and how they can find ways to be more inclusive of historically marginalized students. Through qualitative interviewing with experienced teachers of African American students, Gloria Ladson-Billings denotes several key principles of cultural relevancy such as providing racially marginalized students with: a.) opportunities of authority within their educational environments, b.) communal and interconnected rather than independent learning, c.) educational connections to their experiential knowledge, d.) various pedagogical methods that foster student inquiry and autonomy in the learning process e.) deeper understanding of racial inequities and united discussion/efforts of reform with teachers; finally she highlights the necessity of teachers' self-recognition of their own privilege and placement within students' learning and within the society at large (2009, p. 126-128). Another example of beneficial strategies to better the education for Black and Brown students stems from key principles of Muhammad's *equity framework for culturally and historically responsive literacy*: "1.) identity development; 2.) skill development; 3.) intellectual development; and 4.) criticality" (2020; p. 12). These historically rooted strategic approaches are rooted in *literary societies* that were established by and for Black people in the nineteenth century in northeast metropolitan regions of the U.S. (i.e. "Philadelphia, New York, and Boston", p. 9) to counter various forms of inequity through reading achievement (Muhammad, 2020; Forten, 1837). Muhammad suggests that this communal practice of not only learning to read, but learning while 1. Understanding and valuing oneself, 2. Continued practice of enhancing one's abilities and skills, 3.) Metacognitively connecting reading to lived experiences and life as well as 4.) Learning through the lens of inequity through social-political authority, White supremacy, and Black and Brown subjugation with the intent of societal reformation (Muhammad, 2020). The literature on CRRE is not only

useful for pre-service teachers and education researchers, but for policy makers especially. Policy makers should reflect on critical and cultural evidence-based literature to find ways to support the academic experiences of historically marginalized populations. It is important that future research continues on this topic and further multicultural relevancy interventions be tested within rural and midwestern communities specifically.

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VITA.....

Curriculum Vitae
Martinique A. Sealy
Doctoral Candidate
Virginia Commonwealth University
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Richmond, VA 23220
martannsealy@gmail.com

EDUCATION

Virginia Commonwealth University: 2019-2023 (expected graduation August 2023)
Doctor of Philosophy in Educational Psychology

American University: 2017-2019
Master of Arts in Education in Special Education

Loyola University New Orleans: 2013-2016
Bachelor of Science in Psychology
Minor in Music (Voice)

AWARDS AND RECOGNITIONS

Virginia Commonwealth University School of Education Research Colloquium
- March 17th, 2023: Sole winner of the Juried Award
  - Highest award awarded to one poster a year
- March 18th, 2022: Honorable mention
  - 'Poster was deemed excellent and near the top of the selections'

International Research Awards on Science, Health and Engineering (SHEN): 2022
- provisionally selected for the Research Award and recommended by their scientific committee

Phi Eta Sigma National Scholastic Honor Society: 2013-2016
Howard University Psychiatry Department Volunteer of the Year: 2009-2014
American Institute for Research Pakistan Student Exchange Program: 2009
Howard University School of Pharmacy ARMS: 2008

LICENSES AND CERTIFICATIONS

Special Education Pre Kindergarten - 12th Grade Teacher District of Columbia: 2020 - present
Certified Teachstone CLASS K-3 Observer: August 2019- August 2021

PREK- 12TH GRADE TEACHING EXPERIENCE

Private Tutor: April 2020 - February 2022

- Student: 1
- RPS student during his time in third-fifth grade
- Virginia Commonwealth University under Dr. Kevin Sutherland Best in CLASS lab
- Richmond, VA
- Working with this student on critical thinking, advancing reading levels, written and verbal expression, mathematics, and enhancing task focus.
- Customized Curriculum to incorporate this student's
    - Racial/ethnic, gender, and religious identities
    - Hobbies of video games, food, and sports
    - Interest in animals and wildlife exploration
- Virtual lessons included
    - Creation of books using students' imagination, google presentations, and google images
    - IXL website personal learning tools including skill practice, assessments, and book reading for multi-grade levels
    - Wilbooks website including poetry, guided reading, and grade level reading
    - Storyberries website, particularly African stories
    - African Storybook website
    - PBS Kids website, books, and games
        - Particular focus on the PBS show Wild Kratts to include books, games, and videos via PBS and other sources
    - Guided reading practice by reading closed captions on educational videos from National Geographic and Youtube with specific focus on animals
    - Educational games included: Starfall Education website, Education website, and abcya website

Prekindergarten Teacher Assistant: August 2017 - June 2019

- Saint Ambrose Catholic Elementary School
- Cheverly, MD
- Assisted lead teacher with lesson planning and classroom set up
- Met with parents throughout the school year
- Assisted students throughout the entire day on individual assignments, behavior, special classes (gym, Spanish, music, and art), recitals and performances, church attendance and etiquette,
- Substituted for other K-8 classes on occasion
- Lead before care for all prek-8th grade students
- Lead Junior Great Books for second grade students two years in a row

Title 1 Mathematics and English Language Arts Instructor: October 2018- June 2019

- Saint Ambrose Catholic Elementary School
- Cheverly, MD
- Tutored three small groups of students ranging from second to eighth grade on reading, writing, and mathematics
- Would mentor these students on occasion throughout the school day

First Grade Teacher Assistant: August 2016 - June 2017
- AmeriCorps, City Year
- Southwest, Washington, DC
- Amidon-Bowen Elementary School First Grade Assistant

RESEARCH POSITIONS AND INTERNSHIPS

Postdoctoral Researcher: August 2023-present
Racial Equity in STEM Center for Teaching, Research, and Learning:
Examining Blackness in Postsecondary STEM Education through a Multidimensional-Multiplicative Lens
PI: Dr. Terrell Morton
Department of Educational Psychology in the College of Education
University of Illinois Chicago
Co-PI: Dr. Andrea Tyler
Graduate Student Services
Tennessee State University
Supervisors: Drs. Brian McGowan and Shari Watkins
School of Education
Center for Teaching, Research, and Learning
American University

Graduate Research Assistant: May 2019 - August 2023
National Science Foundation Faculty Early Career Development Program (CAREER):
Building on diverse students' funds of knowledge to promote science discourse and strengthen connections to science learning in urban classrooms
PI: Dr. Christine L. Bae
Department of Foundations of Education
Virginia Commonwealth University
- Abstract screening, summary of empirical studies, synthesis and coding
- Lead the development of classroom video data collection protocols
- Leading teams data collection
- Collecting and coding classroom videos to examine discourse patterns in urban classrooms
- Develop survey collection platform using RedCap software, collect teacher and student survey data
- Contribute to the development of survey and interview protocols
- Co-facilitate professional development in the summer and lesson study throughout academic year
- Assisted in recruiting new graduate students through Q&A and tours
- Participated in and observed grant writing processes

Graduate Research Assistant: June 2019 - August 2023
The Institute of Education Sciences:

Testing the Efficacy of INSIGHTS for Promoting Positive Learning Environments and Academic Achievement in Nebraska: A Replication Study
PI: Dr. Gwen C. Nugent
Department: Center for Research On Children, Youth, Families and Schools
University of Nebraska-Lincoln
Co-PI: Dr. Kathleen M. Rudasill
Office of Research and Faculty Development
Virginia Commonwealth University

- Classroom coding using the Classroom Assessment Scoring System, CLASS (August 2019-present)
- Literature review of teacher perceptions of non-White elementary school students' temperament in the rural Midwestern region
- Analyze initial statistical results from the first cohort
- Influence and support intervention remodeling and logistics

Laboratory Manager: August 2019 - August 2023
Discourse and Learning Lab
Director: Dr. Christine Bae Virginia Commonwealth University

- Training incoming graduate students on data collection and analyzation
- Recruit, interview, train, and supervise research assistants in audio/video transcription and quantitative and qualitative data entry
- Create protocols (e.g., schedules, task sheets, instructions) for research tasks for the entire lab
- Facilitate weekly virtual lab meetings
- Prepare and facilitate bi-monthly research meetings

VCU Employee and Student Visitor: April 2020- August 2023
IES: Best in CLASS:
A Classroom-based Model for Ameliorating Problem Behavior in Early Childhood Settings
PI: Kevin S Sutherland; Maureen Conroy
Department of Foundations of Education
Virginia Commonwealth University

- Attend lab meetings and workshops
- Private tutoring: April 2020- February 2022 (detailed in teaching experience)
- Grant Writing Experience
    - Took course SEDP 708: Grant Writing in Special Education and Other Social Sciences with professor Dr. Kevin Sutherland (Spring 2021)
    - Applied for Building Future Faculty Program at North Carolina State University 10/12/21 (Status: No Response Received)
    - Applied for American Dissertation Fellowships (AAUW) 11/1/21 (Status: Denied)
    - Applied for American Education Research Association (AERA) Minority Dissertation Fellowship in Education Research 12/1/21 (Status: Denied)
    - Applied for Ford Foundation Dissertation Fellowships 12/9/21 (Status: Denied)

Research Assistant: Spring 2021- August 2021

iScholar
Director: Dr. DeLeon Gray, NC State University

- Audited Belonging Course: Spring 2021
    - Networked with other doctoral students
    - Received feedback and mentorship from Dr. Gray on a motivation and belonging course writing project
- **Summer 2021 Externship** (3 credits)
    - I attended manuscript meetings for The Cultural Significance of "We-Ness": Why Communal Approaches are Essential to the Design of Equitable Learning Environments. (Gray, et. al., 2022)
        - Assisted with two revisions of the manuscript
        - Literature review of African theoretical frameworks such as Ubuntu
        - Literature review of critical race methodologies
    - I attended Dr. Gray's lectures at various universities
    - Individual meetings with Dr. Gray regarding professional development, networking with students and faculty, the dissertation, etc.
- Continuous check ins and development mentoring
- DEI Community Conversation: An Evening with Dr. DeLeon Gray: 3/17/22
    - Peter Paul Coleman Promise Center Richmond, Virginia from 4:30-6pm
    - Title: Phones, Fashion, and Cold Hard Cash: Breaking Conventions to Support Belonging in Predominantly Black Schools
    - I was invited, by the VCU DEI committee chair Dr. David Naff, to introduce the keynote speaker, Dr. Gray
    - Visited Armstrong High School with Dr. Gray and other doctoral students to answer questions and conversate with graduating students 3/2022
- Networking opportunities through Dr. Gray at AERA 2022, San Diego & APA 2022, Minneapolis

RESEARCH AND SCHOLARSHIP

Line of Research: Integrating students' ecologically based Funds of Knowledge (FoK) with academic, specifically scientific, language and knowledge to critically impact Historically Marginalized BIPOC (Black, Indigenous, and People of Color), multilingual, and low-income students' achievement, belonging, and engagement which in turn will foster their development and critical consciousness (i.e. social-political cognizance and communal responsibility; Gray, et. al. 2022; López, 2017; Ladson-Billings, 1995).

Publications

Gray, D. L., Ali, J. N., McElveen, T. L., **Sealy, M.** (2022). The cultural significance of "we-ness": Why communal approaches are essential to the design of equitable learning environments. *Educational Psychology Review*. https://doi.org/10.1007/s10648-022-09708-y

Bae, C. L., **Sealy, M. A.,** Cabrera, L., Gladstone, J., & Mills, D. (2022). Hybrid discourse spaces: A mixed methods study of student engagement in US science classrooms. *Contemporary Educational Psychology, 71*, 102108. https://doi.org/10.1016/j.cedpsych.2022.102108

Wilson, E., Eum, J., Joo, Y., **Sealy, M. A,** Barrett, J. S., Nugent, G., Carraher, J., Hinrichs, A. (2022). Rural parent's experiences of stress and resilience during the COVID-19 pandemic and school closure. *Online Journal of Rural Research & Policy*, *17*(2). https://doi.org/10.4148/1936-0487.1113

Acar, I. H., Celik, M. V., Rudasill, K. M., & **Sealy, M. A.,** (2021). Preschool children's self-regulation and learning behaviors: The moderating role of teacher-child relationship. *Child and Youth Care Forum*. https://doi.org/10.1007/s10566-021-09615-3

Bae, C. L.**,** Mills, D., Zhang, F., **Sealy, M.**, Cabrera, L., & Sea, M. (2021). A systematic review of scientific discourse in urban K12 classrooms: Accounting for individual, collective, and contextual factors. *Review of Educational Research.* 91(6). 831-877. https://doi.org/10.3102/00346543211042415

Sealy, M. A., Rudasill, K. M., Barrett, J. S., Eum, J., Adams, N., Hinrichs, A., & McClowry, S. (2021). *Temperament in the Early Elementary Classroom: Implications for Practice*. In Hernandez-Serrano, M. J. (Eds), Teacher Education in the 21st Century - Emerging Skills for a Changing World. London: IntechOpen. *http://*10.5772/intechopen.96270

Rudasill, K. M., Reichenberg, R. E., Eum, J., Barrett, J., Yoo, J., Wilson, E., & **Sealy, M.** (2020). Promoting higher quality teacher-child relationships: The INSIGHTS intervention in rural schools. *International Journal of Environmental Research and Public Health* (Special Issue: Mental Health of Children and Young People), 17, 9371. https://doi.org/10.3390/ijerph17249371

In Preparation

Bae, C., Matewos, A., Cabrera, L., & **Sealy, M**. (Manuscript in progress). Coding discourse in science classrooms: Re-imagining productive disciplinary engagement in hybrid spaces.

Gladstone, J.R., Bae, C., Cabrera, L., **Sealy, M.**, & Hayes, K. (Manuscript in progress). Different opportunities to participate in science and their relationship to elementary student engagement.

Sealy, M., Bae, C. L. (Manuscript in progress). The Relationships among Black Students' Racial/Ethnic Identity, Languages/Dialects, and Academic Experiences in the U.S.: A Systematic Literature Review. *Review of Research in Education*

Sealy, M., Bae, C. L., Hogan Rapp, E. (Manuscript in progress). Integration of Historically Marginalized Students' and Teachers' Identities, Languages, and Lived Worlds in Urban Middle School Classrooms. *Learning, Culture, and Social Interaction*, IF: 2.059, ranking it 155 out of 264 in *Education & Educational Research*

Sealy, M., Eum, J., Joo, Y., Rudasill, K. M. Barrett, J. (Manuscript in progress). A QuantCrit Analysis of Historically Marginalized Students' Interactions, Behaviors, Social Emotional Development, and Academic Achievement in Rural Midwestern Classroom Contexts. *Journal of Community and Applied Social Psychology*

PROFESSIONAL PRESENTATIONS

Hankour, K., Braxton, J., **Sealy, M.**, Sun, H., Young, D., & Bae, C.L., (2023, August, 4) Profiles and Perspectives of Middle School Students on Science Talk Engagement and Relevance: A Mixed Methods Analysis. [Poster Presentation] American Psychological Association 2023, Washington, D.C. United States.

Sealy, M. A.*, Figueroa-Rivera, R., (2023, April, 16). New directions: The dissertation and beyond [Division C Invited Speaker Session]. 2023 Convention of the American Educational Research Association, Chicago, IL, United States.

***Sealy, M. A**.*; Gladstone, J.; Cabrera, L; Hankour K.; Braxton, J.; Bae C. L. (2023, April, 15). Talk in hybrid spaces: Expanding opportunities for student engagement in science discourse, In Ruzek, E. (Chair), New approaches to the study of engaging and motivating classroom instruction. [Symposium]. 2023 Convention of the American Educational Research Association, Chicago, IL, United States.

McCoy, W., **Sealy, M. A***, Hattan, C., Figueroa-Rivera, R., & Morton, T.* (2023, April, 14) Division C Shark Tank: Graduate Students Pitch Equity and Inclusion–Focused Research Designs (for Money) [Invited Speaker Event]. 2023 Convention of the American Educational Research Association, Chicago, IL, United States.

Sealy, M. A.* (Chair and Discussant; 2023, April, 14) Freedom Dreaming, Freedom Teaching (Table 19), In Fairmont Roundtable Session Six [Roundtable Session]. 2023 Convention of the American Educational Research Association, Chicago, IL, United States.

Sealy, M. A.* (Chair and Discussant; 2023, April, 14) Faculty and Doctoral Students' Teaching Experiences in Higher Education [Paper Session]. 2023 Convention of the American Educational Research Association, Chicago, IL, United States.

Sealy, M.*, Eum, J., Stoneman Barrett, J., Joo, Y., Rudasill, K. M., & Hinrichs, A. (2023, April 13). *A Critical Analysis of Rural Midwestern Kindergarten Teachers' Perspectives of Teaching Approaches Towards Historically Marginalized Student Populations: A Critical Race Transformative Convergent Mixed Methods Case Study* [Roundtable Session]. 2023 Convention of the American Educational Research Association, Chicago, IL, United States.

Figueroa-Rivera, R.***, Sealy, M. A.,** (2023, April 13). Games are most definitely not a waste of time: Perspectives about games, learning, and community [Division C GSC Fireside Chat].

2023 Convention of the American Educational Research Association, Chicago, IL, United States.

Sealy, M. A.*, Eum, J., Joo, Y., Barrett J., Hinrichs, A., & Rudasill, K. M. (2023, March, 25). Historically Marginalized Students' Social Emotional and Academic Development in Rural Midwestern Contexts [Poster session]. 2023 Society for Research in Child Development Biennial Meeting, Salt Lake City, UT, United States.

Eum, J., Reichenberg, R. E., Rudasill, K. M., Stoneman Barett, J., Wilson, E., Joo*, Y., **Martinique Sealy**, Nugent, G. C., Kugler, K. S., Rejman, E., & Adams, N. (2023, March, 24).The Effects of INSIGHTS on Developmental Trajectories of Children's Self-regulation Skills [Poster session]. 2023 Society for Research in Child Development Biennial Meeting, Salt Lake City, UT, United States.

Acar, I. H., Veziroglu Celik, M., Rudasill, K. M., & **Sealy, M.** (2023, March, 23). Turkish Children's Self-Regulation and Learning Behaviors in the Context of Teacher-Child Relationships, in Ibrahim Hakki Acar (Chair), Children's Self-Regulation in the Context of Teacher-Child Relationships in Colombia, Turkey, and the United States [Symposium]. 2023 Society for Research in Child Development Biennial Meeting, Salt Lake City, UT, United States.

Sealy, M.* (2023, February). Leveraging Black American Student Academic Experience by Incorporating Their Funds of Knowledge: A Systematic Literature Review [Poster session]. AACTE's 75th Annual Meeting, Indianapolis, IN, United States

Sealy, M.*, Eum, J., Barrett, J., & Rudasill, K. M. (2022, August 4-7). Teacher bias regarding minoritized students' temperament, behavior, and achievement [Poster session]. 2022 Convention of the American Psychological Association, Minneapolis, MN, United States.

Sealy, M.*, Cabrera, L., Bae, C.L., Gladstone, J., Walls, K. H., Sun, H., & Hayes, K. (2022, August 4-7). Science learning opportunities and student engagement: A mixed methods study [Poster session]. 2022 Convention of the American Psychological Association, Minneapolis, IN, United States.

Sealy, M.*, Wilson, E., Eum, J., Joo, Y., Barrett, J. S., Nugent, G., Carraher, J., Hinrichs, A., (2022, June 29). Something Had to Give During Shutdown, and It was Schoolwork [Poster session]. The Administration for Children and Families' National Research Conference on Early Childhood, Virtual.

Gladstone, J.R., Cabrera, L., **Sealy, M.,** Bae, C., & Hayes, K. (2022, April 21-23). Different opportunities to participate in science and their relationship to elementary student engagement. In A. Haber and S. Kumar (Chairs), Exploring children's early engagement and motivation in science: Implications for cognitive development [Symposium]. Bi-Ennial Cognitive Development Society Meeting, Madison, WI, United States.

Matewos, A., Bae, C. L., Cabrera, L., **Sealy, M.**, & Gladstone, J. R. (2022, April 21-26). Re-imagining classroom discourse in hybrid spaces: Development of a scheme and codebook [Paper presentation]. 2022 Convention of the American Educational Research Association, San Diego, CA, United States.

Sealy, M. A.*, Bae, C. L., & Hogan Rapp, E. (2022, April 21-26). Teachers' and students' identities, languages, and lived worlds in historically minoritized middle school classrooms [Roundtable session]. 2022 Convention of the American Educational Research Association, San Diego, CA, United States.

Sealy, M. A.*, Regier, C., Garcia, N. M., (2022, April 21-26). Critical and equity-driven quantitative, qualitative, and mixed methodology [Firesidechat]. 2022 Convention of the American Educational Research Association, San Diego, CA, United States.

Regier, C. & **Sealy, M. A.*,** (2022, April 21). New Directions in Culture, Learning, and Motivation [Division C Invited Speaker Session]. 2022 Convention of the American Educational Research Association, San Diego, CA, United States.

Nugent, G.*, Wilson, E.*, **Sealy, M.**, Barrett, J., Eum, J., Joo, Y., Carraher, J., & Hinrichs, A. (April 13th, 2022). Something Had to Give During Shutdown, and It was Schoolwork! [Conference Presentation]. The Nebraska Center for Research on Children, Youth, Families & Schools (CYFS) Summit. Lincoln, Nebraska.

Sealy, M. A.*, Bae, C. L., & Hogan Rapp, E. (March 2022). Teachers' and Students' Identities, Languages, and Lived Worlds in Urban Science Middle School Classrooms [Poster Session]. Virginia Commonwealth University School of Education (VCU SOE) Research Colloquium, Richmond, VA. (Winner of the Juried Honorable Mention Award)

Sealy, M. A.*, Bae, C. L., & Hogan Rapp, E. (March 2022). Teachers' and students' identities, languages, and lived worlds in historically minoritized middle school classrooms [Poster Session]. American Association of Colleges for Teacher Education, New Orleans, LA.

Barrett, J.S., Wilson, E., **Sealy, M.***, Eum, J., Joo, Y., Nugent, G.C. (2021, October 22). Something had to give during the shutdown, and it was schoolwork. [Conference Presentation]. Metropolitan Educational Research Consortium. Richmond, Virginia.

Sealy, M.*, Bae, C. L., Cabrera, L., Gladstone, J. R., Hogans-Foster, T., Stange, M., Salem, E. (2021, October 19). Hybrid spaces that promote science discourse in CCPS & RPS middle schools [Paper]. Metropolitan Educational Research Consortium, Virginia Commonwealth University, Richmond, VA. Online Format.

Bae, C. Mills, D., & **Sealy, M.**. Hybrid spaces in urban classrooms that support students' engagement in science discourse. *AERA, 2021.*

Bae, C. L., Mills, D. C., Zhang, F., **Sealy, M.,** Venning, C., & Cabrera, L.. A systematic review of scientific discourse in K12 urban classrooms: The role of individual, collective, and contextual factors. A*merican Educational Research Association, 2021.*

Rudasill, K.M.*, **Sealy, M.*,** Eum, J., Barrett, J.S., Nugent, G. (2020, October 16) Understanding children's temperament as a pathway for productive classroom interactions. [Conference Presentation]. Metropolitan Educational Research Consortium, Richmond, VA.

Sealy, M. A., Camp, E., Vickery, T., Rudasill, K. M. Using Critical Race Theory to Understand Rural, Kindergarten Teacher Perceptions of Non-White and White Student Temperament in the INSIGHTS Intervention. *Occasional Temperament Conference,* Virginia Polytechnic Institute and State University. November 2020. [Accepted, but canceled due to COVID]

Sealy, M. A., Bae, C. L. Primary School Gender Differences in Efficacy, Belongingness, Engagement, and Academic Achievement. American Psychological Association Division 15, at the Convention Center Washington, DC. August 6-9, 2020.

Sealy, M. A., Bae, C. L. Primary School Gender Differences in Efficacy, Belongingness, Engagement, and Academic Achievement. Poster Session at *Virginia Commonwealth University School of Education Research Symposium*. March 6, 2020.

UNIVERSITY TEACHING EXPERIENCE

Guest Lectures

- **Mixed Methodology** (EDUS 712): September 22nd, 2022
  - Virginia Commonwealth University
  - Course Professor: Dr. Christine L. Bae
  - Doctoral Seminar
  - Guest Lectured on the recently published *Hybrid Discourse Spaces* (Bae, et. al., 2022)
  - 4pm-4:30pm Hybrid Course
  - Students: 18
- **Seminar in Cognition and School Learning** (EDUS 720): March 28th, 2022
  - Virginia Commonwealth University
  - Course Professor: Dr. Christine L. Bae
  - Doctoral Seminar
  - Guest lectured on "language diversity, socio-historical context, and nuances"
  - Class period also featured guest lecturer Dr. Jason Chow
  - 4pm-4:30pm Virtual Course
  - Students: 5
- **Motivation in Context Lab**: October 14th, 2021
  - Virginia Commonwealth University
  - Lab Director: Sharon Zumbrunn Co-Director: Alison Koenka
  - Graduate and undergraduate level educational psychology laboratory

    - Guest lectured on involvement in professional organizations, specifically my role as Division C Graduate Junior Chair
    - 7pm-7:30pm Virtual Meeting
    - Lab members estimate: 20
- **Mixed Methodology** (EDUS 712): September 9th, 2021
    - Virginia Commonwealth University
    - Course Professor: Dr. Christine L. Bae
    - Doctoral Seminar
    - Co-Guest Lectured on the Engagement in Hybrid Spaces Paper along with Lauren Cabrera
    - Guest Lectured on Explanatory Sequential and Convergent Mixed Method Designs
    - 4pm-5pm Virtual Course
    - Students: 11

University Teacher Assistant

- **Applied Multilevel Modeling in Education** (EDUS 664): August 2022 - December 2022
    - Virginia Commonwealth University
    - Richmond, VA
    - Professor: Michael Broda
    - Attending each class
    - Presented both R Studio as well as Stata Content Reviews on the following topics and dates
        - Getting Started with Stata/R (R Studio and Stata presentation): 9/12/22
        - 2-level random slope/coefficient models (R Studio presentation): 10/10/22
        - Introduction to 3-level models (Stata presentation): 10/24/22
        - Growth Curve/ Nonlinear Models (Stata presentation): 11/07/22
        - Generalized multilevel models for binary data (Stata presentation): 11/14/22
        - Assessing assumptions (Stata presentation): 11/28/22
    - Managing email requests
    - Meeting with small groups of students and the professor to troubleshoot questions
    - Meeting with students one on one to troubleshoot questions
    - Students: 15
- **Applied Multivariate Statistics in Education** (EDUS 663): January 2021 - May 2022
    - Virginia Commonwealth University
    - Richmond, VA
    - Professor: Michael Broda
    - Attending each class
    - Presented Stata Content Reviews on the following topics and dates
        - Getting Started with Stata: 1/26/22
        - Advanced Regression (Moderation/ Interaction Effects): 2/9/22
        - Advanced ANOVA (Repeated Measures): 2/16/22
        - Checking Assumptions of Statistical Models: 2/23/22
        - Cluster Analysis: 3/23/22

        - Confirmatory Factor Analysis: 4/6/22
    - Meeting with small groups of students and the professor to troubleshoot questions
    - Meeting with students one on one to troubleshoot questions
    - Students: 15
- **Educational Psychology for Future Teachers** (EDUS304): January 2020 - May 2021
    - Virginia Commonwealth University
    - Richmond, VA
    - Professor: Christine L. Bae
    - Co-facilitate in-class discussion about topics of educational psychology theory in relation to effective classroom teaching
    - Guest lecture on how to acknowledge students' individuality within a classroom through uplifting their learning ability and cultural diversity.
    - Update gradebook
    - Student estimate: 20
- **Advanced Educational Psychology for Secondary Teachers** (EDUS617): August 2020 - December 2020
    - Virginia Commonwealth University
    - Richmond, VA
    - Professor: Christine L. Bae
    - Student estimate: 40
- **Human Development and Learning** (EDUS301): January 2020 - May 2020
    - Virginia Commonwealth University
    - Richmond, VA
    - Professor: Ashlee Lester Morgan
    - Assisted with classroom management and discussion
    - Student estimate: 30

MEMBERSHIPS IN PROFESSIONAL ORGANIZATIONS

AACTE American Association of Colleges for Teacher Education: 2021-present

Holmes Scholar at Virginia Commonwealth: 2021-present

- Attended the Holmes Dissertation Retreat in Boca Raton, Florida (April 3rd-4th, 2023)
- Newsletter Committee
- Received mentorship from Dean Andrew Daire alongside multiple Holmes Mentors from numerous universities on conference submissions, curriculum vitae, cover letters
- Mentor and collaborate with peer Holmes members
- Attend meetings
- Engaged and presented in AACTE (and Holmes) conferences (March 2022 and March 2023)
- Conducted interviews and evaluated applicants Fall 2022

United Campus Workers Virginia (UCWV): 2021-present

- Pay dues
- Attend and participate at meetings

- Vote for/discuss plans with Executive Board members

American Educational Research Association: 2020- present

Division C, *Member:* 2019 - present

AERA Motivation SIG, *GSC Member:* 2020 - present

Division C Graduate Student Council, *Senior Co-Chair*: 2022-2023

- Lead Division C New Directions Chat: April 2023
- Advised Junior Chair on creation of Fireside chat
- Continued engagement in Slack and twitter social media
- Attendance at Graduate Student Council meetings across divisions (in person and virtual)
- Met with junior chair bi-weekly
- Division C Shark Tank 2023
    - Met with Equity and Inclusion Committee monthly in regards to Division C Shark Tank 2023 (lead by Dr. Terrell Morton)
    - Create flyers and call for proposal
- Evaluated student proposal
- Emailed listserv of hundreds of graduate students
- Surveyed for student interest
- Lead and organized with volunteering Division C Graduate Student Committee members
    - Created Div C Grad GSC call
    - Professional development event planning
- Solidified Division C, Motivation Sig, and Teaching Education Psychology Sig graduate student networking
    - Communal writing groups (twice weekly)
    - In-person networking: April 2023

Division C Graduate Student Council, *Junior Co-Chair:* 2021-2022

- Lead Division C Fireside Chat: April 2022
- Created Division C slack channel and increased usage of twitter engagement
- Attendance at Graduate Student Council meetings across divisions monthly (virtual)
- Met with senior chair bi-weekly
- Division C Shark Tank 2022
    - Met with Equity and Inclusion Committee monthly in regards to Division C Shark Tank 2022 (lead by Dr. Terrell Morton)
    - Create flyers and call for proposal
    - Evaluated student proposal
    - Spoke and sat on the panel at the in person conference
- Solidified Division C and Motivation Sig graduate student networking
    - Communal writing groups (twice weekly)
    - In-person networking: April 2022

American Psychological Association: 2020- present

Division15: Educational Psychology, *Member*

Initiative for Race Research and Justice

Vanderbilt Peabody College, *colleague and attendee*: 2020-present

Saint Lucia National Trust: 2017 - present

Living Our Vision Everyday Chapter of the NACWC: 2016 - present

National Association of School Psychologist: 2013 - 2019

PROFESSIONAL COMMITTEES AND SERVICE

Department of Foundations, School of Education Chair Search Committee (2022)

- Tenure-Track 12 month Faculty Position at Virginia Commonwealth University
- Committee Members: 7
  - Assistant Dean Kathleen M. Rudasill, Dr. Christine L. Bae, Dr. Kurt Stemhagen, Dr. Rachel Gómez, Dr. David Naff, Dr. Hillary Parkhouse, and Martinique Sealy
  - Served as sole student committee member
- Reviewed roughly ten applications in terms of job post requirements, school of education preferences, as well as my own perspectives
- Attended meetings
  - 11/29/22 2:30pm-3pm
  - 12/6/22 9am-10am
- Discussed opinions with faculty committee members
- Assisted committee in reaching consensus by offering student perspectives

Conference Review

- AERA Division C
  - 2022 Reviews (9/2021)
  - Division C - Learning and Instruction / Division C - Section 1a: Literacy 2023 Reviews (9/15/2022)
- APA Division 15

Ad hoc reviews, co-reviewer: 2020-2021

Learning and Individual Differences Journal: 2021

- Read articles and summarized detailed feedback regarding grammar, theory, methodology, and overall soundness of the study alongside co-advisor Dr. Kathleen Rudasill

Contemporary Educational Psychology, Journal of Educational Psychology: 2020

- Read articles and summarized detailed feedback regarding grammar, theory, methodology, and overall soundness of the study alongside advisor Dr. Christine Bae

VOLUNTEER

Students Moving Into the Lives of the Elderly (SMILE): 2014 - 2016
Uptown Shepherd's Senior Center New Orleans, LA

Howard University Psychiatry Department Volunteer: 2009 - 2014
Howard University Hospital, Washington, D.C.

Anna's Arts for Kids: 2013
Saint Anna's Episcopal Church New Orleans, LA