

From “They” Science to “Our” Science: Hip Hop Epistemology in STEAM Education

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Abstract

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Keywords: hip hop; science; math; critical race theory; epistemology; pedagogy

Hip hop has moved from being considered a type of music into being understood as a culture in which a prominent type of music originates. Hip hop culture has a philosophy and epistemological constructs as well. This study analyzed those constructs to determine how conceptions of science factor in hip hop worldviews. Pedagogical models in culturally responsive teaching and Science, Technology, Engineering, Arts, and Mathematics (STEAM) education were also examined to discern their philosophical connections with hip hop culture. These connections were used to create two theoretical models. The first one, Hip Hop Science, described how scientific thought functions in hip hop culture. The second model, Hip Hop STEAM Pedagogy, proposes how hip hop culture can inform STEAM teaching practices.

The study began by using Critical Race Theory to create a theoretical framework proposing how the two theoretical models could be derived from the philosophical and pedagogical concepts. Content analysis and narrative inquiry were used to analyze data collected from scholarly texts, hip hop songs, and interviews with hip hop-responsive educators. The data from these sources were used initially to assess the adequacy of the proposed theoretical

framework, and subsequently to improve its viability. Four overlapping themes emerged from the data analyses, including hip hop-resistance to formal education; how hip hop culture informs pedagogical practice in hip hop-responsive classrooms; conceptions of knowledge and reality that shape how hip hoppers conduct scientific inquiry; and hip hop-based philosophies of effective teaching for hip hoppers as a marginalized cultural group. The findings indicate that there are unique connections between hip hop epistemology, sciencemindedness, and pedagogical practices in STEAM education. The revised theoretical framework clarified the nature of these connections, and supported claims from prior research that hip hop culture provides viable sites of engagement for STEAM educators. It concluded with suggestions for future research that further explicates hip hop epistemology and Hip Hop STEAM Pedagogy.

Table of Contents

Abstract.....	i
Table of Contents	iii
List of Figures.....	vi
List of Tables	vii
Acknowledgements	viii
Dedication	x
Chapter I - Introduction.....	1
An Explanation of Terms: From Hip Hop to Hip-Hop to Hiphop.....	1
From STEM to STEAM: The Creation of Intellectual Space.....	2
“They” Science	2
“Our” Science	3
STEM, Hip Hop, and the President of the United States.....	5
Purpose of the Study	7
The Need for the Study.....	8
Theoretical Framework.....	10
Organization of the Study	13
Chapter II - Review of Relevant Scholarship.....	14
Critical Race Theory	14
Core Aspects of CRT	14
Whiteness as Property.....	15
The Intractability of Racism	16
Critiques of Liberalism in Education	16
Narratives.....	18
Interest Convergence	19
The Application of a CRT Framework	20
Culturally Responsive Pedagogy	21
Culturally Responsive Pedagogy in Practice	23
Sociocultural Constructivism: A Combination of Learning Theories	25
Sociocultural Theory.....	26
Constructivism and STEAM Education.....	27

Sociocultural Constructivism vs. Banking in Education	29
Hip Hop Vs Rap: A Brief History of Hip Hop Culture	30
Hip Hop Philosophy.....	33
The Pillars of Hip Hop as Epistemological Constructs	33
Realness, Authenticity, and Praxis.....	36
Hip Hop-Based Education	39
Hip Hop vs the Formal Classroom.....	41
Critical Hip Hop Pedagogy	43
Reality Pedagogy	45
Summary	48
Chapter III - Methodology and Research Procedure.....	49
Content Analysis.....	49
Mapping using Content Analysis.....	49
Analyzing the Texts	50
Narrative Inquiry.....	52
Research Questions.....	54
Research Procedures	55
The Traditional Scholarly Texts	55
The Hip-Hop Scholarly Texts.....	57
The Interviewees.....	60
Data Collection	63
Triangulation.....	64
Positionality of the Researcher	65
Summary.....	68
Chapter IV – Data Analysis and Results	70
Analytical Frameworks: Voices of Critique and Resistance	70
Critical Race Theory	71
Hip Hop-Resistance to Education.....	75
Emergent Connections and Concepts from the Philosophical and Pedagogical Models:	78
Hip Hop Philosophy, a Hip Hop-Worldview, and Hip Hop-Based Education.....	79
Teaching and Learning in Hip-Hop Ways	87
Hip Hop Connections to Pedagogical Philosophies.....	96
Convergent Pedagogical Philosophies.....	101
Summary.....	104
Chapter V –Summary, Discussion, and Recommendations	106

Summary	106
Discussion	107
Stories of Critique and Resistance	108
The Strength of Street Knowledge.....	110
Supreme Mathematics: Knowledge, Build or Destroy, and the Cypher.....	113
Hip Hop Science	116
Hip Hop STEAM Pedagogy	118
Revised Theoretical Framework	120
Limitations	124
Hip Hop Culture as Pathology: A Confounding Factor.....	126
Significance of the Study	127
Recommendations.....	129
Final Statement	132
References.....	134
Appendices.....	155
Appendix A: Interviewee Consent Form.....	156
Appendix B: Interview Template	159
Appendix C: Methodology for Hip Hop Text Search.....	161
Appendix D: Data Coding.....	163
Appendix E: Map Analysis of Interviews and Hip Hop Text Data.....	165
Curriculum Vitae	166

List of Figures

Figure 1: Proposed Theoretical Framework	11
Figure 2: Revised Theoretical Framework	121
Figure 3: Map Analysis of the Interview and Song Data.....	165

List of Tables

Table 1: Hip Hop Scholarship Texts.....	59
Table 2: Data Codes for Frameworks	163
Table 3: Data Codes for Framework Connections.....	164

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Dedication

This work is dedicated to the memory of my grandfather, Hubert L. "I.Q." Ellis, whose living room was the first cypher I ever sat in to build knowledge.

Chapter I - Introduction

An Explanation of Terms: From Hip Hop to Hip-Hop to Hiphop

The *street language* used in hip hop culture, with its built-in versatility and the creative nuance with which it is used, can quickly become confusing. Even the phrase “hip hop” itself is a source of challenge: Should it be hyphenated, like it is on the cover of *Schooling Hip-Hop* (Hill & Petchauer, 2013)? Should it be capitalized, like all proper nouns? Is it hyphenated and capitalized? Marcyliena Morgan, Harvard University professor and Executive Director of the Hiphop Archive, capitalizes it and combines it into one word. To provide at least some clarity, the following conventions will be used for “hip hop” in this study:

- The default appearance is “hip hop”; two words, not capitalized, and unhyphenated when used as a noun
- The phrase “hip-hop” will be used as an adjective (e.g. hip-hop dress or hip-hop state of mind)
- When quoted from another text that uses another convention, the phrase will appear as it does in that text (Petchauer writes, “The incorporation of hip-hop...”)

The term “hip hopper” is used to describe people who participate in or are of hip hop culture. There are other terms describing hip hoppers that are used as well, many of which refer to the level a person is perceived to be immersed in hip hop culture (i.e. a head, a god, or a G). Each of these is defined as it appears in the narrative text.

Finally, the phrase “hip-hop scholarship” is used to distinguish the texts created by hip hoppers—including music, graffiti art, and breakdancing (hip hop dance)—from traditional academic scholarship. Both are labeled “scholarship,” and are thus treated equally with regard to their importance in the study. While more and more academic scholars are studying hip hop, this

designation rightly honors the role of hip hoppers in defining and describing their own worldview, which is formed largely outside of the academy and its traditions.

From STEM to STEAM: The Creation of Intellectual Space

An important shift has begun in science education toward incorporating the arts into the traditional STEM concept, refashioning STEM into STEAM—Science Technology, Engineering, Arts, and Mathematics (Bequette & Bequette, 2012; Piro, 2010; Robelen, 2011; Watson & Watson, 2013). This movement reflects the idea that aspects such as aesthetic beauty in architecture, or the ability of a scientist to be a persuasive speaker, are integral parts of how science is conducted. In STEAM pedagogy, students are taught explicit connections between humanities and science. Ideally, this understanding will also improve teacher efficacy and student engagement. The STEAM pedagogy concept provides a viable space to explore potential connections between hip hop and science education.

“They” Science

In music, “sampling” is a process in which a part of a song—a short drum pattern, a guitar riff, or maybe a brief vocal—is recorded and then incorporated into a new song. In one of many popular examples from old school hip hop, the iconic horns from James Brown’s “Papa’s Got a Brand New Bag” (1965) were slowed down and then sampled into Kool Moe Dee’s platinum hip hop song “How Ya Like Me Now” (1987). Brown ranks as the most sampled artist in history according to Complex magazine (X, 2014), with small portions of his vocals, horns, and drum patterns appearing in over 3000 songs. In hip hop, sampling is not an act of theft or lazy musicianship. Just the opposite, sampling honors the music and artists from which it was taken, and is an explicit acknowledgment of just how good it sounded in the original track.

The concept of “sampling” in hip hop has meanings that extend beyond music. “Sampling” can refer to taking a portion of anything and incorporating it into something new. In hip-hop terms, a cited quotation in a formal paper is a “sample”. Seeing someone’s shoes, buying that same pair, and then wearing them with your own unique outfit is “sampling” as well.

As a part of this study I interviewed Stic.man, one half of the hip hop duo Dead Prez. The title of one of their most popular songs is “They” Schools (2000). The lyrics are a scathing narrative, describing the alienation Stic.man and fellow MC M-1 felt during their time as high school students. The “they” in “They” Schools are the teachers, administrators, students, and anyone else who participated in the hegemony masquerading as formal education that Stic and M-1 were forced to endure.

I used the idea that schools are not designed for those of us from hip hop culture to succeed in them as the foundation for this study, applying that notion specifically to STEAM education. I argue that “they” science marginalizes and dismisses hip hop culture, and is unaware that we are constantly engaging with science in complex and positive ways. I asked Stic.man if I could sample the title of his song for the title of my dissertation, and he willingly gave me his blessing to do so. Hopefully our work will help move “they” schools to teach “our” science.

“Our” Science

Born in Brooklyn in 1966, Gary Grice’s passion for science and knowledge as a child eventually earned him the nickname “The Genius” from his friends. Despite the moniker, Grice never completed the 10th grade, dropping out of high school midyear. Though he later regretted that decision, he described his choice as being driven in no small part by feeling like he knew

more than his teachers (Sussman, 2012). There were plenty of other contributing factors to Gary's leaving school, including his being drawn to the then budding hip hop scene. But what if one of those teachers had been able to nurture the thirst for learning and science he had displayed? Would it have kept him in school? What if they could have even harnessed and developed it through hip hop?

Gary Grice went on to become known as The GZA, one of nine members of the hip hop group The Wu-Tang Clan. He traveled the world and sold millions of records, becoming renowned for the intellectualism and the critical depth of his rhymes. At the age of 45, after a lucrative career in hip hop, The Genius's love for science led him to studying astronomy with Hayden Planetarium director and prominent cosmologist Neil deGrasse Tyson. He also partnered informally with professors at Massachusetts Institute of Technology to continue his study of outer space. Grice eventually released a rap LP about astronomy, describing what he learned through a hip-hop lens.

There are students like Gary Grice in schools across the United States; young people of color, from marginalized communities, whose love of science and knowledge fits easier into their hip hop cultural mores than into the formal learning environments that are alleged to foster them. I was one of those hip hoppers myself, who wanted to one day wield a microphone on a stage in one hand, and a real-life lightsaber I designed—like the Jedi in Star Wars movies (Lucas, 1977)—in the other hand. Unlike The GZA and countless others, I earned a degree in biology, largely protecting my passions for science and mathematics from being extinguished as I navigated my way through middle and high school. Like the GZA, however, I found my hip hop-influenced ways of approaching scientific inquiry followed me through adulthood, including my career as a middle and high school science teacher.

This anecdote provided the impetus for conducting this study. I began with the premise that hip hoppers have a unique way of understanding the world— asking and answering questions, learning about things that were previously unknown, and learning more about things that are already familiar—that is scientific in nature. I argue that because hip hop is a marginalized urban culture consisting largely of people who are racial minorities, providing efficacious and culturally responsive teaching for hip hoppers is a vital social justice issue in education. I focus on how this can occur in STEAM education due to its particular connections with hip hop worldviews and notions of science, mathematics, and inquiry. Factors besides a conducive learning environment do loom large in determining success in STEAM for hip hoppers. However, that does not absolve educators of their obligation to effectively do their part in connecting with and cultivating STEAM conceptions among them. Most hip hoppers will never experience the mitigating success The Genius had, or I had. Thus in their teaching endeavors, it behooves STEAM educators to provide the unique support these students need.

STEM, Hip Hop, and the President of the United States

In a 2010 speech, President of the United States Barack Obama declared, “Leadership tomorrow depends on how we educate our students today—especially in science, technology, engineering and math.” (Obama, 2010a). To reach this goal, he said the country needed to develop an additional 100,000 science, technology, engineering, and mathematics (STEM) teachers over the next 10 years, and that colleges and universities needed to graduate another 1,000,000 students with STEM degrees. The President then declared that without purposefully engaging ethnic minorities and women in STEM, the United States would never reach those two goals (Obama, 2010b). These two goals challenged the entire educational system to prioritize STEM in ways it historically had not. It also carried with it the urgency of a 10-year deadline.

This meant the increased engagement of students in STEM, the re-conceptualizing of science educator training, the continued reformation of science standards and the assessment of their effectiveness, and every other factor considered part of this task needed be accelerated as well. Obama's third goal is implicit, but inextricable from the first two. His third goal is to link the success of STEM education initiatives to the degree to which they are attractive to underrepresented minorities (URMs).

As an arts-based cultural movement, hip hop has worked for decades as a unifying force for marginalized minorities (Chang, 2005; Kitwana, 2002; Rose, 1994). Two years after issuing his challenges, President Obama, stopped in Cleveland, OH during his re-election campaign. He was interviewed there by Colby Colb of the local hip hop radio station Z107.9. Obama told him, "There's a bunch of Jay-Z songs on my iPod. I gotta say 'My First Song' keeps me steady. It reminds you that you always have to stay hungry." (Jo, 2012). In "My First Song," Jay-Z (2003) uses the concept of hunger in a biographical narrative that describes his desire to rise from managing a crack cocaine business to managing a hip hop business.

To those familiar with *street language* in hip hop, "hunger" has a connotation that goes further than being a synonym for "desire." Hip hoppers regularly describe "eating" as a metaphor for acquiring monetary and social success, as well as describing how one overcomes an opponent (i.e. consuming them). For example, in describing the relationship between Jay-Z and his current business partners, Jay-Z's former business partner Damon Dash warned, "...every single person I see hanging around him [Jay-Z] is making money off him. They all conform so they can eat off him." (Lobenfeld, 2014). Dash invoked the monetary notion of "eating," as well as its implications for the social success of the "eaters" hanging around Jay-Z.

Thus, when Jay-Z describes his hunger in “My First Song,” it relates to how he changes the way he “eats” from illegal means to legal ones.

Throughout the course of his presidency, Obama and Jay-Z developed a friendship, and the President was clear about the general influence hip hop had on him as well (Jackson, 2013). His use of the term “hungry” then, in the context of an interview on a hip hop radio station, while quoting a hip hop song by his friend who is a hip hop artist, is a nod to the hip-hop definition of “hunger”. It indicated that re-election, for Barack Obama, was as essential as eating is in the literal sense.

The President of the United States was very public about the level of importance the U.S. should be placing on STEM (STEAM) education, the specific challenges it faces with his decree, and his embrace of hip hop and its mores. From a policy level, the demands the President placed on STEAM education helped stimulate three major efforts that define its course, including the development of Common Core State Standards (CCSS) for Science, the Framework for K-12 Science Education, and the Next Generation Science Standards (NGSS). These three policies define what STEM means with regard to education in the United States, and set guidelines for how it should be assessed. The connections between federal STEAM education policy mandates and the responsibility to effectively engage marginalized and minoritized students through STEAM pedagogy provide an important site of convergence for research that can meet both obligations.

Purpose of the Study

This study had two main purposes. The first one was to create a theoretical model that begins to define how a hip hop worldview grounds hip-hop conceptions of knowledge as they relate to science. While research on hip hop as a culture is extensive, the scholarly explication of

a cogent hip hop epistemology, much less a science-based one, has yet to be accomplished. Examining the connections between scientific inquiry and hip hop epistemology also helped further define hip hop culture in general, providing insight on how science functions within it.

The second aim of the study was to create a theoretical framework for hip hop responsive STEAM pedagogy that effectively combined hip hop ways of knowing with STEAM teaching practices. Even though hip hop has been used in some capacity in teaching practices for over 30 years, describing how it can be incorporated in science pedagogy is a nascent undertaking (Emdin, 2010). A viable framework could become a model for how STEAM educators conceptualize classrooms in which they purposefully interface with scientific notions within hip hop epistemology, improving the experiences of students who identify with hip hop culture. Additionally, Anyon (1981) and Heath (1982 & 1983) suggested that teaching which includes multiple ways of knowing engages, challenges, and benefits students from all cultural backgrounds in a classroom. Creating and refining a framework that helps teachers effectively engage in a hip hop epistemology would make them more effective at educating not just the hip hoppers in their classrooms, but all students they instruct. This would allow STEAM educators to respond to the President's challenges and much more.

The Need for the Study

The three major reforms in science education have placed a renewed emphasis on teaching scientific inquiry in K-12 science classes. One of their foundational undertakings is the meticulous description of each concept in the "STEM" acrostic. In defining "Engineering", the Framework and the NGSS expand the term from simply describing a profession, and re-conceive it broadly as being able to apply science to the natural world (National Research Council, 2012). Taken together, the three reforms identify a set of scientific inquiry standards for students in

grades K-12, setting precedents for the skills students should develop as they progress through science education. At the core of these standards is the ability of students to reify the world around them in increasingly complex ways. This paradigm affirms the conception used in this study of STEAM classes as courses in knowledge construction. Modern philosophers of science describe the course content taught in a science class as largely inconsequential to most people. For example, understanding the light and dark reactions of photosynthesis, knowing the constant for speed of light in a vacuum, and describing strong and weak nuclear forces in atoms are answers to trivia questions for those who are not cellular botanists or theoretical physicists. Instead, science philosophers like Kuhn (1996) and Losee (1972) describe the purpose of a science class as teaching students how to ask and answer questions, how to take the unknown and learn of it, and how to take what is known and learn more about it. This presents science as essentially a study in epistemology, and effective science learning is therefore bound to the epistemological constructs students bring with them into science classrooms. Harvey Siegel explains (2014):

Science educators who investigate ‘epistemology’ are generally investigating teaching and learning in the science classroom, including both the psychological processes taking place in the minds of individual students and the social processes taking place during classroom communication and socialization. A key focus of this research concerns the impact of students’ beliefs concerning knowledge, science and practices of inquiry, and their understanding of these, on such learning. (p. 373)

Research on science teachers suggests that the extent to which teachers engage the epistemologies of students in their classrooms correlates positively with their ability to effectively teach them (Apostolou & Koulaidis, 2010; Kang, 2008). These factors, combined

with the emphasis on scientific inquiry, make the ways of knowing students bring with them into the classroom a vital factor in determining their science class experiences.

Theoretical Framework

Figure 1 is the originally proposed framework for Hip Hop STEAM Pedagogy and Hip Hop Science. The framework uses nodes, the labeled squares and ellipses, to denote the philosophical and pedagogical models in the framework. The connectors between the nodes indicate the types of proposed relationships between the concepts. At the center of this framework are two theoretical concepts: Hip Hop STEAM Pedagogy and Hip Hop Science. They are formed from the intersections of six conceptual ideas. Hip-Hop Based Education (HHBE), Culturally Responsive Pedagogy, and Constructivist Science Pedagogy comprise the three pedagogical concepts, while Hip Hop Culture, Hip Hop Epistemology, and Sociocultural Constructivism make up the three philosophical concepts.

Critical Race Theory (CRT) provides the analytical framework through which the entirety of the study is conceived, and frames how the concepts and their intersections are conceptualized.

Hip Hop Culture is foundational to Hip Hop-Based Education, providing its primary philosophical influences. It reflects the direct influence of hip hoppers themselves, as it has been the people who grew up in hip hop culture who have become the primary hip hop pedagogues (Hill & Petchauer, 2013). One of the challenges addressed in this study is how to get teachers who are unfamiliar with hip hop culture to become effective hip hop-based educators.

The description of the relationship between Hip Hop Culture and Hip Hop Epistemology as “filial” was reflective of how the philosophy of a culture births the primary ways knowledge, wisdom, and understanding are conceived within that culture.

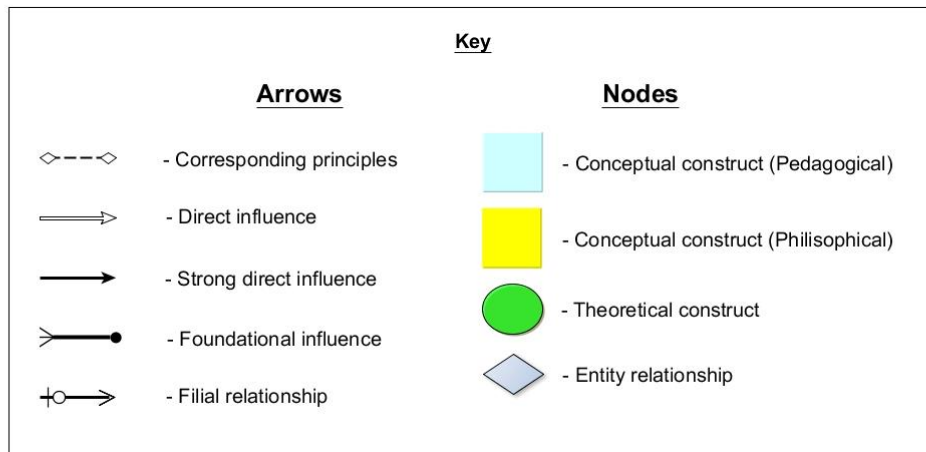
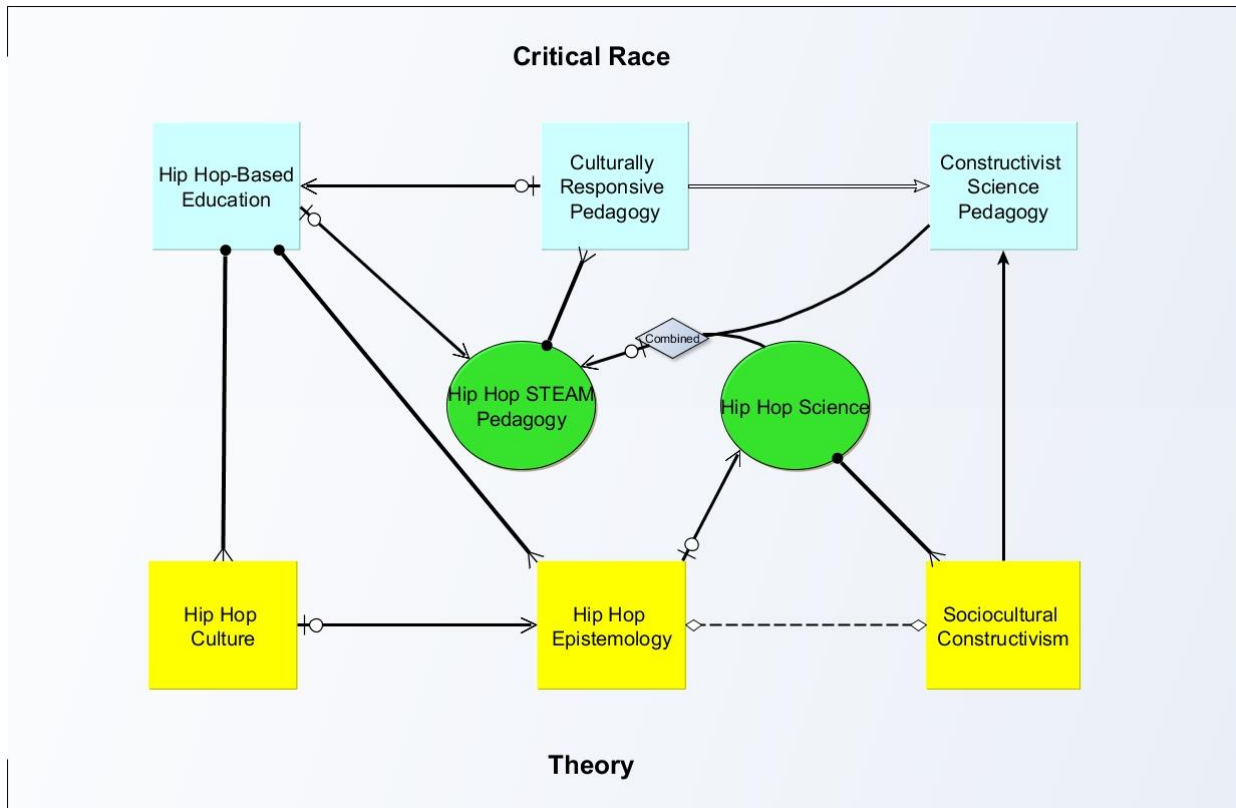


Figure 1: Proposed Theoretical Framework

Ronald Judy, in his research on authenticity and hip hop, described “hip hop science” as an “ontology of higher thinking” which centers hip hop’s dogmatic pursuit of being “real” (2004, p. 118). This is literally the last sentence of his article, and neither he nor any other scholars offered further clarification of “hip hop science.” This study takes that idea and expands it. The theoretical framework proposed that Hip Hop Science is an emergent theoretical construct that comes directly from Hip Hop Epistemology, and has foundations in Sociocultural Constructivism. The latter two concepts in turn were proposed to share enough in common to have their own congruent relationship, but the supposition was that they did not directly influence each other.

Constructivist Science Pedagogy was suggested to be strongly influenced by Sociocultural Constructivism, its philosophical foundation. Culturally Responsive Pedagogy was considered influential to Constructivist Science Pedagogy, providing what studies suggest is an important connection for teaching science to diverse learners (O. Lee & Buxton, 2010; Rodriguez & Berryman, 2002). The theoretical construct Hip-Hop-Based Education was proposed to be a form of culturally responsive pedagogy. The philosophies that inform Hip Hop-Based Education came from hip hop culture and its epistemological constructs.

The culminating theory proposed in this study was Hip Hop STEAM Pedagogy. It is a form of hip hop-based education, with foundations in culturally responsive pedagogy. The teaching philosophy in Hip Hop STEAM Pedagogy is posited in the framework as coming from a combination of the sociocultural foundations within constructivist science pedagogy, and the scientific worldview within Hip Hop Science.

Organization of the Study

Chapter I introduces the research topic, describes the need and the purpose for the study, and concludes with an explanation of the proposed theoretical model for Hip Hop STEAM Pedagogy. Chapter II is a review of the relevant research and scholarship that inform the study. In Chapter III, the methodological choices are explained, and the positionality and subsequent influence of the researcher is explored. Chapter IV is a discussion of the analysis from the collected data, while Chapter V includes a summary and discussion of the findings from the study, limitations of those findings, and the resultant recommendations.

Chapter II - Review of Relevant Scholarship

Each of the frameworks in the proposed model, whether analytical, theoretical, or conceptual, has extant scholarship that provided and described its foundation. In this chapter, each framework is defined in general terms, and then described with regard to how it specifically relates to this study.

Critical Race Theory

Critical Race Theory came from Critical Legal Studies. It was created by scholars of color who found Critical Legal Studies inadequate in describing how race was a mitigating and confounding factor in applications of the law. Despite iconic representations of American justice as a blindfolded woman holding a scale, these legal scholars saw clear patterns where the law favored Whites and their interests (Bell, 1987, 1992; K. Crenshaw, Gotanda, Peller, & Thomas, 1996). Critical Legal Studies provided an analytical framework that conceptualized racial injustice as not just the legal mistreatment of non-White people, but the purposeful use of the justice system to empower and privilege White people. Scholars such as Derrick Bell (1987, 1992), Kimberlé Crenshaw (2011), and Richard Delgado (1989) quickly realized that their theory applied to systems outside of the justice system, and could describe the empowerment of Whiteness and its effects in social, political, economic, and educational systems as well. As an applied framework for understanding how disparities in racial equity are maintained in society in general, the concept of Critical Race Theory was born.

Core Aspects of CRT

There are several consensual tenets regularly ascribed to Critical Race Theory (Ladson-Billings & Tate, IV, 1995; Tate, IV, 1997; E. Taylor, 1998; Thomas, 2000). The ones used in this study are: 1) Whiteness as property, 2) racism as normal and intractable in the United States,

3) the use of counter-narratives in social justice, 4) critiques of liberalism and the status quo, and 5) interest convergence.

Whiteness as Property

Critical Legal Studies helped create an understanding for how socioeconomic factors influenced legal notions of physical property and ownership, but did not provide thorough explanations of how intangible properties affect those legal notions, such as Whiteness and its affiliated privileges. Derrick Bell (1995) explained that:

[E]ven though the law is neither uniform nor explicit in all instances, in protecting settled explanations based on white privileges, American law has recognized a property interest in whiteness that, although unacknowledged, now forms the background against which legal disputes are framed, argued, and adjudicated.

(p.8)

This idea of Whiteness as a possessed privilege explains how citizenship and racial identity affect all U.S. citizens in matters of justice that are not only legal, but social as well. Decuir-Gunby (2006) elaborates on this notion, describing Whiteness-as-possession as a set of cultural markers and the accompanying privileges to which citizens are pushed to aspire. With Whiteness thus prioritized and reified, it transforms from a benign set of cultural practices into a valuable tool for cultural hegemony. Whiteness becomes an unattainable set of idealized cultural mores that most White people themselves—much less people of color—do not necessarily possess (Harris, 1993). This creates a fictive, yet prevalent sociocultural scale that holds “Whiteness” as the ultimate standard, while simultaneously positioning “Blackness” as the opposite, undesirable bottom of that scale.

CRT conceptions of Whiteness provide a perspective through which race is analyzed in

this study. The “Whiteness scale” describes how the inextricable racial aspects of hip hop culture are lived, and how hip hoppers are marginalized by mainstream society. It also provides a construct for understanding the figurative distances between hip hop and idealized notions of American culture, as well as the distance between teachers and the hip hoppers in their classrooms (Cokley & Chapman, 2008; Emdin, 2012; Gosa & Fields, 2012).

The Intractability of Racism

CRT characterizes racism as a product of Whiteness-as-property, and the use of “Whiteness” as a set of normative cultural standards in the United States (Bell, 1992, 1995; Crenshaw, 2011). The historical and legal deployment of these two ideologies provide financial, social, and political benefits to some, at the expense of others. Whites and non-Whites alike, who are able to meet some of the cultural standards that are ascribed to Whiteness (i.e. intelligence, education, fortitude, speaking “academic” English, and non-violence), are summarily privileged (Solórzano, 1997). Within this framework, racism is defined as the set of systemic practices that empowers and confers privilege to Whiteness, while disempowering non-Whiteness. It is sustained because incentives for dismantling these practices do not outweigh the benefits they provide. These benefits entrench racism as a normal and expected characteristic of U.S. society. To that end, CRT moves discourse away from ending racism through legally mandated racial integration, or by changing the hearts and minds of bigots, and toward dismantling the systems that empower and sustain privileged Whiteness.

Critiques of Liberalism in Education

CRT analyzes how liberal notions of culture affect schooling in the United States, specifically in terms of race and class. Educational institutions consistently perpetuate the hegemonic systems of whiteness as property and White cultural supremacy in society in general. They become unwitting participants in institutionalized racism (Ladson-Billings & Tate, IV,

1995; Ladson-Billings, 1998; Solórzano & Bernal, 2001; Solórzano, 1997). Neoliberal ideology in education construes the performance of underprivileged minorities as a function of their ability to engage in White cultural mores. Those who cannot or will not do so are considered to be hindered by “their culture”. According to Solórzano (1997), this belief:

gets applied in the classroom, and to Students of Color [sic], by teachers who are professionally trained in colleges, and specifically in a teacher education curriculum that reflects an individualistic and cultural deficit explanation of low minority educational attainment. (p. 13)

CRT is a progressive theory and a liberal one in comparison to traditional ideologies, but it is distinct from liberalism in education when it comes to uncovering the sources of educational underachievement in non-mainstream students. Research by Vaught and Castagno (2008) and Matias (2013) describes most teachers as generally liberal, but as often displaying socially conservative attitudes with regard to their students of color. These teachers consistently use conservative narratives—particularly cultural deficiency models—to describe why students from marginalized cultures do not perform as well as their mainstream peers in their classrooms. Conversely, teachers who take a CRT approach take into account the systemic factors that often cause non-mainstream students to be ambivalent toward formal education, and view these students as culturally capable rather than deficient (Solórzano & Ornelas, 2004).

Analyzing whiteness as property and privilege along with intransigent racism, CRT is critical of well-meaning, progressive educators who have been socialized in a society that prioritizes students’ ability to wield White cultural capital as the standard for measuring their ability to succeed in classrooms.

Narratives

Another foundational aspect of CRT is the use of narratives. According to Delgado (1989), narratives in CRT are vital ways for people to name their own reality. He says, “[because] much of reality is socially constructed, these stories provide members of outgroups [with] a vehicle for psychic self-preservation...” and, “[t]he exchange of stories from teller to listener can help overcome ethnocentrism and the dysconscious conviction of viewing the world in one way.” (Delgado, 1989, p. 1073). CRT narratives can include stories about real people and scenarios, or they can be works of fiction that provide allegories for real-life situations. In either case, the purpose of CRT narratives is to use storytelling as an empowering tool for people to describe and reify the world around them—often in ways that are culturally relevant. CRT narratives are not, however, anecdotes posed as evidence. Their utility is in providing a rationale for why things occur, rather than serving as proof that they do occur. Derrick Bell’s (1992) fictional short story *Space Traders* is a CRT narrative about aliens who come to Earth and offer the United States nearly infinite wealth, a chemical means to end pollution, and a nuclear replacement for fossil fuels. In return, they request to take the country’s Black population, no questions asked. After weeks of deliberation, the United States ultimately decides to make the trade. Bell’s use of humor, sarcasm, and political commentary in this fictional story serve to impugn the very real social constructs that adversely affect Black American lives. It also offers a unique and cathartic perspective on the ambivalent relationship the U.S. has with its Black citizens.

In this study, hip hop texts are incorporated into STEAM education. This follows the use of narratives and counter-narratives in hip hop, a fundamental aspect of the culture. These narrative texts are also a means themselves for defining hip hop as a culture, because within

them, hip hop scholars reify their philosophical constructs, explicitly defining them as part of a “hip hop culture.” By understanding its epistemology, STEM educators can begin to undo cultural deficiency models of hip hop, and understand how it can inform culturally responsive science teaching (Emdin, 2009, 2010, 2011, 2013).

Interest Convergence

Derrick Bell (1980) entered the idea of interest convergence into academic discourse in his analysis of the *Brown v Board of Education* case. The presented rationale for the Supreme Court’s decision in *Brown* was that the history of racism in the United caused racially segregated public facilities to be inherently unequal, and that the country had an ethical responsibility to provide a quality education for all of its children. Bell argued that other underlying, but prevalent motivations for the Court’s ruling included protecting worldwide perceptions of the United States as it battled the spread of communism, placating the African American community by assuring them that progress was being made toward racial equality, and satisfying Southern White economic interests by posing racial integration as a means to move the south away from an agrarian-based economy and towards industrialization. He described these converging political and socioeconomic interests between Blacks and Whites as the compelling reasons why the *Brown* ruling was grudgingly palatable to the US. This argument is also a critique, as Bell defines the impetus for the move toward racial equality in education as being based in diplomacy and economy, rather than morality and justice. He later broadened this argument, applying it to how equity was attained in the United States in general. Rather than relying on moral outrage, notions of social justice, or legal mandates, Bell posited that progress in matters of equity occur as a function of the converging interests of the privileged and the unprivileged.

Interest convergence is also used to describe smaller systems within the framework of

social justice. Tate, Ladson-Billings, and Grant (1993) described how student diversity, curriculum and instruction, and parent-community involvement are all sites of intersecting interests within individual schools in the United States. They argued that equity in these areas facilitates integration by combining the scholastic interests of all racial groups, and is more successful than models relying on federal legislation or appeals to morality.

The Application of a CRT Framework

Taking these tenets in sum, CRT construes social inequity as an inherent aspect of society in the United States (Bell, 1992; K. Crenshaw et al., 1996; Ladson-Billings, 1998). The permanence of this inequity is maintained by hegemonic structures which gives benefits to privileged groups. Society has become so used to this imbalance of power that the people within it work to maintain it—often including those who are harmed by its preservation. A vital part of this cultural hegemony is the pervasive narrative of dis-empowered “outgroups” (i.e. racial minorities, women, LGBTQ people, and the impoverished) as deficient, and empowered “ingroups” as superior. Delgado (1989, p. 2412) stated, “The stories of narratives told by the ingroup remind it of its identity in relation to outgroups, and provide it with a form of shared reality in which its own superior position is seen as natural.” In education, this narrative often causes teachers to view their students of color as deficient (Baldwin, 2008; Solórzano, 1997, 1998; Vaught & Castagno, 2008). Non-Black students who identify with hip hop culture are “Blackened” relative to this CRT scale, and are proposed in this study as experiencing the same subsequent marginalization in their educational experiences. The need to counter the effects of this hegemonic narrative in education is one of the primary purposes of culturally responsive pedagogy.

CRT provides a lens for understanding the concepts being investigated in this study, the

analysis of the intersections between them, and for the theoretical framework created from them. Because this framework is philosophical and pedagogical, the application of CRT is also philosophical and pedagogical. In analyzing the philosophical concepts, a CRT perspective centers how race and racial power dynamics operate within them. For the pedagogical concepts, the CRT-based analysis centers how race affects the ways students are taught. This includes examination of the worldviews of hip hoppers, the teachers who teach them, and how their interactions affect classroom pedagogy.

Culturally Responsive Pedagogy

A foundational aspect of multicultural education is teaching in ways that are relevant and responsive to the cultural backgrounds of students. Researchers have developed frameworks, based on theory and practice, that define the ‘what, how, and why’ of culturally relevant teaching (Banks, 1993, 1995; Gay, 2005, 2010; King, 2005; 1995, 2009; Sleeter, 2001). Educators use this framework to create proposals for equity by addressing the persistent and disproportionate disparities between the academic and social performances of students from marginalized ethnic groups and those of their mainstream peers. Ladson-Billings called this model “culturally relevant pedagogy” (1995), while Gay used the term “culturally responsive teaching” (2010) to describe it. These terms and their premises are largely interchangeable in practice, with the latter representing the focus on teaching agency in Gay’s conceptualization.

Culturally relevant pedagogy has three primary classroom components (Ladson-Billings, 2009). The first is the imperative that students experience academic success. Students who are never able to do well in school feel alienated from it. Ladson-Billings (2009) found that African American students who were alienated developed an adversarial attitude towards formal schooling. Gay (2010) contended that although these students may maintain a positive view of

formal education, they nonetheless experience an academic and cultural disconnect within the classroom. The remedy is not for teachers to artificially inflate the grades of culturally marginalized students, but to use pedagogy that is relevant and responsive to their culture. For example, students who are allowed to communicate some academic content in their native languages—both colloquial and formal—can express themselves comfortably, and also have an important part of their cultural identity validated in the formal learning environment. This type of academic success is particularly important for students from non-mainstream cultures in science classes (O. Lee & Buxton, 2010).

A second feature of culturally relevant pedagogy is the conception that students must develop and/or maintain cultural competence. The greater the disconnect between students' cultural heritages and the pedagogical strategies their teachers use, the more difficulties they are likely to encounter academically. Gay (2010) stated,

Students of color who are most traditional in their communication styles and other aspects of culture and ethnicity are likely to encounter more obstacles to school achievement than those who think, behave, and express themselves in ways that approximate school and mainstream cultural norms. (pp. 78–79).

Kelly-Jackson and Jackson (2011) supported the notion that African American students in science classes are more engaged and perform better when teachers use concepts and activities that are culturally relevant to them. They concluded that teachers must go beyond being aware or even inclusive of their students' cultural backgrounds. Culturally responsive educators help marginalized students improve their understanding of their own cultural backgrounds through the content and concepts they use in their classrooms.

Ladson-Billings' (2009) third premise is that students must develop a critical

consciousness to challenge the status quo of the existing social order. This concept builds on research by Paolo Freire (1970) and Carter G. Woodson (1933), who both described the importance of education for marginalized cultures in terms of its application as liberatory praxis. They claimed that an effective education causes students to recognize the injustices and cultural marginalization, and teaches them how to counter those practices as agents of social change. Banks (1995) called this type of teaching *transformative multicultural education*, as it ultimately dismantles the hegemonic ways societies operate by helping students become social justice advocates. Transformative multicultural education also ensures that the cultural values and premises of marginalized students are inherent in classroom instruction.

Culturally Responsive Pedagogy in Practice

Educational inequities permeate the United States, affecting differences in areas of performance that include graduation rates, standardized test scores, college admission rates, grade point averages, behavioral interventions, and diagnoses of learning disabilities. African American, Native American, Latino/a American, and Southeast Asian and Pacific Islander children are disproportionately placed at the deprived end of these categories in comparison to their European American, East Asian, and South Asian counterparts (Anyon & Greene, 2007; Baruth & Manning, 1992; Delpit, 1988; Grant & Sleeter, 1993; Ochs, 1986).

These persistent discrepancies have been commonly described as “achievement gaps.” The primary flaw with this description is the large space it leaves in discourses for describing the gaps as being rooted in inherent deficiencies among underperforming students, rather than as a result of systemic and systematic inequality of opportunities afforded them. The deficiency model has been presented as being based in genetic inferiority (Murray & Hernstein, 1994; Rushton & Jensen, 2005; Rushton, 1994) or ingrained cultural flaws (D’Souza, 1996; Fordham

& Ogbu, 1986; Rouse & Barrow, 2006; Sowell, 2013). Either way, the result is a reduction in the perceived amount of help that can be provided for students who simply arrive at school irreparably damaged. Some scholars challenge these models and the subsequent resignation they promote by re-conceiving achievement gaps as “opportunity gaps” (Da Silva, 2007; St. John, 2002). They argued that this is a more accurate description of how historical, economic, and social inequities create deficiencies in the educational opportunities available to underprivileged students.

Ladson-Billings (2006) applied a critical race theory lens to the analysis of opportunity gaps. She subsequently reframed them as an accumulated “educational debt.” This notion centers the agency educators must use in order to alleviate the “debt” owed to underprivileged students; caused by the racial, educational, and economic inequities inherent in the United States. The acceptance of this notion is important because if the academic and behavioral differences between racial groups are due to biology or cultural pathology, then the remedies to them lie outside the purview of what happens within schools. The educational debt concept magnifies the importance of educators, who instead of being viewed as powerless against a tide of intrinsically damaged students of color, are responsible for helping these students achieve. They can do so by using pedagogies that counter the conditions created by social injustice. That agency is, in practice, the “debt” that is owed to these students.

In this study, hip hop is posited as a culture to which teachers must be responsive in their STEAM classrooms. Pedagogical practices that are culturally unresponsive and irrelevant have a particularly negative effect on non-mainstream groups in science. Their significant lack of representation in STEAM curricula and professions causes these marginalized students to feel even more alienated in science classrooms (O. Lee & Buxton, 2010). The belief that the formal

school environment is not a place for their cultural values, orientations, and experiences is thus magnified for students in STEAM education. Emdin (2010, 2011) indicated that because hip hoppers function as a secondarily marginalized cultural group in STEM education, they need a hip hop-responsive STEAM pedagogy that facilitates their success, fits and affirms their cultural epistemology, and promotes social justice.

Sociocultural Constructivism: A Combination of Learning Theories

Sociocultural constructivism combines sociocultural theories of learning and development with constructivist notions of knowledge. Sociocultural theories tend to focus upon the how individuals learn and the cultural influences on those processes, while constructivist theories describe how epistemologies function in learning environments in general. Schoen (2008) stated that,

Sociocultural constructivism [focuses on] social and cultural factors that potentially impact learning. Sociocultural constructivists are concerned in not only contextual variables affecting the learning of individuals; but also those affecting the learning environment. For example, this might include studies of student learning in relation to school dynamics, or educational policy upon teacher selection of instructional methods. (p. 38)

Packer and Goicoechea (2000) elaborate on the connections between sociocultural and constructivist theories, highlighting the ability to address ontological aspects of culture when they are combined, while challenging the idea that they are wholly complementary. They describe the two theories as compatible, applying this notion to education. They argue that the complex interactions of culture, learning, epistemology, and ontology all function in learning environments. It is the inclusion of the ontological aspects in particular that make sociocultural

constructivism important in this study, as authenticity and being “real” are pervasive in hip hop culture.

Sociocultural Theory

Often considered the creator of sociocultural theory, Lev Vygotsky studied learning from a psychological point of view, describing it as inextricable from the sociocultural interactions that surround it (Vygotsky, 1978, 1987). Writing about cognitive development in *Mind in Society*, Vygotsky (1978) stated:

Every function in the child’s cultural development appears twice: first, on the social level and, later on, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relationships between individuals. (p. 57)

Vygotsky further explained that the experiential world is a function of socially constructed knowledge, and that cultural development is a fundamental part of that world. The ways of knowing that inform worldviews for children originate from sociocultural interactions, and they remain influential throughout their lives. Vygotsky’s philosophy further combines the process of reifying the world through building knowledge, an understanding of how interactions between people guide that process, and the perpetual influence of culture on both. In one example, he described how a child builds an understanding of a flower (1987). At first, the child learns to assign the word to the single object defined for her as a flower. As she matures and become acculturated, she may assign more complex meaning to the word “flower,” turning it from a definition into a concept. She may learn to associate flowers with beauty, gender-specific roles (i.e. “men give them to women”), and commemorative symbols for concepts like death and

love, giving them more complex associations that have social and cultural connotations.

While the focus for the sociocultural aspects in this study comes from work by Vygotsky, researchers in have expanded his core work into aspects of multicultural education. Boykin (2005, 2013) has done pioneering work on sociocultural theory in psychology and learning in African American children, while Lee (C. D. Lee & Majors, 2003; 2003, 2006) has done the same in studying aspects of sociocultural theory and epistemology. Their work and similar research also inform this study, providing examples of the underlying theories in practice with the communities represented.

Constructivism and STEAM Education

Constructivism is an epistemological worldview in which knowledge is conceived as being built through active learning processes. In this construct, knowledge is synthesized in order to create understandings. Learners apply prior knowledge to the unknown, or combine knowledge of the known in order to make sense of the world around them. The constructivist worldview challenges traditional, objective notions of knowledge, which often describe it as a set of facts a person can possess.

According to Harding (1991), the idea that scientific inquiry is a wholly and purposefully objective tool for explaining the physical world as “physics.” Her colloquial version of the term, which she places in quotation marks to distinguish it from the actual science of physics, represents the dogmatic adherence to this belief. Earlier scientists called this belief “scientism” (Hayek, 1942), an allusion to the contradictory nature of the conception that involves a religious-like devotion to the supposed elimination of subjectivity from science. Despite these critiques, science educators regularly teach using a banking model, in which students memorize a set of supposed universal truths and laws, and the techniques for testing them (Duit & Treagust, 2003;

Lederman, 1999; Lorscheid & Tobin, 1992). These conceptions conflict with sociocultural constructivism, which grounds learning in the subjective foundation of a children's sociocultural orientation.

Constructivism in science pedagogy combines scientific inquiry with the notion that meaning-making is embedded in cultural influences. It builds on the premise that science is inherently subjective—from the selection of what will be studied, to how that study is conducted, to the conclusions drawn from it—and that conducting and teaching science is a cultural endeavor. Von Glasersfeld (1988, 1995) associated the value of knowledge with its ability to organize the experiential world. This is an effective concept for science classes, as teachers who incorporate socially constructivist epistemologies are better at helping students understand scientific inquiry and engage in purposeful learning.

The Framework for K-12 Science Education was created to be the fundamental text describing the nature and purpose of STEM education in U.S. schools. Regarding the STEM acronym, The Framework defined “science” as the natural sciences, “technology” as the physical and intellectual means for meeting human needs and wants, and “engineering”, as the application of scientific inquiry to the natural sciences, technology, and mathematics. To understand the world in a scientific manner, The Framework (2012) stated that,

Before they even enter school, children have developed their own ideas about the physical, biological, and social worlds and how they work. By listening to and taking these ideas seriously, educators can build on what children already know and can do. (pp. 24-25)

This statement positions teachers of scientific inquiry as MKOs who teach children to use and create technologies to help them engineer and understand their world. It also considers students

in STEM as having agency for their own understanding, rather than being repositories for an objective form of scientific knowledge. This agency is grounded in the sociocultural aspects of children's epistemologies (National Research Council, 2012) because:

There is increasing recognition that the diverse customs and orientations that members of different cultural communities bring both to formal and to informal science learning contexts are assets on which to build—both for the benefit of the student and ultimately of science itself. (p. 28)

These aspects of The Framework thus provide a point of entry for sociocultural constructivism into science education through its definition of STEM, and its emphasis on culturally responsive teaching.

Sociocultural Constructivism vs. Banking in Education

Traditional conceptions of knowledge-as-object are prevalent in schools in the U.S., comprising its primary epistemological systems. These systems prioritize students whose social and cultural orientations involve the use of knowledge as a set of facts that are repeated in order to demonstrate understanding (Atwater, 1996; Cakir, 2008). This is demonstrated commercially in the movie *Waiting for "Superman"* (Guggenheim et al., 2011). At one point during the film a cartoon sequence is shown. In this sequence, a teacher pulls the top of his student's head off, pours the contents from a box labeled "Knowledge" inside of it, puts it back on, and then watches the student sprout wings and fly blissfully out of the classroom window. This "banking" conception of knowledge in schools prioritizes students who come from cultures that objectify knowledge as bits of information, transferred from full vessel to empty vessel (Freire, 1970). Edmondson and Novak (1993) found that students with banking conceptions of knowledge were more oriented toward getting good grades while deprioritizing their understanding of concepts.

Conversely, they found that students with constructivist orientations prioritized the use of learning strategies to build understanding, while deprioritizing getting good grades. Their findings do not put getting good grades into an adversarial relationship with understanding concepts, but they do help elucidate how epistemological orientations affect the perceived importance of both. Researchers also have found that student engagement and interest in scientific inquiry are more effective indicators of interest in STEM than their grades (Appleton & Asoko, 1996; CC Tsai, 2006; Chin-chung Tsai, 1998).

In order to be inclusive of students who have constructivist orientations, STEAM educators commonly use Vygotsky's (1978) *zone of proximal development*. The zone of proximal development (ZPD) is the learning space between a student's ability to understand a task without the help of someone else, and the point at which he or she needs constant guidance to understand that task. Vygotsky described this "someone else" as a *more knowledgeable other* (MKO), a persons who help the child move thorough the zone of proximal development while he "acquires new mental functions and patterns of thought from the mediational assistance of tools, signs, and human scaffolding..." (Bonk & Cunningham, 1995, p. 37). The teacher as MKO aids students in moving through their ZPD by helping them construct new understandings, and new tools to further develop those understandings. Because this construction process and the resultant constructs are grounded in cultural worldviews, it is imperative for the MKO to engage with student in culturally responsive ways (Bonk & Cunningham, 1995; Mahiri, 1998; Verenikina, 2010).

Hip Hop Vs Rap: A Brief History of Hip Hop Culture

A fundamental premise of this study is the conception of hip hop as a culture. Describing hip hop as such distinguishes it from "rap," which is often used as a synonym for hip hop. KRS-

One is widely acknowledged as a “god” in hip hop, a designation reserved for people who have made vital contributions to the culture (Dimitriadis, 2009; Hill, 2009; Shusterman, 2000). In his song “Hip Hop vs Rap” (2003), he distinguished between the terms declaring, “Rap is something you do, hip hop is something you live”. KRS-One’s description included using the word “rap” as a verb and “hip hop” as a noun, and epitomizes the hip hop-as-culture view.

Rap music, however, remains hip hop’s most visible export. The prevalence of rapping in music often overshadows cultural aspects of hip hop. Hip hoppers themselves add to this conflation by often referring to their music interchangeably as “hip hop” and “rap.” Rapping has roots that are often precariously tied to the storytelling tradition of west African griots, the primarily male elders who learned to retell oral histories as entertaining and instructive narratives (Keyes, 2002). Some scholarship (Sajani, 2013) disputed that claim. The tradition is referenced here as part of recognizing the fictive connection to Africa that permeates African American culture (Akbar, 1991; Asante, 1988; Karenga, 1996), and how that connection continues through hip hop, which is heavily influenced by African American cultural roots. Rap does have origins in the African American tradition of “signifyin’,” a poetic and often rhyme-based method of making fun of someone or something through humor and wit, which scholars suggest began during African American enslavement (Gates, 1988; C. D. Lee, 1993; Morrell & Duncan-Andrade, 2002). Its traceable history is also transmitted through the lyrical narratives and call-and-response traditions of preaching in the African American church (Crawford & Troeger, 1995).

Hip hop began in earnest when Robert Moses completed the construction of the Cross Bronx Expressway in New York City (Chang, 2005) in 1955. The highway, which eventually spanned 6.5 miles, divides the Bronx. Its construction displaced more than 60,000 Bronx

residents, most of whom lived in low-cost housing. This housing was replaced with the high rise brick apartment buildings in park-like areas that are synonymous with the New York ghetto.

According to Chang (2005):

To Moses, the ‘tower-in-a-park’ model was a blackboard equation that neatly solved thorny problems—open space in the urban grid, housing for the displaced poor—with a tidy cost-efficiency... So in the New York area’s construction explosion of the 1950s and ‘60s, middle-class [W]hites got sprawling, prefab, white picket-fence, [W]hites-only Levittown suburbs, while working-class strugglers and strivers got nine or more monstrous slabs of housing rising out of the isolating, desolate, soon-to-be-crime-ridden ‘parks’ (p. 11).

Hip hop culture came from African American and Puerto Rican youths who endured the desolation, crime, and isolation of the newly formed South Bronx. The unique ways they coped with life’s daily challenges were reflected in the art they produced, and the lifestyle that came to surround those arts. As the music, the dancing, and the visual art that came from the South Bronx gained recognition, young marginalized people in similar communities across the United States found deep and enduring connections to this lifestyle as well. In the song “Jus Lyk Compton” (1991), DJ Quik describes the similarities between his hometown of Compton, CA and the other urban areas he visited around the United States. His song highlights the breakdancing, rapping, graffiti, gang violence, drug abuse, poverty, and other factors that are part of and contribute to the rise of hip hop culture in these places that he deems “just like Compton” in the chorus. Quik and other hip hoppers recognized the ubiquity of their shared ghetto experiences, and how they combined with signifying traditions, call and response, and Latin and African American dance as centerpieces of the burgeoning culture.

Hip hop moved quickly beyond its New York City roots, and into a global consciousness of cultural expression and reflective social commentary (Perry, 2008). It has become a prominent voice of social protest and a cultural space for the marginalized in places ranging from Senegal (Niang, 2006), to Brazil (Pardue, 2008), to New Zealand (Mitchell, 2000), all of which have ethnic groups that share cultural experiences with the disenfranchised children in the South Bronx of the 1960s and 70s. Academic and non-academic scholars iterate KRS-One's declaration, describing hip hop as a "culture" which includes rapping as an important aspect (Chang, 2005; Kitwana, 2002; Morrell & Duncan-Andrade, 2002; Rose, 1994; Scarface, Nas, & Khaled, 2012).

Hip Hop Philosophy

The spread of hip hop, primarily through the language of rap, united diverse groups of people across the United States and throughout the world. However, as suggested by the title of popular hip hop artist Rick Ross's album *Deeper than Rap* (2009), there is more than rapping and identifying with struggle that create a cohesive hip hop culture. The study of hip hop, beyond its history, has led scholars to uncover the underlying philosophical constructs that inform the culture. Their work, examined in this section, is described in terms of epistemology (conceptions of knowledge), ontology (notions of what exists and how to determine it), tautology (what is true and notions of truth), and praxis (philosophical guidelines for how to live). These four concepts are commonly described as guiding aspects of study within an overall philosophy (Bunge, 1983, 2003; Nicolini, 2012).

The Pillars of Hip Hop as Epistemological Constructs

South Bronx native Afrika Bambaataa is credited with first describing the basic principles of hip hop, which he referred to as "pillars." These pillars provide the foundation for hip hop

culture (Chang, 2005). They are based on how the arts that originated in the South Bronx reflected the mores of the Black and Puerto Rican youths who lived there. The original pillars are:

- *DJ-ing/turntablism* - the production of music, whether through the use of studio equipment, live turntables, or on radio as an on-air personality; it also includes the art of using turntables to create extemporaneous music and sounds
- *B-boying/B-girling* - dancing styles that are rooted in New York street performance; they began as highlighted dance-floor exhibitions which occurred during a "breakbeat" - the portion found in songs during which the rhythm is featured and no lyrics are sung or rapped (e.g. a "B-girl" is a "Breakbeat-girl, or a "break-dancer")
- *Graffiti art* - storytelling using stylized visual art and writing that is primarily influenced by urban cultural narratives and experiences
- *MCing* – the rhythmic and poetic speech that has its roots in signifying, the African oral history tradition, and the politically conscious poetry of the Civil Rights Movement; it began as a means to engage crowds at parties and verbally highlight the skills of the DJ and B-boys/girls

Bambaataa created the Universal Zulu Nation in the 1970s. This sociopolitical arts movement united Bambaataa with others who shared interests in Black Nationalism, the teachings of the Five Percent Nation of Islam, Afrocentrism, and mysticism (Chang, 2005; Davey D, 2000). The Five Percent Nation of Islam in particular, also known as the “Nation of Gods and Earths” and “Five Percenters,” had a seminal influence on hip hop culture as it grew (Chang, 2005; Knight, 2007). The Five Percent Nation emerged out of a schism in the Nation of Islam when one of Malcolm X’s former students, Clarence 13X, later known as Allah, denied the

divinity of Nation of Islam founder Wallace Muhammad. The Five Percenters described Black men as Gods, and Black women as Earths, due to their roles as the fathers and mothers of all humankind. They had harsh critiques of the political and religious subjugation of Black people worldwide, and combined those critiques with an abiding adherence to studying and learning. The Five Percenters shared the Nation of Islam's strict adherence to clean living and upstanding citizenship, and similarly embraced former gang members and other criminals among its adherents, in order to help them redirect their lives. This was especially important in the South Bronx, where the poverty, the drastic reduction in resources, and neglect left in the wake of the Cross Bronx Expressway pushed a disproportionate number of youth into criminal activities (Chang, 2005). These aspects all appealed to Bambaataa and the other early founders of hip hop. The Zulu Nation welcomed and incorporated all young people—criminal and otherwise—in an attempt to create positive directions for their energy.

This early association of hip hop with criminality still permeates conceptions of authenticity within it, causing an ambivalence between real and performative criminality in the culture. Commenting on the place of the Five Percenters in hip hop culture, Christopher Emdin (personal communication, September 9, 2014) noted that,

Because the Five Percenters had such an important influence on the foundations of hip hop, people not just in New York, but in Atlanta, LA, and everywhere else automatically incorporate their epistemology in their lives as hip hoppers, whether they're cognizant of it or not.

In moving the nascent culture beyond simply being an arts movement that deterred gang activity, Bambaataa later added "Knowledge" to the original four pillars. This was also demonstrative of the influence of the Five Percenters on hip hop. In their system of numerology,

the number 1 stands for “Knowledge”. Bambaataa’s addition represented the first stated philosophical shift in hip hop, and it opened the culture up to richer epistemological exploration (Chang, 2005). KRS-One (2010) used the increased cultural space to expand on the original five pillars. He made the following additions:

- *Beatboxing* – creating music using only one’s body and the sounds it can make; it has its origins in the jazz, blues, and doo-wop traditions of African American music.
- *Street Entrepreneurialism* – the literal ability to sell items, as well as the metaphor for the persuasive ability to “sell” or barter ideas and ideologies
- *Street Fashion* – the sartorial expression of urban youths that often sets popular trends
- *Street Knowledge* – the recognition and application of commonsense knowledge and wisdom, possessed by urban youth, that originated outside of traditional education settings
- *Street Language* – Ebonics or African American Vernacular English (AAVE)

These expanded pillars show how hip hop scholars engage in reflective praxis that illuminate the epistemological constructs within the culture. In this study, the conception of hip hop as a culture is valuable for distinguishing between the terms hip hop and rap. It honors the ways hip hoppers describe their traditions and mores, and frames the epistemological constructs that students who identify with hip hop culture consistently employ. These distinctions are vital for determining how educators can be responsive to hip hop culture as a part of science pedagogy.

Realness, Authenticity, and Praxis

The distinction between “doing” rap and “living” hip hop is central to notions of “realness” for hip hoppers. Low, Tan, and Celemencki (2013) described how commonly used

expressions such as “keep it real,” “real hip hop,” “real recognize(s) real,” and “really real,” are representative of how authenticity is centered in hip hop culture. These components of *street language*, especially the tautologies, are indicators of the premium hip hop places on realness. Hip hop conceptions of authenticity reach the status of dogma, going beyond notions of fidelity and integrity. Many hip hoppers in the case studies conducted by Low, Tan, and Celemencki (2013) demonstrated their *street entrepreneurialism* by writing rhymes and crafting experiences about the violence, criminality, and savvy of selling drugs. Almost none of them were involved in any of those activities themselves. Their empathy with and ability to demonstrate their *street knowledge* on the subject helped them adhere to the hip hop ontology of “realness.” McLeod (1999, p. 142) described this as the “socio-locational dimension” of hip hop authenticity. It provides a means for hip hoppers who are physically or figuratively removed from the streets to still identify as being “of” the streets. This dimension positions the ability to recognize and elucidate hip hop pillars in an authentic manner as tantamount to actually engaging in them.

In the documentary *Rhyme and Reason* (Spirer, 1997), Imani of the hip hop group The Pharcyde is asked what it means to be a hip hopper. In responding, he points to a cup sitting on a nearby table and states that if asked to pass it to someone, he could “pass the cup in a hip hop way.” He then picks the cup up, and laughs as he moves his arm in a wave like a B-boy, while handing it to his bandmate. At the same time, like the hip hop artists McLeod (1999) studied, Imani talked about nuanced but vital differences between performative hip hop culture and “real” hip hop culture at another point in the interview. In doing so, he distinguished his joking, pantomimed b-boying from the type of artificial hip hopness in which people engage that is actually offensive to the culture. As a part of hip hop praxis, distinguishing between real and pseudo-cultural actions is central. The tautology, “real recognize real” is used by hip hoppers in

many forms to validate their own authenticity, and to position themselves as judges of realness. This judgement extends beyond the artistic aspects of hip hop, and into assessing the words and actions of other hip hoppers as well. (Clay, 2003; Oliver, 2006; Rodman, 2006). The cultural roots of this practice are found in African American modes of recognition, which are methods of personal engagement and communication that identify a person as being of African American culture. From recognizing the interplay of, and engaging in signifyin (Gates, 1988), to executing handshakes and hugs (Morgan & Bennett, 2011), African Americans have used these symbolic modes of identification to recognize each other as being a part of a familiar cultural experience. As a culture heavily influenced by African Americans, hip hop exhibits congruency with many of these modes of recognition.

This relationship between African American modes of recognition and hip hop praxis is not necessarily bi-directional. Clay (2003) challenged the use of performative hip hop praxis as a measure of African American racial identity, arguing that successful engagement in hip hop praxis does not necessarily denote a person's "Blackness". However, his work does support the claim that hip hop has tools for identifying and assessing realness within it.

The zealous pursuit of defining and being "real" is as foundational to hip hop as the original four pillars. It is the ontology that grounds hip hop philosophy. The language hip hoppers use to describe this ontology provides insight into the importance of the relationship between truth and reality in hip hop. These complex but emergent connections between how knowledge is constructed and how tautology and reality define a hip hop existence provide a conceptual template for hip hop praxis (Judy, 2004).

Hip Hop-Based Education

Hip hop first appeared in urban K-12 classrooms with teachers using rap music to help students learn the concepts being taught. Students in these classrooms who identified with hip hop culture were engaged through their familiarity with the music, and by the novelty of hearing it in a formal learning environment (Baker, 1993). This type of instruction was used most often in humanities classrooms to teach traditional history lessons, poetry, and parts of speech. Rice (2003, p. 454) described the purpose of early hip hop pedagogy as “provid[ing] students with familiar situations and language that allow for complex textual readings, situations that allow students to identify with the figures of American and European literature.” Early hip hop pedagogues also used rap songs as texts for study, and encouraged students to create their own raps to demonstrate mastery of content knowledge. The rhyming and the repetitive aspects of these songs helped students to remember information, and the fact that they could communicate in the *street language* of hip hop encouraged their academic improvement (KRS-One, 1999; C. D. Lee, 1993).

The use of rap and street language to teach aspects of mainstream culture in the humanities was an effective place to begin for hip hop-based education. In addition to improving student performance and engagement, it provided a place of comfort for teachers (especially for those who were unfamiliar with deeper cultural aspects of hip hop) to connect with the hip hoppers in their classrooms. Despite its efficacy, scholars saw this use of hip hop as limited in scope. Baker (1991), for example, described the effectiveness of literature lessons he taught which posited King Henry V as a rapper. His students were intrigued with the idea of a medieval king being considered a MC, and were able to successfully use raps to convey what they learned about him. At the same time, Baker recognized that outside of his classroom, hip hop MCs were

taking on topics that were much more controversial and political. Within a year of when Baker's work was published, New York rap group Public Enemy released its album *Fear of a Black Planet* (1990), and California MC Ice Cube released *Death Certificate* (1991b). The music on these albums tackled issues such as Black Nationalism, police brutality in Black communities, and Black political and socioeconomic empowerment. At the same time, "gangsta rap," a term often applied to hip hop music which focused on the violence and criminality in ghetto life, was also very popular. McLaren (1999) commented, in hip hop-style hyperbole, on the prevalence of this type of hip hop:

Strutting apocalyptically across the urban landscape, today's gangsta rappers have, for some listeners, become the new black [sic] superheroes invested with dangerous, ambiguous, uncontrolled, and uncontrollable powers, the force of nature bound up with self-conscious and grandiose marginality. (p. 34)

As critical scholars, both McLaren and Baker concluded that classroom raps about mainstream culture by themselves could not capture the range and the urgency of the messages in hip hop. From political manifestos, to competitive boasting, to tales of urban violence, the gravitas of the topics prevalent in hip hop music meant that rapping about Henry V in an English class did not meet hip hoppers where they were culturally. Gosa and Fields (2012) explained this inclusion of rap in classrooms as hip hop curricula to distinguish it from what they called hip hop pedagogy, a broader application that includes classroom management, teaching styles, forms of communication, and an overall deeper engagement with hip hop culture. They considered hip hop pedagogy superior to hip hop curricula, since it is more culturally responsive to students, and pushes teachers to broaden their own cultural conceptions.

Education scholars who grew up in hip hop culture began to address this difference. They moved from the idea of using rap music as a tool for teaching English lessons to creating a cohesive framework for how hip hop culture could shape overall educational practices. They began with the premise that hip hop culture is, “a framework that informs how youth interpret, represent, and negotiate aspects of their sociocultural identities, including race, ethnicity, class, sexuality, and gender.” (Low et al., 2013, p. 119). Further, youth and young adults who identify as part of the culture use it to conceive of themselves and the world around them, providing, “a distinct worldview with related sensibilities and epistemologies that can inform teaching and learning” (Petchauer, 2011, p. 1412). This deeper view of hip hop began to define its epistemological foundations, as well as the prevailing sense of identity among hip hoppers. Together, they outlined a hip hop worldview to which the emerging hip hop pedagogy could be culturally responsive.

Hip Hop vs the Formal Classroom

Early scholars of hip hop pedagogy found hip hoppers to have a distinct ambivalence toward formal education that accompanied their hip hop worldview. Au (2005) described how hip hoppers have a critical view of traditional education discourse that both reflects and goes beyond that of other minoritized students. After analyzing lyrics from rap songs, he described the hip hop culture critique of formal education as having the following premises:

- Schools do not provide content deemed worthwhile
- Schools do not teach the skills necessary for economic survival
- Schools are associated with enforcing/teaching whiteness
- Schools do not pedagogically engage or interest students
- The school curriculum is full of racist lies and misinformation (Au, 2005, p. 216)

Thus, the particular emphasis hip hop culture places on knowledge, authenticity, and practicality, all couched in a general distrust of schools, places it at odds with traditional classroom environments. Hip hop pedagogy must navigate this difficult space between a culture that is pro-learning, but often anti-school (Clay, 2003; Paul, 2000; Prier & Beachum, 2008).

As a part of this ambivalence toward formal educational institutions, this study accordingly occupies an awkward space. Academic research on hip hop can simultaneously be considered laudable and questionable with regard to authenticity. The song, “Hip Hop” (2012), by DJ Khaled, Nas, and Scarface is a reflective critique of hip hop culture, and its relationship with education. Scarface raps:

Got a nigga feeling like I up and left ya
Get away, now you all in the lectures
Being studied by the college’s professors
Now I regret the day I met ya

His lyrics are indicative of the concern hip hoppers have toward their culture being coopted through its acceptance in formal education, and in the academy in particular.

In an ironic twist, Nas, who raps on the song and whose given name is Nasir Jones, had a hip-hop fellowship endowed in his name at Harvard University less than one year after this song was released. The Nasir Jones Hiphop Fellowship has brought hip hop artists and academic scholars together to study hip hop culture at this renowned educational institution (Sullivan, 2013). The press release for the Fellowship described Nas as “A quintessentially honest artist, [who] has taken great risks in exposing his deepest vulnerabilities while still staying relevant to a wide audience. He has tackled both intense political issues and hardcore street topics.” (Hiphop Archive and Research Insittute, 2013, para 5). In 1994, Nas described himself in “Represent” as,

“This nigga raps with a razor, keep it under my tongue/The school drop-out, never liked the shit from day one.” This apparent contradiction illustrates the ambivalence hip hoppers have toward formal education, and helps to define the awkward space in which this study resides. The difficulty lies in maintaining integrity with the authenticity espoused in hip hop culture and its accompanying skepticism of school environments, while conducting a formal academic study of it.

Critical Hip Hop Pedagogy

Hip hop culture incorporates a youthful type of agency in naming and describing experience, which help form a hip-hop worldview. Scholars have found an effective way to combine all of these concepts by creating Critical Hip Hop Pedagogy (CHHP) (Akom, 2009; Alim, 2007; Hill, 2009; Stovall, 2006). They established congruencies between Freire’s (1970) assessments of traditional schools as political, hegemonic institutions that treat marginalized students as passive receptors of knowledge, and hip hop notions of schools as alienating places for children of color, where indoctrination rather than learning occurs. They also prioritized the agency of hip hoppers and their worldview, viewing them as vital to informing how learning environments should operate. According to Akom (2009):

CHHP starts from the premise that hip hop is an important lens for socio-political analysis and representation of marginalized communities, and that youth-driven research on hip hop and popular culture is an instantiation of reading and acting on the world, that is, critical pedagogy. (p. 55)

Critical hip hop pedagogy merges critical and culturally responsive pedagogy in order to engage hip hop worldviews in education. It utilizes rather than suppresses the inherently skeptical views hip hoppers have of formal school environments.

The use of CHHP in actual classrooms demonstrates how it works in both theory and praxis. Stovall (2006) incorporated critical pedagogical practices in a high school social studies unit on hip hop. In one assignment, many of his students made connections between nihilistic displays of materialism in popular rap lyrics and videos that were promoted by racist media companies, and the deceptive promises of “success through high academic performance” made by their own racist schools (2006, p. 595). These connections uncovered a latent mistrust of their academic institutions.

Stovall also found that as part of their critical reflection, students assessed the violence and misogyny in some hip hop music as only a portion of a complex and robust self-actualization. They described violence in particular as both metaphorically used in hip hop braggadocio, and reflective of the congruent aspects of inner city life. This creates a complex positioning of inner city life, real or perceived, and how hip hoppers deploy notions of inner city violence as a function of systemic structures—like the construction of the Cross Bronx Expressway—to identify authenticity (Petchauer, 2009). Scholars describe this positive, negative, and validating conception of violence as unique to hip hoppers and their music (Low, 2009; Morrell & Duncan-Andrade, 2002). By combining critical and hip hop pedagogies, Stovall was able to engage students in explicating their hip hop identity, while analyzing that identity metacognitively within the context of school as a marginalizing institution.

Engaging hip hoppers by invoking their worldview is an important aspect of critical hip hop pedagogy. It distinguishes CHHP from the instruction that occurs in most of their formal learning environments. It allows hip hoppers and their teachers to critique structures that marginalize hip hop worldviews, in order to teach skills to remake those structures themselves.

Reality Pedagogy

Critical hip hop pedagogy, with its emphasis on authenticity, youth, and real-world problem solving, has created classroom environments that require educators to have new competencies. Hill (2009) suggested that fully engaging hip hoppers and their culture in classrooms requires teachers who constantly work to maintain the emotional and intellectual safety of everyone in the classroom. He conducted research on a Hip Hop Literature course he taught to students as part of an alternative education program at a south Philadelphia high school. The students in this class were largely at-risk for leaving high school before graduating. Hill's students regularly used the course to tackle larger societal issues, delving consistently into emotionally and intellectually challenging discourses. Describing the students as "wounded healers," Hill recognized the importance of "keeping it real" and "keeping it safe" while he and his students navigated important, culturally relevant, and emotionally taxing terrains (2009, p. 97). Jenkins (2006) attributed this type of increased need for safety in hip hop-responsive classrooms to the confluence of critical pedagogy, schools being seen as antagonistic to hip hoppers, the high value placed on formal education by marginalized students, and the prevalence of realness as hip hop ontology. He noted (2006):

The appeal of hip hop... warrants the educational arena studying and extracting its critical components of engagement, which seem to include a sense of autonomy; encouraging deep and conscious reflection, even if this includes the verbal communication of rage; accepting criticisms of power structures, even if this includes the school systems, political constituencies, and communities in which [hip hoppers] are involved... (p. 149)

Creating a critical classroom centered on hip hop ontology requires careful attention to the

intellectual and emotional challenges to both students and teachers.

In response to these challenges, Emdin (2011, 2013) created *reality pedagogy*, a conceptual framework for HHBE in science with applications for non-STEAM classrooms as well. Reality pedagogy combines CHHP and hip hop ontology in a manner that “focuses explicitly on understanding the realities of youth within a particular classroom and supports the teacher in utilizing and understanding of these realities as an anchor for instruction delivery.” (Emdin, 2011, p. 287). The core concepts of what Emdin called “The Five C’s of Reality Pedagogy” are, in order:

1. *Cogenerative dialogues* – A hip hop *cypher* is a group of people, in a circle, who are MCing, B-boying/girling, or simply sharing with each other. Modeled after the *cypher*, cogenerative dialogues are small groups in which students and teachers work and interact in ways that conceive knowledge as shared information used to come to new understandings that everyone in the group must respect. In a cypher, there are understood rules for who presents and when, and a premium is placed on analyzing and responding to the other voices, ideas, and actions. Cogenerative dialogues help teachers remain culturally responsive to students by ensuring they are constantly learning, in a hip-hop manner, about how students experience what is being taught.
2. *Coteaching* – Students take on teaching roles and some of the authority over content and concepts being taught. They prepare for teaching in the same ways hip hoppers prepare for performances, and teachers assess their efficacy as a part of grading. The preparations and assessments occur before, during, and after class. Coteaching can occur in cyphers, in the classroom as a whole, or in one-on-one situations.
3. *Cosmopolitanism* – This construct is based on ways of knowing in a society that

embrace a human sense of responsibility for each other, while valuing differences between them (Appiah, 2006). Applied in a classroom setting, cosmopolitanism combines these notions with hip hop culture and culturally responsive pedagogy. Students maintain responsibility for each other's learning, emphasizing the non-traditional roles of participants through cogenerative dialogues and coteaching.

4. *Context incorporation* – This aspect of reality pedagogy involves the inclusion and use of physical artifacts from students' environments. It is ideal in science classes, as students regularly investigate physical items and their properties. Using artifacts with which they are familiar allows students to demonstrate prior knowledge and expertise about them. This is vital to those students whose understandings have been marginalized and ignored in traditional classroom contexts.

5. *Content development* –The last step in reality pedagogy is for students to understand that information from teachers and textbooks does not comprise all there is to learn. The teacher and students use cogenerative dialogues, co-teaching, cosmopolitanism, and context incorporation to fill in knowledge gaps, and to create new knowledge about their subject. This means that reality pedagogues have a “willingness to both expose and embrace the limitations of their content knowledge within the classroom” (Emdin, 2011, p. 291). When they couple this with joining their students in content research, these reality pedagogues model inquiry in a manner that meets hip-hop conceptions of “building” and “sciencemindedness” in terms of knowledge and praxis. It is also particularly well-suited for STEAM classrooms.

Through reality pedagogy, teachers can account for hip-hop ambivalence toward school-based learning. Because it is critical in the Freirean sense, reality pedagogy engages hip hoppers

as experts of street knowledge to make school knowledge useful for defining and improving the world around them. Emdin (2010, 2012) identified this as important to hip hoppers who struggle to maintain their authenticity in an educational environment that regularly expects them to act and think inauthentically by hip-hop standards.

Summary

The research reviewed in this chapter provides an understanding of three pedagogical concepts (Hip Hop-Based Education, Culturally Responsive Pedagogy, and Constructivist Science Pedagogy) and three philosophical concepts (Hip Hop Culture, Hip Hop Epistemology, and Sociocultural Constructivism) from the theoretical framework suggested by the researcher. Critical race theory provided a means for understanding racial inequities in student educational performance as a function of systemic structures designed to maintain power discrepancies between Whites and people of other races. In order to subvert these educational inequities, culturally responsive pedagogy was conceived. Scholars are now describing hip hop as one of the cultures to which pedagogy can and should be responsive, and have termed it Hip Hop-Based Education. A brief historiography of hip hop also was included in this chapter. It helps explain the underlying epistemological and ontological constructs in hip hop culture.

For STEAM educators, constructivism has been an entry point for doing culturally responsive pedagogy. Scientific inquiry inherently includes the social and cultural mores of the people engaging in it, making instructional relevance and responsiveness to those mores paramount.

Chapter III - Methodology and Research Procedure

This study was designed to create a theoretical framework for defining Hip Hop STEAM Pedagogy and Hip Hop Science. These two theoretical concepts were elucidated from an established body of scholarship. The theoretical framework was assessed by analyzing the strength of the proposed connections among its contributing components.

The research methods had to fit within a CRT framework, prioritizing the narratives of marginalized people in naming, describing, and evaluating their experiences. These narratives came from a variety of “texts” that included scholarly articles and books, rap lyrics, and personal interviews. To accommodate this mixture of sources, the research methodology used was a mixed-methods approach—not in the traditional sense of combining quantitative and qualitative methods, but in that it combines two qualitative methodologies.

Content Analysis

The connections between the six philosophical and pedagogical concepts were assessed using *content analysis*. Krippendorff (1989) described content analysis as a methodology used to create theoretical models, that has a particular utility for interpreting and synthesizing disparate types of texts. This broad applicability made content analysis a useful methodological orientation for testing a theoretical framework that required the researcher to combine and analyze hip hop scholarship, traditional scholarship, and interview data. The specific type of content analysis used to assess the concepts and their connections was deductive in application. Deductive content analysis involves combining selected conceptual constructs to determine their viability in previously unexplored contexts (Elo & Kyngäs, 2008).

Mapping using Content Analysis

The visual frameworks used were created through *map analysis*. Map analysis provides guidelines for extracting concepts and themes and making connections among them in a

figurative and literal manner (Carley, 1993). This mapping aspect also aids in conducting a rich epistemological analysis. According to Carley (1994, p. 309), “Content analysis enables the researcher to locate the rhetoric of change and the extent to which different concepts are used. Map analysis takes the researcher a step further and enables the analysis of meaning.” Because meaning-making and ways of knowing were vital to this study, map analysis was used to assess the collected data. The yEd mapping software program was used to create the graphic models needed to perform this analysis. Its graphics-based interface simplified the creation of nodes and edges, which are the concepts and the connectors among them, respectively. The software also provided statistics for the type and frequency of the nodes and edges used, and created analytics from them as well. The graphic models improved the ability to convey the researcher’s suppositions, the results from the data analysis, and the subsequent changes to the original proposed framework.

Analyzing the Texts

Evaluating the texts required a form of exegesis that was compatible with content analysis and CRT, and had a specific orientation toward understanding epistemological and ontological conceptions. It also had to account for the intimate relationship between the interpreter and the content of the texts. Employing a hermeneutic approach provided a method for meeting all of these parameters. Describing this method, Gardiner (1999) stated:

The hermeneutic approach stresses the creative interpretation of words and texts and the active role played by the knower. The goal is not objective explanation or neutral description, but rather a sympathetic engagement with the author of a text, utterance or action and the wider sociocultural context within which these phenomena occur. (p. 63)

As a hip hopper, a formally trained scientist, and a teacher, the researcher had epistemological and ontological orientations that were reflected significantly in the content of the texts. In hermeneutic content analysis, new understandings alter the philosophies of the analyzer. This hermeneutic circle (Gadamer, 2004), shown in Figure 2, improves the ability of the researcher to assess and discuss understandings.

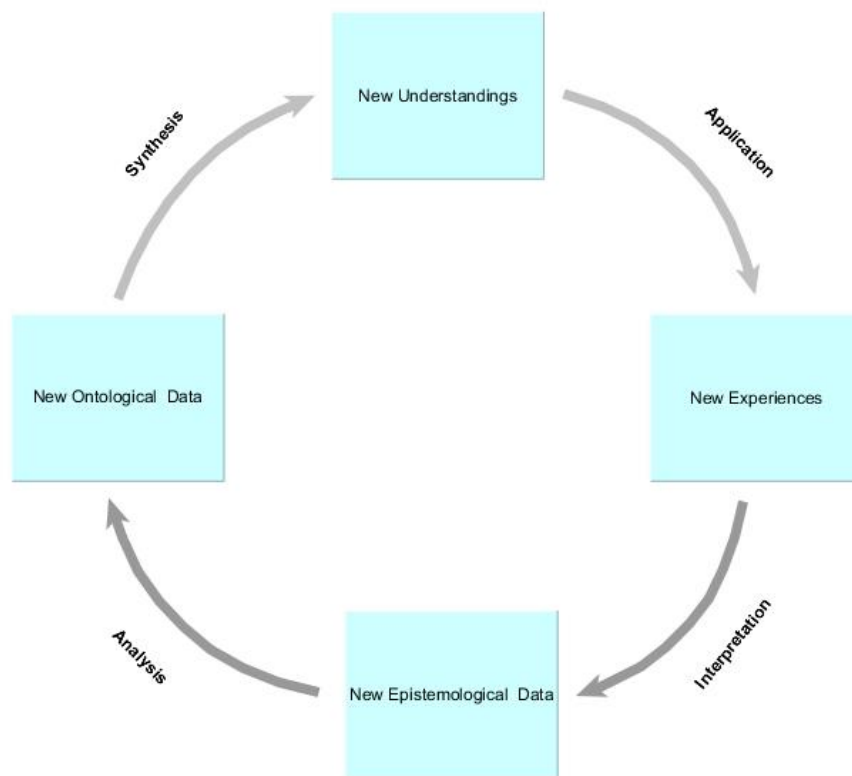


Figure 2: Hermeneutic Circle

In a hermeneutic circle, the application of newfound understandings causes new experiences. Those new experiences are interpreted, creating new epistemological data. The new data about knowledge constructs, when analyzed, causes new conceptions of what is real and what exists. Synthesizing these ontological data and the underlying epistemological conceptions causes the analyzer to come to new understandings. In this study, the circle helped to meet the goal of reporting on and improving the general understanding and application of hip-hop cultural and pedagogical philosophies.

Hermeneutic analysis has been used to combine Vygotskian constructivism with content analysis of cultural texts, making it a particular fit for this research (Burbules & Berk, 1999). Lave and Wenger (1991) elaborated on Vygotsky's ZPD and created a cultural analogue called "cultural ZPD". Cultural ZPD is "the distance between the cultural knowledge provided by sociohistorical context [and] the everyday experiences of individuals" (Lave & Wenger, 1991, p. 38). In this study, the academic texts provided cultural knowledge from sociohistorical context, and the non-academic texts provided the everyday experiences. This application of hermeneutic analysis was used to create a Hip Hop Science model, which included analyzing connections between sociocultural constructivism and hip hop epistemology.

Narrative Inquiry

Part of the data collected in this study came from interviews of experts in hip hop culture, education, and science. Like the textual analysis, the interviewing procedures had to be compatible with the Critical Race Theory framework. To do so, a CRT approach to interviewing was used. It foregrounds the expertise embedded in the experiences shared by the interviewees, presents them in terms of social justice and equity, and prioritizes marginalized voices (Thomas, 2000). These aspects were important for this study, as the primary purpose of the interview

narratives was to explicate the experiences of marginalized groups as they relate to hip hop, education, and STEAM.

All of the experts interviewed identified significantly with hip hop culture. Because hip hop relies on the accounts of its participants in narrative form, analyzing their stories necessitated the use of a methodology that builds and interprets narratives as a form of data synthesis.

Narrative inquiry was thus a good fit for this study. It involves conducting interviews, synthesizing data, and then analyzing the narratives that emerge from the individual experiences of the interviewees (Connelly & Clandinin, 2006). Narrative inquiry also complements content analysis as a means of synthesizing interview data into conceptual and theoretical models (Clandinin, 2007; C. Smith, 2000). It provides depth to the models by turning multiple interviews into cohesive narratives that focus on how social experiences influence the interviewees (Craig, 2009). This aspect was important in determining how the social experience of being a hip hopper, who is involved in various aspects of pedagogy, influenced the epistemological and ontological notions of the experts interviewed and vice versa.

Gergen (2003) stated that data from interviews in narrative inquiry should be coded using methods that preserve the qualitative integrity of the interview data. One of the suggested methods is image-based mapping, which is a form of mapping analysis. Because the interview data and the textual data from the content analysis were analyzed in relation to each other, it was helpful to use a similar coding system from a compatible methodology. The yEd program was again used to do a map analysis of the interview data. Using the same nodes, edges, and analytics throughout all analyses made it easier to compare and synthesize the data for the creation of the theoretical framework.

Research Questions

The combination of methodologies in this study was used to address the following:

- 1) To what extent are hip hop conceptions of science and knowledge viable sites of pedagogical engagement for STEAM teachers? It was addressed through three more specific questions:
 - a) What are the relationships between the pedagogical and philosophical frameworks in the proposed theoretical model?
 - b) Which of the relationships are supported by the collected data, and to what degree are they affirmed?
 - c) What are the implications for connections that may be found that are not accounted for in the proposed model?
- 2) What is a hip hop epistemology, and how are hip hop conceptions of knowledge identified? Since the intent of this study was creating a model for Hip Hop Science, and assessing its utility in informing Hip Hop STEAM Pedagogy, the following questions related to hip hop epistemology were examined:
 - a. How does hip hop epistemology inform the formation of a model for Hip Hop Science?
 - b. What insights does Hip Hop Science provide insight into the scientific ways of mind of hip hoppers?
 - c. How does the viability of the Hip Hop Science model impact the creation of a model for HHSP?

Research Procedures

The Traditional Scholarly Texts

The texts from traditional scholarship were selected through a process called *purposive sampling*. Purposive sampling is a general description for processes that select data sources that are not chosen randomly. *Theory-guided sampling* is a purposive method for choosing texts that are exemplars of the theoretical constructs they present (Palys, 2008). The purposeful choice of representative texts is useful for research based on analyzing conceptual theories, rather than actually testing those theories through implementation (Lincoln & Guba, 1985; Patton, 1990).

This study required a set of scholarly texts that were exemplars for the six pedagogical and philosophical concepts. The researcher chose to use exemplars because it would not be possible to analyze all of the extant data on each of the constructs, and because there are certain texts about each construct that are clearer in their implied connections to other constructs.

Another consideration was ensuring the data collected were representative of the three sources in proper proportion and function. The purpose of using the scholarly texts was to ground the theory behind the six constructs, while keeping the research focus on the interview and hip hop text data. Five scholarly texts were ultimately chosen using theory-guided purposive sampling. They are:

Can't Stop Won't Stop: A History of the Hip Hop Generation (Chang, 2005)

This text approaches hip hop history from a cultural perspective, using narratives about hip hoppers to tell an overall story. It includes interviews and other research that are reflective of the academic background of its author, who is himself a hip hopper. Amongst the body of scholarship and other writings on hip hop, *Can't Stop Won't Stop* has critical acclaim that includes winning the American Book Award and the Asian American Literary Award. It has

been used as a textbook in college courses on hip hop, and was chosen as an exemplar for understanding hip hop culture and hip hop epistemology.

The Five Percenters: Islam, Hip Hop and the Gods of New York (Knight, 2007)

This text was selected using the University of Washington WorldCat to search libraries worldwide for a book that included the terms “Five percenters” and “Hip Hop” in its description. Of the six books found in the search results, it was the only one in which the subject matter was only about the connections between Five Percenters and hip hop culture. The other five contained sections or chapters about one or both topics, and included a book about being a Five Percenter by the same author. Doing the same search replacing “hip hop” with “rap” returned *The Five Percenters* and another text dedicated to the two groups. Of these two, the author of *The Five Percenters* identified as a hip hopper, making that text preferable. It was chosen as an exemplar for understanding hip hop culture, hip hop epistemology, and science-mindedness amongst hip hoppers.

Mind in Society (Vygotsky, 1978)

Lev Vygotsky is one of the most cited scholars on the foundations of sociocultural theory and cultural influences on learning. His ideas inform how constructivist science teaching practices are currently used in classrooms worldwide (Boudourides, 2003; Cakir, 2008; Garbett, 2011; Patchen & Cox-Petersen, 2008). Of his books, *Mind in Society* is widely read. It is a collection of Vygotsky’s essays that have been organized by scholars who studied his work on learning and development in children. In order to analyze sociocultural constructivism and the foundations of constructivist science pedagogy, *Mind in Society* was chosen as an exemplar.

Schooling Hip-Hop: Expanding Hip Hop Based Education across the Curriculum
(Hill & Petchauer, 2013)

This text was selected to inform the models for Hip Hop-Based Education and Culturally Responsive Pedagogy. It is a collection of scholarly articles by hip hoppers in academia.

Schooling Hip-Hop was recommended by an expert in the field, and was edited by one of the interviewees. From a search on the WorldCat system, *Schooling Hip-Hop* was the only book of the 171 found on “hip hop based education” that was an edited volume with multiple contributors from a variety of educational fields. The range of scholars contributing to the text allowed the researcher to draw conclusions about the content with greater reliability.

Urban Science Education for the Hip Hop Generation (Emdin, 2010)

The limited amount of scholarly texts on the intersections of hip hop and science education is one of the premises for this study. A search on WordCat for books on “hip hop” and “science education” produced six results. Of those six, only *Urban Science Education for the Hip Hop Generation* was dedicated entirely to studying science and hip hop. The book was written by one of the committee members for this dissertation research. The committee decided that there would be no conflict of interest in using the text. *Urban Science Education for the Hip Hop Generation* focuses on teaching STEAM education in hip hop-responsive ways, while this study focuses on clarifying the theoretical framework that should govern such pedagogy. This text was chosen to provide a foundation for the models for constructivist science pedagogy and hip hop STEAM pedagogy.

The Hip-Hop Scholarly Texts

Hip hop songs were used in this study to ensure that the voices of hip hop scholars were a primary source of data. Determining which MCs and songs would provide those voices meant combining the methods for determining who has validity in hip hop with methods for

determining who has validity in traditional scholarship. While academic peer review are common ways to determine the merit and credibility of academic scholarship, the same type of formalized system does not exist in hip hop scholarship. Hip hoppers who are considered heads, gods, or G's receive the designation of "scholar" within the culture, along with the right to help determine what is "real" (Chang, 2005; Hill, 2009; Stovall, 2006). Having the support of powerful and influential voices can determine who is a hip hop scholar or head. In addition, one of the fundamental debates within hip hop is deciding who has earned one of these informal titles. These debates themselves are informal and reflexive ways for hip hoppers to demonstrate their own authenticity and even their own claims to these titles (Clay, 2003; Keyes, 2002; Scarface et al., 2012). This means that aspects like geographic location and popularity can confound notions of which MCs are truly gods or Gs.

The system used to select MCs and their songs combined academic and hip-hop methods. Daniels (2014) analyzed popular MCs and their vocabulary. The MCs were chosen based on his own insider knowledge of hip hop, and personal and online debates he had with other hip hoppers. The final list included 105 MCs, and he analyzed the first 35,000 words they used in their songs, using a computer-based method called *token analysis*. He created a visual chart showing how many unique words each MC used, and ranked them in order from least to most. This process effectively combined the informal aspects of hip hop scholarship with a formal quantitative research methodology. It also provided a rationale for the MCs work included in this study, as vocabulary size and unique word usage are indicators of a person's levels of knowledge and understanding (Nation & Waring, 1997).

The list of MCs from Daniels' research was used to select the relevant hip hop texts for this study through a similar methodology, detailed in Appendix C. The website genius.com, the

largest online repository for hip hop lyrics at the time of this study, was used to search for songs by the 105 MCs. Using the Python programming language, a script was created that selected and ranked these songs in order of the occurrence of the following specific words: *education*, *knowledge*, *school*, *science*, *teach*, and *teacher*. The rationale for using these words with the cross-referenced list is that these artists, songs, and words would elicit the richest texts for understanding hip-hop notions of the eight concepts from the theoretical framework.

From an initial 16,173 songs, the top 100 were chosen for possible inclusion. Seven ended up being selected from this grouping, as almost all of the other songs had subject matter that had little to do with the topics of this study, despite the frequency with which the six cross-referenced words appeared. The songs analyzed are listed in Table 2.

Song Title	Artist	Cross-Referenced Word Count
<i>“They” Schools</i> (2000)	Dead Prez	36
<i>A Bird in the Hand</i> (1991a)	Ice Cube	13
<i>Malcolm X (A Song to Me)</i> (2012)	David Banner	8
<i>The Science</i> (2008)	Murs	5
<i>School</i> (2004)	Masta Killer ft. RZA	6
<i>State of Grace</i> (2013)	Talib Kweli	18
<i>Teach the Children</i> (1992)	Eric B & Rakim	17

Table 1: Hip Hop Scholarship Texts

The Interviewees

Guidelines provided by Marshall and Rossman (2006) were used to initially determine who would be considered an expert in one or more of the three fields pertinent to this study. They describe these experts as *elites*, who are "...considered to be influential, prominent, and/or well-informed in an organization or community; they are selected for interviews on the basis of their expertise in areas relevant to the research..." (p.155). The elites in this study were selected using the *snowball sampling method* (Thompson, 2002), in which a few initial experts are identified, and then each of them in turn recommends others with similar or relevant expertise. The initial invitees were chosen with help and input from the researcher and the dissertation committee members. They were selected based on their identities as hip hoppers and their expertise in either science, education, or both. The subsequent invitees were contacted by the initial experts, and then by the researcher to solicit their participation. Through this procedure, six people were interviewed (Table 3). A seventh ultimately had to withdraw due to scheduling conflicts, after initially having agreed to participate.

Each of the experts was given the option of anonymity and choosing a pseudonym before and after the interviews, but all of them chose not to have their identity hidden. They made their decisions due to the nature of the selection process, the lack of sensitive or potentially damaging information dispensed in their interviews, and their position as experts rather than the people on whom the research is being conducted. A brief profile of all the interviewees and their expertise is provided below:

Jeffrey Arthur

Jeff teaches multimedia, photography, and general multimedia education in a STEAM program that serves an urban population in the western U.S. He is also active as an MC, and goes by the name Silence. Jeff left formal education to teach in the informal arena in which he is

currently employed. He works actively to make connections between STEM and the Arts, and helps both students and teachers learn to do so as well.

Leshell Hatley

Trained formally as a computer systems engineer, Leshell is an educational entrepreneur who created and directs multiple STEAM education programs for children in a large, urban, east coast city in the U.S. Her programs involve teaching subjects from robotics to smartphone app development. During her undergraduate studies, Leshell co-founded an organization dedicated to promoting hip hop culture. This organization hosted some of the earliest and largest hip hop conventions on the east coast of the U.S., engaging hip hoppers in panels, performances, and active discussions about the culture.

Bettina Love

Bettina is Associate Professor of Educational Theory and Practice at a university in the southeastern United States. She described herself as having grown up in hip hop culture, and has studied hip hop, education, and K–5 science education both formally and informally. She has expertise in all three areas and their intersections, and is a regular contributor to academic and non-academic research.

Emery Petchauer

Emery is Associate Professor of Teacher Development and Educational Studies at a Midwestern university in the U.S. He is also a hip hop DJ who goes by the name Ill-Literate. He has published books, journal articles, magazine articles, and many other forms of media that discuss hip hop, education, and oftentimes, both. Emery regularly studies hip hop culture and how teachers can and should engage with it in K – 12 classrooms.

Stic.man

Khnum Muata Ibomu is a self-described musician, producer, writer, and wellness advocate who is best known by his MC name “Stic.man.” He regularly performs by himself, and as half of the acclaimed hip hop group Dead Prez. Stic.man and Dead Prez are renowned for their social and political activism, which provides much of the content for their music. Stic.man has written books on MCing as an art form, fitness and nutrition, and African culture.

Christopher Wright

Chris is an assistant professor of STEM Education at a southeastern university in the U.S. He grew up in a large urban city as a child who was always interested in science, but had minimal engagement in the science classes during his primary education. Christopher primarily studies and teaches about STEM education, and considers his “hip hopness” an inherent part of who he is, and how he goes about his research and his instruction.

Name	Gender	Ethnicity	Profession
Jeffrey Arthur	M	African American	Hip hop artist and STEAM educator
Leshell Hatley	F	African American	STEAM educator
Bettina Love	F	African American	Elementary Education professor and educator
Stic.man	M	Cameroonian, Bisseau-Guinean, and Native American	Hip hop artist and social activist
Emery Petchauer	M	European American	Education professor and Hip Hop Artist
Christopher Wright	M	African American	Science Education professor

Table 3: Interview Participants

Data Collection

The primary tasks in coding the data from the three sources were to analyze the constructs for the frequency with which they were referenced, test the strength of the connections among the three sources, map the results, and compare the findings to the original theoretical framework. The strength of the connections was prioritized, as the validity and reliability of the philosophical and pedagogical constructs alone had been affirmed by previous scholarship. To that end, the scholarly texts were used to create a theory-based narrative to describe the frameworks and their connections, while the hip hop texts and the interviews were coded and analyzed using traditional qualitative methods. The data from each of the three sources were given equal weight, making the hip hop texts and interviews account for two-thirds of the analyzed data. The overall priority given to these two sources was based on the assumption that they would reflect the strongest indicators of the constructs and the connections between them among hip hoppers and educators.

The coding system created to analyze the frameworks and their connection is presented in [Appendix D](#). It includes the connections from the proposed model, as well as connections that were uncovered during the coding process.

The interviews were conducted and recorded online using ClickMeeting software. Each interview was conducted individually, and framed as a semi-formal discussion about hip hop, science, and education between the researcher and the interviewee. Following the narrative inquiry model for interviewing, almost all of the questions were open-ended. Some of the prompts for the interviewees were, “What does the phrase ‘hip hop culture’ mean to you?”, “Do you have any personal connections to hip hop and education, and if so, how would you describe them?”, and, “How would you describe your experiences as a student in science classes (grades

K - 12)?” (see [Appendix B](#) for the full interview template). These prompts encouraged the interviewer and interviewee to engage in dialogue that created both specific and general narratives (Kramp, 2004).

The interviewees had the right to refuse to answer or otherwise respond to any of the prompts. They also were given the opportunity to edit and clarify any of their responses at the conclusion of their interview, and before the online software was closed. Interviewees maintained access to the recording of their own video online, but they were not able to edit or otherwise alter it.

Map analysis was used to create graphic models of the intersections of the theoretical and pedagogical concepts from the coded data. These models were then compared to the originally proposed framework, which was then refined to reflect the findings of the study.

Triangulation

One of the consistent challenges in conceptual research is validating the strength of the conclusions drawn from the data collected. Testing the cogency of ideas without actually implementing them carries with it the need for alternative means of validation. Triangulation is a means for confirming the integrity of data collected and analyzed in both qualitative and quantitative research, and it can be done in multiple ways (Denzin, 2012). In this study, three different forms of triangulation were used. Using interviews, traditional scholarly texts, and hip hop texts provided *data triangulation*. This form of triangulation involves the purposeful incorporation of multiple data sources from different times, settings, and people (Begley, 1996). Analyzing a book by Vygotsky, a rap written by The RZA of the Wu Tang Clan, and data from an interviewed science educator in relation to each other is an example of how this type of triangulation was utilized.

Theoretical triangulation is the second way in which data were cross-checked in this study. It involves the use of multiple theories to inform data analysis and conceptual models (Banik, 1993; Hussein, 2009). Sociocultural constructivism (Vygotsky), hip hop epistemology (RZA), and critical pedagogy (science educator) are the different theories represented in the above example. They were combined for concurrent analysis, creating theoretical triangulation.

Using multiple qualitative methodologies to analyze data creates *methodological triangulation*. Combining content analysis and narrative inquiry in this study provided what Denzin (2012) described as “within-method triangulation,” which occurs when two qualitative or two quantitative methodologies are used in one study. This strengthened the internal validity of the study. Strong internal validity also improved the overall reliability of the study by confirming that the models created for Hip Hop Science and HHSP were derived from the expertise of the interviewees and the analyzed texts, not just the experiences of the researcher.

Positionality of the Researcher

The word “critical” is pervasive throughout the practices of this study. Being critical goes beyond simply referring to inequity in disparaging ways. It includes a thoughtful and purposeful critique of that inequity, as well as the practices designed to eliminate it. An important aspect of being critical in multicultural education is reflectivity (Gorski, 2009; Howard, 2003; May & Sleeter, 2005). This means that everything and everyone involved was subject to scrutiny. Disclosing and analyzing my own positionality was important for this research, because my identity and my voice are entangled within it (Collins, 1986; Goba, 1996; Harding, 1993; Ladson-Billings, 2000; W. Smith, Hung, & Franklin, 2011). My cultural identifiers, as well as my own experiences as an educator and a teacher educator provided what Harding (1991, 1993) described as “strong objectivity,” a non-neutral assessment approach that

acknowledges and advantages my positionality.

I am a Black male, a hip hopper, and an educator. As a Black male hip hopper, I was privy to—and often victimized by—programs designed to close the achievement gap and engage underrepresented minorities when I was a K–12 student. At my high school, for example, the English and Social Studies departments jointly ran an advanced set of electives called “Humanities.” The program was acclaimed for its rigor and its quality, but almost never had any Black students enrolled. The leaders of the program made a concerted effort to get so-called high-achieving Black students into the class my senior year, and encouraged me personally to join. I found the class to be rigorous, challenging, and well-taught, just as advertised. I also found myself studying “classic civilization” day-after-day that never included people who shared my African ancestry. Despite their welcoming efforts and the quality of the teaching, I was no more interested in the course than any other social studies or English elective that held almost no cultural relevance for me. Beyond the racially homogeneous curriculum, I remember one day sitting in confusion, as what felt like the entire class laughed repeatedly at what must have been jokes the instructor had craftily incorporated into his lecture on Greek mythology. I did not share whatever cultural capital was necessary to understand the jokes, and ended up being alienated during a moment that for many in the course was welcoming and affirming. My experiences in Humanities helped refine my understanding of how important culturally relevant teaching is for Black male hip hoppers. I learned that detailed, well-planned curricula and academic rigor are not inherently culturally responsive practices.

Later, during my career as a science teacher and school administrator, some of my seminal experiences involved challenging dubious methods of educating marginalized students. One of these experiences occurred while I was teaching at a an urban school, where the student

population was 98% Black, and over 90% of them received free and reduced lunch—an indicator of their families’ socioeconomic challenges. I was in the teachers’ lounge watching a teacher make a large stack of worksheet copies for students in her social studies class. As she gathered the pages, she remarked aloud, “These kids... they know everything there is to know about Lil’ Wayne [a popular rapper]: what he’s saying, how he wears his clothes, who he’s dating, the names of his kids... but they don’t wanna learn history. Can’t get them to learn this stuff to save their lives!” I thought to myself, “Apparently Lil’ Wayne is a more effective teacher than you are. If nothing else, he’s gotta be a lot more interesting than that stack of worksheets you’re about to give them. And I wouldn’t want to “learn” either if it just meant filling stuff out on a giant pile of paper. I might say to you, “I don’t wanna learn today! Please don’t ‘learn’ me with all those social studies papers.” It was then that I began to really consider how the worldview of hip hoppers affects what is culturally relevant to many African American youth. I wanted to explore how we really learn, and I knew it did not include being figuratively hit over the head with an endless stack of worksheets.

As a social scientist, I have a research background in “hard” sciences as well. My undergraduate degree is in biology, and I taught life and physical sciences at the middle and high school levels. Before I began my career as an educator, I worked at the Walter Reed Army Institute of Research, so I have practical experience in conducting research in hard science. I recount this to demonstrate my affinity for hard science, and as an indicator of my own privileged positionality as both an insider and an outsider with regard to notions of scientific inquiry and how it “should” be done. They have strong influences on how I conducted this research.

Because of my background, I have vested interests in researching and developing

pedagogical models which help all students, and a particular interest in ones that better engage students who share my experiences. However, this does not cause me to become indiscriminate when exploring ideas about improving education for marginalized students. In fact, my positionality causes me to be more discerning in my analysis of these ideas. Being self-critical adds a reflective nature to my assessments, and further ensures that I properly challenge the efficacy of the models I identify and construct. My strong objectivity is therefore an aid to this research and not a hindrance.

I highlight this scrutiny because my study is transparently autoethnographic—I conducted research that is ultimately about myself as a learner—and it affected my application of the methodologies. At the center of this research lies a version of the classic scientific question of nature versus nurture; in this case revised to ask, “Is there something inherently wrong with youths who identify with hip hop culture that makes them unfit students? Or is the ‘something’ that needs fixing the pedagogical practices that cause their disproportionately poor performance?” My research ultimately implied the very personal question, “Is there is something wrong with me? Is my hip hop way of conceiving science actually another viable way of teaching?” Though I am convinced of the latter, being a self-critical multiculturalist, I am capable of determining whether or not my own research generates viable pedagogical models that may work for hip hoppers like me.

Summary

In this chapter, two research methodologies were identified, and rationale was provided for their use in the study. The research questions were stated, and the procedures for addressing them were described. The three data sources—traditional scholarly texts, hip hop scholarly texts, and interviews—were described in depth, and the processes that brought about their selection

was discussed. An overview of how the data were collected and analyzed through content analysis and narrative inquiry also was included. The chapter concluded with an explanation of how data triangulation was achieved, and an examination of how the researcher's positionality affected data analysis.

Chapter IV – Data Analysis and Results

To address the research questions, data from the interviews and the hip hop texts were synthesized (see Appendix E for the process used), with the scholarly texts used to supplement congruencies or discrepancies between the two primary data sources. The findings are reported in an order matching the research questions, beginning with an analysis of the frequency and connectivity among the analytical, philosophical, and pedagogical concepts. The models are denoted with capital letters when referred to directly, and are not capitalized when the concepts they represent are referenced. For example, the phrases “Hip Hop Epistemology” and “Hip Hop Culture” are used to describe connections in the data between the two models, while “hip hop epistemology” and “hip hop culture” are used in presenting how an interviewee talked about hip hop worldviews or hip hop pillars.

The themes in each of these sections are placed in descending order of the degree to which the interview and hip hop textual data support them. They include emergent models and connections not in the original framework.

Analytical Frameworks: Voices of Critique and Resistance

Critical Race Theory was the analytical lens through which all of the concepts and their connections were viewed. The belief was that CRT principles would be embedded in how the texts and interviewees explained the concepts, and subsequent methodological choices were made based on that assumption. Three CRT principles appeared consistently in the collected data, but a new framework emerged as well. Common among references to hip hop culture were allusions to how hip hoppers critique and rebel against formal educational environments. The frequency of these references was almost exactly equal to those of the CRT references. They were used by the authors of the texts and the interviewees to demonstrate the importance and the

fervor of this resistance. This emergent theme was termed “Hip Hop-Resistance to Formal Education,” and is included along with Critical Race Theory as an analytical framework for explicating the results of the analyses.

Critical Race Theory

There were three consistent themes that emerged from the interviews and the hip hop texts that are integral to Critical Race Theory. They included the indictment of racialized power structures, the use of narratives, and critiques of liberalism. All of the interviewees referred to these aspects of CRT at least once, or used narratives that described and empowered their hip hop worldview. Six of the seven hip hop texts also made direct references to these themes. The one that did not was a narrative critiquing the perceived failings of the rapper himself and hip hoppers in general. Because hip hop lyrics can often be atypical or address numerous topics at once, the song lyrics quoted in this section are substantial in length. This reflects how the MCs incorporated CRT themes as part of a larger overall narrative, distinguishing them from a series of tangential, unconnected references.

None of the data sources mentioned Critical Race Theory explicitly, but its themes were still prevalent. For example, in “Teach the Children” Rakim raps:

Teach the children, save the nation
I see the destruction, the situation
They're corrupt, and their time's up soon
But they'll blow it up and prepare life on the moon
Sounds like Total Recall
But who gotta spaceship, you get it, we fall
So hope for the best and expect the worst

The end is near and it's U-N-I verse
The one's that interfere with nature
Labeled you limited and underrate ya
His plans over rule when he separates ya
Now it's U-N-I verse, the one that hates ya
So we gotta let them know we're hip to the script
Change the skit, or we're about to flip
Cause we want access to happiness
Living the good life and much success
Equal opportunity
Self-awareness and unity
Education, the kids need a sculpture
Teach them the abacus and their culture
And that'll help stop the robbing, raping and killing
Poison neighborhoods are illing
But they import more keys from across seas
A drug disease hits the streets with ease...

Rakim used “they” in the same manner that Stic.man defined “they” schools and how this study posits “they” science. “They” was the corrupt system that, according to Rakim, would rather blow up Earth and start civilization over on the Moon (as was done in the popular science fiction movie “Total Recall”) than share their power. His spaceship reference was an analogy for how the disempowered (i.e. hip hoppers and other marginalized groups) do not have the resources or access to be able to survive such destruction. Rakim pronounces “universe” as “U-

N-I verse” (“you and I”), which he and fellow Five Percenters do to indicate that the universe is comprised of a plurality of people, and to place himself and other unprivileged people in conflict with the corrupt “they.” He goes on to suggest that success for “U-N-I” can be achieved through social justice and culturally responsive education, and concludes with the admonishment that “they” will continue to purposefully undermine communities of color by placing drugs in them (“keys” is *street language* for “kilos”, the metric used to determine the mass of a quantity of drugs).

Rakim’s critiques reflected a general sense of “us versus them,” which permeated how hip hop culture was defined in all data sources in this study. This mentality critiques power imbalance and the resistance to it. When Rakim states, “So we gotta let them know we're hip to the script / Change the skit, or we're about to flip”, he moves from identifying hegemony, to purposefully demonstrating his awareness of it, and warning “them” of the repercussions if the power imbalance persists.

Bettina Love reflected on how CRT critiques impact hip hop culture. She stated:

As someone who is a feminist, I have to take hip hop and look at it within the context of White patriarchy first. And racism first. Hip hop was not created in a vacuum. It has been co-opted within capitalism and within a neo-liberal agenda. All those things play into the hip hop music that we see and will always be created. Hip hop is as American as apple pie, and it will always be affected by those ills.

Like Rakim, Love indicted systemic cultural hegemony. But instead of the categorical “they,” she named them—chauvinism, White patriarchy, racism—and described them as an intractable part of hip hop culture. She also warned against simplistic views of hip hop as a “positive culture” and HHBE as the “end all, be all” for effectively teaching hip hoppers.

In *Can't Stop Won't Stop* (Chang, 2005), Jeff Chang echoed the sentiments expressed by Rakim and Love in telling the story of the origins of the rap group NWA, and the systems that created the violent, Compton, CA streets that molded the identities of the group members. Similar to what happened in the South Bronx, Chang noted how the anti-drug and anti-gang policies instituted during the presidency of Ronald Reagan caused social and economic upheaval in Compton. Black and Brown youths in both cities considered themselves victims of increasingly punitive laws designed to deter drug sales, drug abuse, and gang violence. In the following comments, Chang (2005) explained how the members of NWA spoke against these systems, and on behalf of Compton youths in their raps:

Reaganism had eliminated youth programs while bombarding youths with messages to desist and abstain; it was all about tough love and denial and getting used to having nothing. Even the East Coast utopians like Rakim and [Public Enemy's] Chuck [D] talked control and discipline. By contrast, excess was the essence of NWA's appeal. These poems celebrated pushers, played bitches, killed enemies, and assassinated police. Fuck delayed gratification, they said, take it all now. 'Gangsta Gangsta' was the first single released from [NWA's recording] sessions. On it, Ice Cube hollered, 'And then you realize we don't care / We don't 'Just say no' / We're too busy saying, 'Yeah!' (p. 319)

According to Chang, some of the music that emerged reflected the thoughtful critiques provided by Rakim, as well as the violence and hedonism in the society at-large to which Love referred.

All of the hip hop texts collected and analyzed for this study included statements about how race, class, culture, and education are lived by hip hoppers in the United States. Christopher Wright recalled how growing up in hip hop culture caused him to understand that joanin'

(signifyin') on his peers was a form of observational comedy that stimulated his sciencemindedness, his ability to discern scientific phenomena, and his insight into how hip hoppers practice collaborative critique. Wright explained further that:

Teachers often hear [joanin'] as criticism rather than as critique, and were resistant to its incorporation in classroom settings. We were using it to analyze how we were represented by others, how we represented ourselves, and we were using it in rich and inventive ways they couldn't understand. It was actually beneficial to the hip hoppers involved.

In his interview, Stic.man described the power and the importance of these types of discourses of hip hoppers:

Think about the great hip hop storytellers—Ice Cube from his hood stories to his Hollywood film stories—who develop a masterful craft. Hip hop allows various skills in persuasion, psychology, counseling, and just dealing with your own struggles and having a creative outlet to process them. You can mentor people and educate them because you have this art in you that can do all of that.

Hip Hop-Resistance to Education

Each of the interviewees described antagonistic aspects of the ambivalent relationship between hip hop culture and formal learning environments. They made as many references to this relationship as they did to CRT aspects. Of the songs, three of them made specific references to this relationship, with two of them using it as a primary topic within the lyrics.

When asked about hip hop and education, Love talked about the presence of resistance. She described it as intrinsic to hip hop culture:

I think one of the important themes is the idea of resistance. Hip Hop, Black music, and Black culture, particularly in the U.S., [are] built on resistance. It's built on perseverance. It's built on wit. It's built on cleverness. It's built on swag. I don't rap, I don't dance, I don't do graffiti, none of that. But I am hip hop.

The RZA's lyrics in the song "School" reflect this focus as well. In the second verse, he describes a confrontation between himself and his teacher:

Sat in the back of the class with my hand up
Two wild security guards, grabbed my man up
Threw him in detention for 5 days suspension
Cause he said, the teacher was lyin' about the Indians
Tryin' to dumb us with the story of Columbus
And brain-numb us, when all you see, that came from us
They copy-carvin', I learned about God and
Taggin' Wu logo on the book margin
Intense like a New York riot, she stood quiet
And asked me, could she speak to me in private
(Mr. Diggs, you actin' like a fool...) Huh?
(You know these rules that we have in these schools) Yeah..
(You and your friends think y'all cool) Why?
(Cuz y'all walk through these halls with the 12 jewels)
Fat shoe laces and tri-colored sneakers
I stood like a man then I questioned my teacher...

RZA's story epitomized how hip hoppers in this study viewed school as often hostile towards them. Beyond simply culturally unfamiliar or questioning, they found that schools impugned and indicted their hip hop culture. In the fictive conversation with his teacher, RZA portrayed her as dismissive of hip hoppers and their belief in the teachings of the Five Percenters. This is shown when the teacher challenges their identification with the 12 Jewels of Islam, which is a part of the Five Percenter numerology system. The 12 Jewels connects the first 12 counting numbers to vital concepts for living. They are: 1 = Knowledge, 2 = Wisdom, 3 = Understanding Freedom, 5 = Justice, 6 = Equality, 7 = Food, 8 = Clothing, 9 = Shelter, 10 = Love, 11 = Peace, 12 = Happiness. She is also critical of his street fashion (fat shoe laces and tri-colored sneakers), a final insult that pushes RZA to openly question her integrity and authority.

Leshell Hatley, who earned undergraduate and advanced degrees in engineering, talked about her experiences as a hip hopper in high school classes that were consistently incompatible with her culture. For her, academic success meant overcoming this disconnect, while navigating how she and other hip hoppers engaged in resistance. Part of her strategy was to find spaces in school environments, but outside of classrooms, to convene and engage in aspects of hip hop culture. Hatley applied those alienating experiences to how she now treats hip hoppers in the science education programs she now directs:

Right now, even [directing] academic camps and stuff like that, people say, 'Make sure you have an application process.' and 'Make sure you have the best; the cream of the crop.' and 'You don't wanna deal with the students who, may not feel like working that day or their grades are the poorest.' And I'm like, 'No, I want everybody! And anybody!' Even if their parents are making them come, they'll be able to learn when they come out of here, know what I'm saying? They should still be able to walk away with something.

The program in which Jeff teaches was created as an alternative for students who are interested in science, but often do not find their interests cultivated in traditional science classes. His formal school learning experiences were often unwelcoming to him as a hip hopper as well. He said that he spent “a lot of time” in his classes sleeping as a part of his resistance. Laughing, he stated, “If somebody would have said, 'Hey Jeff, why don't you write a rap to help you remember these symbols on the Periodic Table?' I might have been interested, you know?”

As a result of conducting research on hip hoppers and the reasons for their resistance in schools Emdin declared (2010):

In my work, I find that for members of the hip hop community, the choice to become disinterested in what is going on in the classroom or to not listen to the teacher is a function of how trivial they think the classroom is, and the fact that they perceive they are superior to even an academically challenging class. In conversations with these students, they neither refer to a fear of or an inability to engage in academic work, nor do they mention a fear of acting White. Rather, they speak about their strengths, the weaknesses of their school, and the inabilities of their teachers to be effective. (p. 10)

Emergent Connections and Concepts from the Philosophical and Pedagogical Models:

Three different levels of interrelationships emerged from analysis of the models and the connections among them (see Figure 1). The first tier includes the strongest relationships between the interview data and the hip hop texts. The emergent themes in this tier provided insight into the perceptions of the interviewees and hip hoppers of hip hop philosophy or hip hop worldview, and how they relate to Hip Hop-Based Education. Although robust, second tier connections were not quite as strong as the first tier. These data indicated how hip hop pillars provided a foundation for the hip hop philosophy alluded to in the first tier. The third tier is

comprised of how the interviewees and the texts regarded connections between hip hop culture and teaching practices. While the connections in this tier were not as strong as they are in the first and second tiers, they were significant nonetheless.

There were also connections made in the interviews that were not found in the hip hop texts. These connections included explanations of how pedagogical constructs inform each other. They are presented at the end of the section.

Hip Hop Philosophy, a Hip Hop-Worldview, and Hip Hop-Based Education

All of the interviewees and four of the seven hip hop songs made significant references to how hip hop positively influences or has the able to positively influence HHBE. The most commonly referenced corresponding concepts were Hip Hop Culture, Hip Hop Epistemology, and Hip Hop Science. Explicit references to hip hop pillars were categorized as Hip Hop Culture, references to knowledge conceptions from hip hop culture were categorized as Hip Hop Epistemology, and references made to hip hop worldviews were categorized as Hip Hop Science.

In “The Science,” Murs tells the story of DJ Kool Herc and the origins of DJing and turntablism as a function of what was happening in community schools. He raps, “Inner city schools stopped teaching us instruments / We took turntables and started flippin' it / Stole electricity from the street lights / Plugged it into a system and made the beat hype.” Later in the same verse, Murs declares, “Now if that ain't science I don't know what is / The ingenuity of these young black kids.” This ingenuity includes a response to a systemic reduction in resources, and resulted in the re-conception of the turntable as a musical instrument. For students who do not have access to horns, violins, drums, or guitars, nor the financial resources for lessons to learn to play them, hip hop provides a method for using these instruments in music by playing

their sounds on a turntable. Bettina Love called this hip hop-ingenuity, “the latest, greatest iteration of Black genius.”

Chang (2005) also invoked science rhetoric in describing how Herc’s ingenuity reconceived turntables as musical instruments. Regarding Herc’s method for continuously playing breakbeats for B-boys/girls, Chang explained:

Like a string theorist, Herc zoomed in on the fundamental vibrating loop as the heart of the record, the break... In a technique he called ‘the Merry-Go-Round,’ [he] began to work two copies of the same record, back-cueing a record to the beginning of the break as the other reached the end, extending a five-second breakdown into a five-minute loop of fury, a *version* excursion. (p. 78)

During his interview, Emery Petchauer talked about the process of becoming a DJ and his experiences learning turntablism. He recalled how he learned the science of DJing as an apprentice to his friend Ronnie, and by trial and error:

When I first started, I would come on at the end of the night, and as time went on, I got on earlier and earlier, to where there's actually still people there!... And that’s like a raw place to cut your teeth; it's not like I was in the basement alone... So from Ronnie—I got my training and my expertise in DJing from him—I mean, I spent a lot of time in the lab alone [by] myself, and then with him, before I could come out on my own and play for a crowd. But you know, I had to build up my record collection, I had to get where I had a rotation [of music] before I came out of the house.

Petchauer’s experiences of being an apprentice and learning from a more knowledgeable hip hopper are indicative of how other the interviewees and the texts connected a hip hop worldview and conceptions of knowledge.

The data also showed a strong connection between hip hop culture and hip hop epistemology, another association indicated in Petchauer's story about becoming a DJ. All of the interviewees and the hip hop texts used hip hop pillars to describe knowledge constructs within the culture. For example, Ice Cube's "A Bird in the Hand" is a reference to the value of street entrepreneurialism vis-à-vis selling drugs (birds) as opposed to low-wage employment. The song tells the story of a young man who has done well academically in high school, but cannot afford college. As a young father, he is now faced with the challenge of raising a child on a minimum wage income. Ice Cube raps,

But there's no SC for this youngsta
I didn't have no money, so now I got to punch the
Clock, gotta slave, and be half a man
But whitey says there's no room for the African
Always knew that I would clock G's
But welcome to McDonalds may I take your order please
Gotta serve ya food that might give you cancer
Cuz my son doesn't take no for an answer
Now I pay taxes that you never give me back
What about diapers, bottles, and Similac
Do I have to sell me a whole lotta crack?
For decent shelter and clothes on my back?
Or should I just wait for help from Bush
Or Jesse Jackson, and Operation PUSH
If you ask me the whole thing needs a douche

A Massengill what the hell crack will sell in the neighborhood

The man in Ice Cube's narrative ultimately makes the choice to sell drugs. His decision to do so is not simply a monetary one, however. It is conflated with notions of Black humanity in the context of racism ("...gotta slave be half a man / But whitey says there's no room for the African"), and an indictment of the culpability of both Blacks and Whites in political chicanery ("Or should I just wait for help from [President] Bush / Or Jesse Jackson and Operation PUSH"). The way Ice Cube positions street entrepreneurialism gives insight into how hip hop often values street knowledge over mainstream and academic or school-based knowledge.

David Banner's "Malcolm X (A Song to Me)" also addressed street entrepreneurialism and street knowledge, but used a different technique in doing so. He declared,

This ain't 'bout y'all, it's about me

My soul, our kids

White folks, their dope and our cribs

Big chains, big whips

'Round your neck and our wrist

No bullshit, no mystery

A man ain't shit on this Earth without history

Banner indicts not only systemic economic oppression, but his own role within it. Like Rakim, he refers to drugs as coming from outside of the Black community. But unlike Rakim and Ice Cube, Banner used metaphor ("whips" means "cars" in *street language*) to directly challenge Black participation in drug dealing. He places street knowledge in contrast with self-knowledge (i.e. history), describing the latter as essential to existence.

Christopher Wright provided another example of how hip hop pillars inform its conceptions of knowledge. He related a story about a science lesson he created that combined *street fashion*, anatomy, and physics:

I was in the classroom and there was a group of young [hip hoppers] and I could see every other day they had a brand new pair of shoes, whether it was Kobe Bryant's shoes or Kevin Durant's shoes, you know? It was a big part of who they were. And so I took that particular interest and came up with this project called 'Tightening Up Your Shoe Game.' The goal was for them to take biology—the anatomy part—and think about it on their own terms. This was stuff that they already do anyway, so now instead of just being the consumers of an actual tennis shoe, they now see why these shoes are made, how they're made for a particular purpose. And, they liked that part about designing a shoe for your actual foot; you know, the aesthetic part. So for them, that showmanship aspect of hip hop is such a part of who they are, but now I'm taking that to see, okay what's the science side? Or the engineering side? Or the design side? It makes things relevant.

Wright's anecdote gives insight into an essential criterion of knowledge in hip hop culture (i.e. personal relevance), and the connections between its value and its applicability to hip hop experiences.

In *The Five Percenters* (2007), Knight describes the creation of "Supreme Mathematics," another aspect of the Five Percenter numerology system that complements the 12 Jewels of Islam. He recalls a conversation he had with Abu Shahid about "sciencing out" (how Five Percenters describe the process of building new understandings) Supreme Mathematics, and Shahid's denial of an alleged argument with Allah about the process (Knight, 2007):

Shahid understood Knowledge to be the foundation of all things, and thus assigned it a mathematical value of 1. Wisdom (2) was the application of Knowledge, and Wisdom added to Knowledge produced Understanding (3)... Abu Shahid denies the legend that he and Allah argued for three days over the proper placement of Knowledge and Wisdom, with Allah advocating Knowledge-Wisdom and Abu Shahid favoring Wisdom-Knowledge. 'How can you have Wisdom,' Shahid asked me, 'if you don't *know* a goddamned thing' (sec. 1362).

Knight's story of the sciencing out of Supreme Mathematics coincides with Wright's experiences with hip hoppers in a science class, and their congruent views on the value of knowledge.

A third prevalent theme that from the data in this study was the connection between epistemological constructs and worldviews in hip hop. Within this theme, there was a difference between how the relationship was described in the interview data and how it was defined in the hip hop texts. The interviewees spoke of how hip hop epistemology informed a hip hop worldview, while the texts simply mentioned the connection without ascribing directionality.

In his interview, Stic.man used an analogy from his study of martial arts to define the relationship between hip hop conceptions of knowledge and its worldview. These conceptions of knowledge are similar to those Christopher Wright spoke about in relation to its practical application. Stic.man explained,

The philosophy of Jeet Kune Do is very, very similar to hip hop if you look at it as a worldview, because most of the martial arts like karate, Taekwondo and others, have their own traditions. 'It's been this way for thousands of years, and that's how we're gonna keep on doing it.' You know, hold your arm down by your waist and punch [with the other arm], even though somebody could punch you in the mouth, because that's how

we've been doing it, right? So Bruce Lee came along and said that doesn't make sense in a living, real world in terms of fighting and in terms of developing yourself. You don't wanna be stuck in that [type of tradition]... So he studied Muhammad Ali's footwork, he studied the French martial art Savate, he studied the Filipino martial art Kali... across the board—Wing Chun Kung Fu—all of these things... And what his worldview helped to do was to break the notion that tradition is *the* way. He said creativity and innovation are more alive. And I see that same inspiration in hip hop in how we sample and put things together. That knowledge piece is what connects our culture to everything.

Similar to combining multiple types of music on turntables to create hip hop music, Stic.man indicates that hip hop epistemology is a way to make connections that have practical applications. This conception reinforces Abu Shahid's insistence that wisdom is the ability to apply knowledge experientially, and that knowledge must first inform an applied worldview.

Jeff Arthur talked about using hip hop knowledge to make connections in the classroom, and the importance of doing so for his students. He stated,

Before hip hop came about, if you grew up poor or you grew up in a certain neighborhood, there might have been a shame or an embarrassment or stigma to that... Part of what hip hop has done is celebrate the good things in the communities [hip hoppers] come from. And, that has been leveraged to celebrating things that you find in yourself.

Arthur went on to use an example involving actor and Grammy-nominated hip hopper Donald Glover (who performed as an MC under the stage name Childish Gambino) to illustrate this point. Glover, a graduate of New York University's Tisch School of the Arts, often rapped about topics not regularly associated with urban youth. Arthur explained that,

[E]ven a guy like Childish Gambino, [who] doesn't come from an impoverished neighborhood, but he takes things that traditionally urban kids would have been embarrassed about, like being a nerd or talking a certain way, and he celebrates that in his music. So I think that part of a hip hop worldview is taking the organic parts of oneself or one's surroundings and celebrating them; bringing them to the forefront.

In "State of Grace", Talib Kweli raps about these introspective aspects of a hip hop worldview and epistemology, but does so without making epistemology a precursor to a worldview. This song is about the complicated and often adversarial relationship between women and hip hop, told in three interrelated stories. The first verse is about a young woman who comes to love hip hop culture:

Raising up like a flag when it's unfurled
Got game listening to her mother's pearls
And she love Beyoncé 'cause she run the world
Her mama used to run this city
Way back before the nigga Puff was Diddy
When it came to the music then she got real picky
From New York, but preferred Tupac over Biggie
No disrespect to Ms. Wallace, but she liked to do the knowledge
And she felt that Pac was more lyrical
Plus she never went to college
But she called herself 'Earth' found rhythm with the gods more spiritual
She God in the physical

Talib Kweli tells how this young woman learned from her mother's wisdom (Got game listening to her mother's pearls), and why she prefers Tupac's content over that of Notorious B.I.G. ("No disrespect to Ms. Wallace" is a reference Biggie's mother, Voletta Wallace) because it has more practical knowledge. The young woman subsequently becomes a Five Percenter.

Teaching and Learning in Hip-Hop Ways

A second theme that emerged from the data connected hip hop to classroom instruction. All of the interviewees provided examples from their own experiences or theorized how the pillars and worldview in hip hop can make culturally responsive teaching into hip hop-responsive pedagogy. Of all of the connections in the framework, the one between Culturally Responsive Pedagogy and Hip Hop-Based Education was the most common among the interviewees. It is included in the second tier because only three of the hip hop texts made this same connection, and it occurred in much smaller magnitude.

Jeff Arthur made this connection in responding to the question about advice he would give to educators in formal learning environments:

I just would hope that traditional classrooms - where [young people] spend the most of their time [learning] - take cues from some of these alternative learning environments and try to meet students where they're at and validate [hip hop] culture and things they find important instead of shunning them. It just makes the learning more relevant.

Bettina Love also spoke in general about the importance of hip hop-responsive education for all students in urban areas. She explained:

When I think about HHBE, I think... you know... it's one of those ways in which we're trying to bring clarity and some understanding to our students, particularly urban students. And not urban students as just Black, but *urban* students... because when I

think about urban I don't think 'Oh these are Black students,' I think about students who are growing up engaged with many languages, engaged with many cultures, engaged with many ethnicities and religions, and already are multifaceted. They do improv and are creative.

Love suggested that using HHBE as culturally responsive teaching practice can engage students from multiple urban experiences and identities, while maintaining extemporaneous and artistic elements from their cultures.

Leshell Hatley provided both depth and boundaries to HHBE as a culturally responsive pedagogy. From her experiences as a science teacher, she cautioned:

In a cypher, it's the person in the middle who is shining. While [students] are learning [in the classroom] though, they don't necessarily want to be the one in the middle with all the attention. That, you know, bold 'I'm gonna show what I know or who I am' identity doesn't necessarily work well when everybody is learning something for the first time. They'd rather all go up at the same time, or take turns, or go in pairs.

In “‘They’ Schools”, M-1 raps about teaching that is hip hop-responsive, and the consequences for hip hoppers when it does not incorporate hip hop pillars and worldviews. He described these consequences stating,

Observation and participation, my favorite teachers
 When they beat us in the head with them books, it don't reach us
 Whether you breakdance or rock suede Adidas
 Or be in the bathroom with your clique, smoking reefer
 Then you know they math class ain't important 'less you adding up cash
 In multiples, unemployment ain't rewardin'

They may as well teach us extortion

Contrary to antagonistic perceptions of HHBE, Pardue (Pardue, 2013) described the *Casa* in the city of Diadema as a positive environment in which Brazilian hip hoppers could learn. The *Casa* is a place where local and internationally-known MCs, DJs, B-boys and girls, and other hip hoppers meet regularly. They create and participate in free workshops and cyphers that emphasize “*na moral*,” which in English means “in solidarity.” DJ Preto EL, one of the instructors there, explained to Pardue (Pardue, 2013) how HHBE worked at the *Casa*:

One of the most important points [of the *Casa*] to me is that I [as a teacher] do not consider myself as the master with all the answers. In our discussions, I try to create a scene where [the students] feel comfortable in contributing. And, in fact, they do help me build up my own knowledge. This is significantly different than what happens at the formal school, where kids come and the idea is that they come to add up (*somar*) with a group. The teacher or educator serves as the bait or ‘start’ for the students to speak out, to express themselves, and to see what they could or did not see before due to social or other forces. They begin to speak their minds. This collective effort is what we call *vivência*. (p. 147)

Pardue explained that *vivência* is “a reassemblage of very real Brazilian experiences and categorical skills” (Pardue, 2013) that comes from using hip hop pillars to engage in political and social justice.

Talib Kweli provided some guidelines for the application of HHBE, and lauded its utility in teaching. In the second verse of “State of Grace,” he described the educational experiences and aspirations of a female hip hopper:

She wanna to be the first in her family with a higher education

Her entire graduation was a dire situation

Did a paper on the state of the hip hop generation

But no longer felt a part of the conversation

He continued, describing her growing ambivalence toward hip hop, despite having been the beneficiary of HHBE in the classroom. She is victimized in an incident committed by a male artist, and Kweli used this anecdote to impugn chauvinism in hip hop:

You can bump it or dump it, the artist she trusted

Just broke her heart, so misogynistic and disgusting

She tried not to judge him, in her heart she still loved him

And the way that he lusting, a part of his suffering

And this young man, clearly not ready for the harder discussion

Another second tier connection derived from the data was between Hip Hop Science and Sociocultural Constructivism. All but one of the interviewees, and five of the seven songs mentioned concepts that are part of both philosophies. This was the first strong connection that lacked directionality. The data contained no references about how hip hop philosophy and sociocultural constructivism could influence each other.

This connection was made was most commonly made through explanations of how knowledge in hip hop is constructed. Summing up this concept, Stic.man said:

Knowledge in hip hop is just the awareness, the openness to learn, right? The keen eye to be aware of things so you can be creative... If you don't have knowledge, you don't have tools for your creativity, right? So the knowledge is that open door part of creativity To put words to it, I would say [conceptions of] knowledge in a hip hop worldview is a sampling-remix mentality. You know, hip hop was created out of pieces of this and

pieces of that and remixed into their new form. So hip hop is also a recycling, sustainable, guerilla art, because it lives off things that already exist.

Rakim in “Teach the Children” also raps about building knowledge, adding his notions of its utility. He ends the song with:

So keep on building, ‘cause we gotta keep building

Til the answers are filled in

And make sure you don't stop till then

And if you do, remember the children

Rakim’s reference to building knowledge as a form of teaching is iterated by Masta Killa in the song “School.” The song begins with Masta Kills arriving at school with a paper he has written the previous evening:

Headed my paper with the proper title

Who wrote the holy Koran or Bible?

Bein' that person with the sent ability

Makes me responsible for the uncivil

The next morning as I entered the building

A cypher goin' on and the Gods is building

His description of himself as a “person with the sent ability” and a responsibility to “the uncivil” is a reference to one of the core beliefs of Five Percenters. In addition to calling themselves a “Nation of Gods and Earths,” they also refer to themselves as “poor righteous teachers.” This is from their ideological beliefs that 85% of humanity lacks vital knowledge (often referred to as “85ers” or “uncivilized”), 10% of humanity has that knowledge but hides it from the masses, and they are the remaining 5% who are the poor, righteous teachers, tasked with enlightening the

masses (Knight, 2007). The RZA recounted how he challenged his teacher's specious lessons with his own knowledge. As a fellow Five Percenter, Masta Killa has a similar obligation toward the 85ers, so his paper on religion helps serve that purpose in a school environment that he and RZA described as culturally and intellectually inhospitable. In "School," the cypher is a place where Masta Killa, RZA, and other Gods insulate themselves from specious lessons, and build knowledge that helps civilize the 85%.

In Supreme Mathematics, the number 8 simultaneously represents Build or Destroy. Michael Muhammad Knight (2007) wrote about building with Serenity Refine, a woman who was a member of the Nation of Gods and Earths. As a writer, she constantly challenged the chauvinism to which she and other women were subjected by fellow male Five Percenters, and in society at-large. For example, in one statement she declared:

In this society we live in we are constantly bombarded with images of half-naked females who leave nothing to the imagination but just endeavor to create the feelings of lust in their male counterparts. Serenity Refine complements her Refinement (5) with Knowledge (1) and Wisdom (2) to *born* Build or Destroy (8). 'Build' means to add positivity; to 'Destroy' is to rid the self of negative things, in this case, [Serenity Refine continues] 'separating yourself from the 10% ideal of what true beauty is, having enough confidence in self and rebuild and construct a new positive representation of the Black woman.' (Knight, 2007, sec. 5368)

Vygotsky theorized that there were both biological and cultural aspects to the development of learning in children, but departed significantly from other psychologists in explaining how these two aspects interact in children. While most were emphasizing the

importance of genetics, Vygotsky emphasized the cultural aspects. Comparing the two, he wrote:

They are characterized by a new integration and co-relation of their parts. The whole and its parts develop parallel to each other and together. We shall call the first structures *elementary*; they are psychological wholes, conditioned chiefly by biological determinants. The latter structures which emerge in the process of cultural development are called *higher structures*... The initial stage is followed by that first structure's destruction, reconstruction, and transition to structures of the higher type. Unlike the direct, reactive processes, these latter structures are constructed on the basis of the use of signs and tools; these new formations unite both the direct and indirect means of adaptation. (Vygotsky, 1978, p. 123)

Vygotsky's description of learning through cultural development as a process based upon building and construction connects to the multiple conceptions of knowledge and learning within hip hop culture.

Another prevalent connection between hip hop and sociocultural constructivism in the data was the conception of how quality teaching occurs. Emery Petchauer's explanation of his own apprenticeship in learning to DJ led to him later discussing how he applied that concept in his own teaching:

There are never two weeks that go by where I'm not either going to a [hip hop] spot or talking to somebody and we're building. I go check this out or that out. I've been in Detroit two years and that's a part of it. I'll be working with kids, and these are like, 15, 16, 17 year-olds, don't know Pharoah Monche. They're doing Nae Nae videos, they're

into like Chief Keef and all his dudes, and I'm like, 'It's all still hip hop! It's all still hip hop!'

Pharoah Monche is a MC who is known for his lyricism and making social commentary in his music, while The Nae Nae is a dance associated with popular rap music that rarely contains complex or political content. Similarly, Chief Keef is a Chicago MC whose simple rhyme patterns and choruses are popular in party rap as well. Petchauer was purposeful in describing the political and non-political hip hop music as all being part of hip hop culture to the teenagers with whom he works. This inclusivity helped position him as a Head for these hip hoppers, who were often maligned by older hip hoppers for their preference of hip hop songs that are not socially conscious. Petchauer continued:

I was working with a student, and I'm like, which Detroit artists do you like? And he's telling me [who he listens to] and I'm like, 'Have you ever heard of Slum Village or J Dilla?' And he's like, 'Nah, where are they from?' And I was like, 'They're from here, and if you give me two artists, I'll check them out this week and I'm gonna give you these two and you can check them out and we'll meet back up.' I wasn't like, 'Son! You from Detroit and you never heard of... WHAT?!?' I couldn't do that to him, because that would push him away. And I think that if you try to always school them [with], 'You should listen to this' or 'Well I bet you didn't know this Nae Nae dance move comes from that,' because I feel like if you do that, young [hip hoppers] feel like you're taking [the culture] away from them.

Petchauer validated his position as a Head because he was willing to listen, learn, and guide simultaneously. He also understood the hip hop and sociocultural constructivist ideas of

building, destruction, and reconstruction of culture as occurring through how young hip hoppers engaged with hip hop pillars.

David Banner in “Malcolm X (A Song to Me)” gave a different perspective on building, destroying, and teaching. The lyrics are an admonishment to himself about his role as both a builder and destroyer for younger hip hoppers, which is referenced in the parenthetical portion of the song title. In the hook (chorus), he raps:

I don't wanna teach him how to sell, chop and cook, yay up
All my favorite rappers either dead or in jail
I don't wanna teach 'em, I don't wanna teach 'em
I don't wanna teach 'em, I don't wanna teach 'em
Don't wanna teach these little girls to put their pussy on the pole
And at the end of the night, get that money off the floor
I don't wanna teach 'em, I don't wanna teach 'em
I don't wanna teach 'em, I don't wanna teach 'em
What about Patrice, Malcolm, Huey P
I don't want these kids to grow up and be me
I don't wanna teach 'em

Some of Banner's most popular music, including the songs “Like a Pimp” and “Play,” made multiple references to violence and drug sales, and have misogynist lyrics. He has also made entire albums and media appearances to decry the same, and has been a vocal proponent for social justice. This dichotomy is represented in the lyrics for the hook in “Malcolm X.” Banner takes himself and other hip hoppers to task for destroying rather than building through their music. He offers Patrice Lumumba, Malcolm X, and Huey P. Newton as builders of culture and

teachers who youths should emulate. Banner's status as a Head is predicated upon teaching younger hip hoppers what he believes they should not do within hip hop culture.

Vygotsky's (1978) described his theory that learning in children is facilitated by someone capable of acting as an intermediary describing the developmental space between their ability to do an intellectual task by themselves and their complete inability to do that task as, "the distance between the actual developmental level 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, 1978, p. 87). Further establishing the role of these more capable peers, he wrote, "Learning awakens a variety of internal developmental processes that are able to operate only when the child is interacting with people in his environment and in cooperation with his peers." (Vygotsky, 1978, p. 89). His sociocultural constructivist notions of development as the culturally-guided process of building, destroying, and rebuilding understandings and the role of more knowledgeable others are congruent with the cultural conceptions of building, destroying, and teaching in hip hop.

Hip Hop Connections to Pedagogical Philosophies

The third theme that emerged from the interviews and hip hop texts connected hip hop philosophy to pedagogical philosophies. This tertiary set of associations differs from the prior two, as the differences between the strength of the connections in the data sources became prevalent. This theme was represented predominantly in the interview data rather than the hip hop texts, but was still present in both.

A consistent way the songs and interviewees referred to Hip Hop-Based Education was how it is informed by hip hop epistemology. Stic.man talked about the challenges of hip hop-

responsive education, Lil Wayne, and some of the common themes within his music related to of hip hop pedagogy. He stated:

The problem isn't that [hip hoppers] can't learn, the problem is that the system won't allow teachers to use Lil Wayne's body of work to teach basic principles. And it's a culture problem! It's your culture that we tell you to stick in your back pocket. And they tell you, 'that's not appropriate for school' and 'it don't belong here,' and they shove their culture down your throat.

He then presented a hypothetical lesson that is hip hop-responsive:

[A teacher] may have a unit on Shakespeare: Here's your homework—find two Wayne songs that have the theme of revenge in the character he's portraying. So now, it's like, 'my teacher is cool' and you're getting that Shakespeare shit, but you're getting jewels too!

The connections Stic.man made between hip hop-based education and hip hop epistemology combined multiple themes regarding hip hop and pedagogy, concluding with a reference to Five Percenter epistemology.

In the song “School”, RZA (birth name, Robert Diggs) challenges his teacher by asking a series of rhetorical questions:

Why don't we speak about the wisdom of the sages?

And how did Europe black out in the dark ages?

And when they got light did they white-wash the pages?

And the Inquisition, why was Christians thrown in cages?

And why would they try to destroy the nation?

With their birth control and brain control fluoridation?

And why it seems that half the school is racist?

She said "Diggs, to the office!" We about faces...

RZA's rhetorical, Socratic questioning of his teacher is a pedagogical method consistently used by Five Percenters in their lessons. He delves into conspiracies that include the proliferation of birth control, the addition of fluoride to water as means of subverting national integrity, and indicting racism in his school. Being removed from class and sent to the school's administrative office was a logical conclusion to his act of rebellion, and indicated the consequences of pedagogy that is antagonistic to hip hop epistemology.

Another prevalent connection within this theme was made between hip hop epistemology and constructivist scientific inquiry. Leshell Hatley provided a statement about how this concept was applied in her classroom. She said, "My definition of applying hip top to STEAM education doesn't always mean - or may never mean – having rap music in the classroom... Yeah it works to make things rhyme, but can [students] express what they mean and apply it to the class?"

Bettina Love talked about the importance of educators recognizing how science and scientific inquiry appear naturally in hip hop culture. She challenged the notion that STEAM educators would struggle to find how hip hop relates to science:

For me, it's not even about 'linking' hip hop. It's more about kids understanding that the things you do in your community every day are science. Even when young girls get their hair done. And Auntie or their cousin does their hair in braids, and the braids are just like, unbelievable! And we say, 'It's cute,' but look at the symmetry! The shapes in their hair! And nobody has a ruler, and it's perfect!

Jeff Arthur also stated that hip hop worldviews can be incorporated into scientific inquiry. He gave an example of it in practice from his own teaching experience:

Traditionally how you would teach Photoshop is, you would open the program, you would take them to the "Tools" (menu), you know, and you would work from there. But in our program, we start with a question, 'Who's your favorite rapper? Okay, let's put your head on their body.' Or 'Let's put you with them on their album cover or on stage with them.' So you're making the whole experience much more authentic. We also do robotics and 3-D modeling as well, and they have 3-D printers to print stuff out. So, in validating their worldview, [students] may decide to design a gold grill in 3-D, something from their immediate [hip hop] culture, and print it out. The experience is authentic and they're applying their worldview to what they're learning. And it's validated [in the classroom]. Somebody hasn't said, 'Don't bring any of that ghetto culture nonsense in here!' It's, 'Bring whatever you want to in here!'

These examples illustrate Emdin's (2013) *context incorporation* aspect of reality pedagogy. The use of artifacts, such as the designs in a student's hair or the jeweled teeth covers (grills) popularized by hip hop culture, are vital to STEAM pedagogy. Emdin explained that, By bringing [hip hop artifacts] into the classroom and connecting their use in hip-hop culture to science, the instruction becomes relevant, and youth are more keyed in to the content. [Context incorporation] also involves using analogy and simile in the same ways that rap artists use them in lyrics. In science, this involves providing understandings of science concepts by first connecting them to concepts related to student culture. (p. 21)

Congruently, STEAM education in the hip hop texts was valued in a sociocultural constructivist manner, with regard to its ability to address issues affecting urban environments. This reflected a lack of directionality in the relationship between the two concepts, as sociocultural constructivism and Hip Hop Science were not described as having an influence on

each other. Instead, there were mentioned in terms of aspects they had in common. For example, Murs offered a traditional view of scientific inquiry before applying it through a hip hop worldview in the first verse of “The Science”:

The systematic knowledge of the physical world
Gained through observation and experimentation
Usually beginning with a hypothesis
Or what some may call an estimation
Record your results from a series of tests
And what you're left with is a theory at best
Now let me give my hypothesis, an educated guess
On why my people on the whole seem to be such a mess
Genocide: the deliberate extermination
Of a race, culture, or an entire nation
Centuries ago they brought us here on a boat
Enslaved us, beat us, til our spirit was broke
Then they gave us freedom and a little bit of hope
Then they killed our leaders and they gave us dope (crack)

In “Teach the Children,” Rakim similarly offered STEAM education as a prescriptive measure for improving urban neighborhoods. He rapped, “Equal opportunity / Self- awareness and unity / Education, the kids need a sculpture / Teach them the abacus and their culture / And that'll help stop the robbing, raping and killing / Poison, neighborhoods are illing.”

Emdin (2010) summed up the connections between hip hop and pedagogical philosophies with his statement about the hip hop worldview in STEAM education:

In order to move beyond the current state of urban science education, and move towards more actively fostering effective science instruction in urban schools, an effort must be made to look at hip-hop as the ways that urban youth make sense of the world. In addition, the structural similarity between the ways they view the world and the way that scientists make sense of the world have to be explored. In this view, a more cultural view of both science and hip-hop allows the teacher and researcher to see them both as entities rooted in the schema and practices of different groups of people. This serves as another way that both science and hip hop are inherently connected to each other. (p. 32)

Convergent Pedagogical Philosophies

The interviewees, six of whom are formally trained educators, all discussed the pedagogical models from the proposed theoretical framework. The most common references concerned how to connect Culturally Responsive, Hip Hop STEAM, and Constructivist Science Pedagogies. In explaining hip hoppers, their identity in relation to science, and the important role educators play in fostering this relationship, Christopher Wright declared,

If you are a science teacher, not only are you responsible for content, but you're also responsible for how your students see themselves as being potential scientists or their relationship to science. And so if you present things in a way that make it seem like their culture isn't a part of what science is, you're going to turn them off.

Bettina Love also talked about the origins of Wright's assertion and how STEM disciplines have been exclusionary toward hip hoppers and other marginalized groups. She suggested,

We have to look historically who science has been for. Science has been for White males. And even if you look at White women, they've been excluded from science. And if you look at the White men in science, we're talking about men who often come from

affluent families and go to really good schools. So I think when you bring in race, class and other aspects of culture, on top of it being exclusionary, where does that leave us Black and Brown people?

Jeff Arthur described how STEAM teachers in his program counter this historical marginalization and nurtured hip hop-identity in science as students are taught to use technology:

If a student raps, or does spoken word, or sings, we teach [him or her] how to use professional software to record it. It's about validating their passion and using the technology as the vehicle to get them on the educational or career paths they want to pursue.

Another connection interviewees made was between Sociocultural Constructivism and Constructivist Science Pedagogy. They specifically placed science pedagogy within a constructivist orientation. Leshell Hatley was asked about giving advice to future and current STEAM educators. Her response included the importance of constructivist pedagogy and how it prioritizes understanding over vocabulary:

It's more important that students understand the concepts before they understand the specific science terms and vocabulary. I think [traditionally taught] vocabulary kinda trips people up and most people say that is typically the first thing you learn when you're learning something new is the vocabulary. But, if students [are trying to] use words that have [root] words and prefixes they haven't even heard of, and they don't do well doing it, they're definitely not gonna wanna find out what [those words] mean and how they apply. So in the classroom I would certainly suggest that teachers reinforce the concepts; what's really happening, why are we doing this, and why are we doing it in this manner? What's the purpose?

Vygotsky (1978) theorized that language and speech are fundamental to how children learn. Because they are intertwined, beginning an activity by attempting to name it and its components is confounding. He wrote:

Children confronted with a problem that is slightly too complicated for them exhibit a complex variety of responses including direct attempts at attaining the goal, the use of tools, speech directed toward the person conducting the experiment or speech that accompanies the action, and direct verbal appeals to the object of attention itself.

(Vygotsky, 1978, p. 29)

Prioritizing the purpose and the conceptual aspects of scientific inquiry, while de-emphasizing the memorization of words as Hatley advised, keeps students from being compelled to engage with new experiences using unfamiliar vocabulary. This method of teaching is consistent with Vygotsky's theories of how children learn.

Love demystified scientific inquiry by describing it as recurrent trials and errors while searching for a better understanding of a problem. She associated this to technological developments and opportunities in STEAM for hip hoppers. Love used the processes involved in producing scientific inventions to make her point:

Look at the dot com millionaires and how many times they had to fail. How many iterations of their apps and programs did they go through? Think about how much time that takes and the knowledge base you have to have. And you have to have the ability to fail! Science is about failing. It's about trying something over and over and over again. And in this day and age, that is something Black and Brown folks can't afford to do. If we fail once, we fail on behalf of all of us. And none of us get another chance.

Emdin (2010) suggested that these opportunities are embodied in constructivist and sociocultural nature of hip hop STEAM and culturally responsive pedagogies. He advised that the needs of hip hop youth in urban science classrooms must be met more effectively:

To meet the larger goal of addressing the needs of hip-hop youth in urban science classrooms, urban science education must allow for the growth of a distinct academic field aligned to, yet separate from, science education where social injustice and the unaddressed sociocultural issues that perpetuate these injustices are addressed. This reframing of urban science education is a large-scale effort that requires a push to reconstruct what is considered scientific knowledge and employ strategies that foster new approaches to pedagogy. In this effort, the knowledge that is named as hip-hop science is considered part of traditional science. This new and more culturally rich science curriculum is focused on the ways transactions (exchanges of ideas, culture and understandings) occur in the social lives of students and considers them in the pedagogical approaches in the classroom. (Emdin, 2010, p. 115)

Summary

The six themes that emerged from analyzing the interview and song data were presented in this chapter. The first two were the employment of a CRT analytical framework, and the emergence of hip hop resistance to education as another analytical framework. The interviewees and the songs consistently used aspects of Critical Race Theory in describing their perceptions of education and society in general. They also emphasized the resistance to conventional learning environments in hip hop culture. The relationship between hip hoppers' worldview and how teaching and learning should occur in schools was strong enough to be considered a distinct analytical framework.

The themes embedded in the connections between pedagogical frames were presented next. They were not completely discrete, and varied in the amount of overlap that occurred between them. The connections between philosophical constructs in hip hop culture and how they inform hip hop-responsive education were the strongest, and also appeared most consistently in the data. Second to that was the theme involving how hip hoppers teach and learn. The third emergent theme involved how hip hop connects to culturally responsive and constructivist pedagogical philosophies. The fourth theme was found only in the interview data, and dealt with perceived connections between all of the pedagogical philosophies in the study.

Chapter V –Summary, Discussion, and Recommendations

This chapter is organized into five sections. It begins with a summary of the study, which includes overviews of the purpose, methodology, research procedures, and findings from the collected data. Next is a discussion of the themes that emerged from those data, how they apply to the originally proposed framework, and the revised theoretical framework based on these themes. The discussion section also includes descriptions of the theoretical models for Hip Hop Science and Hip Hop STEAM Pedagogy that were elucidated by the results of the study. The limitations of the study are presented in the third section of the chapter, followed by the significance of the study. The chapter ends with recommendations for future research on hip hop and its connections to STEAM pedagogy.

Summary

The purpose of this conceptual study was to examine intersections between hip hop culture and worldviews, and culturally responsive pedagogy in STEAM education. The hope was these analyses would generate insights that could be used to begin crafting a theoretical framework for Hip Hop STEAM pedagogy. Ideally, this new framework would engage and benefit hip hoppers in STEAM classes, as well as students from mainstream cultures.

The study began with a proposed theoretical framework that demonstrated how seven philosophical, pedagogical, and analytical concepts could be combined to form two theoretical models (**Error! Reference source not found.**). There were 13 distinct connections in the framework, and they were organized according to strength and degree of directionality. The data used in this study were collected from interviews with six experts, the lyrics from seven hip hop texts, and analysis of five texts from traditional scholarship. Each of these sources included overlapping combinations of hip hop culture, culturally responsive pedagogy, sociocultural constructivism, and scientific inquiry.

Two qualitative research procedures, narrative inquiry and content analysis, were used to collect and analyze the data. This provided methodological triangulation for the study.

Narrative inquiry was used to interpret the data collected from the interviews. Each interview was analyzed three times to ensure reliability and validity. These interviews focused on creating narratives about the interviewees' areas of expertise and how they conceived and applied them in their lives.

Content analysis was used to interpret the data from the song lyrics and the traditional scholarly texts. The references made in them were analyzed in relation to the concepts and connections from the proposed theoretical framework. The lyrics of each hip hop text was analyzed three times, and the traditional scholarly texts were examined using a hermeneutic approach to content analysis. The use of these two sources helped triangulate the data collected in the study. The data from all three sources were combined and assessed using a mapping form of content analysis, which involved creating a new graphical model representing the revised framework.

The analysis of the data reinforced Critical Race Theory as an analytical framework for the study, and revealed another analytical framework about hip hop culture and its resistance to educational practices in schools. Other results included conceptions of how hip hop culture informs aspects of pedagogical practice in hip hop-responsive classrooms, and how knowledge and notions of realness in hip hop culture shape the ways hip hoppers conduct scientific inquiry. The data also made nascent connections between the pedagogical philosophies from the theoretical model and hip-hop perspectives.

Discussion

The primary research question in this study was whether hip hop conceptions of science

and knowledge are viable sites of pedagogical engagement for STEAM educators. This was addressed by analyzing theorized connections between pedagogical and philosophical concepts in hip hop and formal pedagogies. The data collected affirmed some of these connections, altered the conceptions of others, and revealed new connections that were not in the original theoretical framework. The themes that emerged from the data analyses also helped define the theoretical models for Hip Hop Science, which combines philosophical aspects of hip hop culture and scientific inquiry, and Hip Hop STEAM Pedagogy, a proposed educational approach that centers Hip Hop Science in STEAM Education.

Stories of Critique and Resistance

The six interviews and the seven hip hop texts created 13 total narratives by hip hoppers in this study. A recurrent feature within them was a critique of systemic and systematic inequities in U.S. society and schools. These stories named and reified their hip hop-worldviews in ways described by Delgado (1989) as fundamental to how CRT narratives are utilized by marginalized groups. The iterative theme of hip hop-resistance to hegemonic forces they discussed harkens to the birth of hip hop culture in the South Bronx, and the systemic resistance that became a part of the culture as it coalesced (Chang, 2005).

Hip hoppers carry these narrative critiques and resistance into their educational experiences. Stic.man summed up this perspective, stating, “For too many [hip hoppers], school is a place where their curiosity and their capacity to learn go to die.” Even hip hoppers in higher education, who demonstrated significant academic acumen in their formal learning environments, engage in acts of resistance that challenge the status quo at their schools. Jeff Arthur’s anecdote about Childish Gambino—a good student and so-called “nerd”—who described his unique form of rebellion against both traditional hip hop and school, illustrates the

multiple facets of resistance in which a hip hopper may engage. This implies that despite successes within educational institutions, highlighting systemic injustice is a central part of hip hop culture. It may come in the form of outright defiance, constant questioning, or CRT-style narratives about how schools inadvertently or purposefully limit opportunities for hip hoppers to experience the academic achievement afforded to mainstream students. These ideas are consistent with Au's (2005) description of how hip hop construes school in an oppositional manner, and they come from hip hoppers with a range of educational experiences and academic success.

The use of narratives, resistance to the status quo, and challenging mainstream systems work together to form an important lens through which hip-hop worldviews can be understood. For this study, it provides a rationale for re-positing resistance to formal education as an analytical framework instead of just a portion of hip hop culture. Although the songs used in this study were chosen for their references to educational topics, the fact that they went beyond the purview of formal education and into systems in general showed the centrality of resistance as a part of hip hop culture. Even the culture itself was not spared from this resistance and critique. Scarface, Nas, and David Banner used allegory in their lyrics to create narratives that were critical of hip hop. Bettina Love also confronted hip hop culture as being influenced by chauvinism, White male patriarchy, and racism. Talib Kweli combined these aspects, using allegory in his song to indict both hip hop and the effects of the oppressive structures that Love referenced. Hip hop is therefore not exempt from the hegemonic influences within U.S. society. This implies that ontological notions of realness in hip hop involve challenging both outside and internal forces within hip hop. This potentially supplements research by Low, Tan, and Celemencki (2013) on what "keepin' it real" means for hip hoppers, suggesting that it also

includes reflexive critiques in addition to the authentic and performative acts of resistance they observed.

For educators, understanding the prevalence and importance of resistance to systemic oppression in hip hop is paramount to understanding the hip hoppers in their classrooms. Because hip hoppers often consider school as a part of that oppression, teachers should expect them to engage in resistance. RZA's story of the young Five Percenter who is sent to the office for questioning his teacher's miseducation embodies the idea that acquiescence to these systems is antithetical to the core hip hop value of realness. This is not, however, to suggest that educators should tolerate or support all defiant behaviors hip hoppers may demonstrate. Leshell Hatley provided an effective approach that began with her stated desire to educate the students who are perceived as most resistant. She and the other hip hop-responsive educators in this study concentrated on making their learning environments particularly supportive of these students. Their institutional practices were based on the premise that the classroom is a systemic structure in which hip hoppers will often be wary and resistant. Instead of attributing resultant insubordinate and churlish behaviors among hip hoppers to pathology within hip hop culture, these educators welcomed hip hop-style resistance, and used hip-hop critiques to make their classrooms more amenable. This challenges deficiency models used to impugn marginalized groups (Banks, 1993), and may require a paradigmatic shift among educators, many of whom believe that hip hop is a negative presence and thus inappropriate in educational settings.

The Strength of Street Knowledge

The two strongest themes from the data connected philosophical aspects of hip hop to teaching and learning in both formal and informal settings. They provide insight into conceptions of knowledge within hip hop culture and a hip hop worldview, and help to define the

concept referred to as “hip hop epistemology” in this study. The data also included consistent references to hip hop pillars and how they relate to knowledge constructs within the culture.

The hip hoppers in the study all discussed the value of knowledge. One manner in which the value of knowledge was regularly demonstrated was through the use of the words “jewel” and “gem.” From more formal versions like the Five Percenter’s 12 Jewels, to Emery Petchauer’s description of the “gems” dropped on him as he learned to DJ, this particular reference was common throughout the interviews, songs, and academic texts. Not all allusions to knowledge in the study received this designation however. Only the knowledge that met KRS-One’s (2010) definition of *street knowledge* was equated with precious stones. This suggests that part of hip hop epistemology is the appraisal and prioritizing of certain types of knowledge. This is of particular importance in the context of a culture that normalizes resistance to formal education, because it counters beliefs that hip hoppers are against learning. In this study, knowledge was assessed based on its congruence with the pillars of hip hop, and its utility in challenging hegemonic structures. The protagonist in Ice Cube’s “Bird in the Hand” ultimately decided to engage in *street entrepreneurialism* through drug trafficking, a decision based largely on the uselessness of his formal education, the systemic oppression that limits his opportunities, and the fact that his street savvy provides a more lucrative and immediate way to financially support his family. While this may be interpreted as glorifying the selling of illegal drugs, Ice Cube’s denouncing of people in government and programs allegedly designed to help urban communities are indictments of systems that make *street knowledge* more useful in a shadow economy than in the economy in society at large.

Adding to the notions of assessment and valuation of knowledge in the study, David Banner challenged the application of street knowledge in selling drugs that Ice Cube addressed.

In “Malcolm X (A Song to Me),” Banner assailed hedonistic street entrepreneurship as being the function of a lack of self-knowledge. His lyrics inferred that Black self-knowledge, through understanding the legacies of Malcolm X, Patrice Lumumba, and Huey Newton, would deter people from challenging unfair systems through illegal means. Instead, they would be encouraged to employ the type of activism in which these three individuals engaged, as they fought for justice. Banner thus makes the case that the application of self-knowledge in civil rights activism is more valuable than the application of street knowledge in self-indulgent causes.

Understanding that knowledge in general is valued in hip hop culture, that hip hoppers recognize multiple types of knowledge, and that there is a hierarchy that discerns these types of knowledge, has important implications for educators. Knowing that hip hoppers do value knowledge can help dispel their potential misperceptions of hip hop culture as being anti-intellectual. In a hypothetical literature lesson, Stic.man has students analyze Lil’ Wayne lyrics for the theme of revenge, and then contrast them with how Shakespeare conceived revenge in his writings. Stic.man contends that if these types of teaching strategies were used in real classroom, students would think, “My teacher is cool! You’re getting that Shakespeare shit, but you’re getting jewels too!” Educators who understand how hip hoppers perceive the purpose of different kinds of knowledge are in a better position to make sense of the rationales for hip hop resistance to traditional school settings, and why, as the results in this study indicated, school knowledge is near the bottom of the hierarchy in hip hop epistemology.

Another important consideration for educators is how to navigate hip-hop conceptions of knowledge utility. Teachers of hip hoppers are challenged by being purveyors of knowledge that is both devalued and seen as antagonistic to what they are charged with teaching. Jeff Arthur and Christopher Wright provided templates for the purposeful incorporation of hip hop artifacts

and *street fashion*, respectively, in science classrooms. Arthur's encouragement and enthusiastic instructions for hip hoppers in his classroom who wanted to design and print out 3-D gold grills challenged preconceptions his students may have had about Arthur teaching "They" science as opposed to "our" science. Wright's "Tightening up your Shoe Game" lesson effectively combined multiple hip hop pillars and knowledge constructs with traditional science knowledge. Though Wright is a hip hopper, his observations of the value his students placed on *street fashion* and the implications it had for their worldviews was the impetus for designing the lesson, rather than just his insider status and prior experiences. These two, along with the other STEAM educators in the study, were able to incorporate and apply aspects of hip hop epistemology through their understanding of its value and influence on their students' learning processes.

Supreme Mathematics: Knowledge, Build or Destroy, and the Cypher

Another prevalent aspect of hip hop epistemology that appeared in the data concerned the nature of knowledge. The Five Percenter's designation of Knowledge with the number 1 in Supreme Mathematics demonstrates that knowledge is essential to all facets of life. Different from notions of knowledge as simply a set of things to be possessed and known, knowledge for them was constructed from sharing wisdom and understanding (Knight, 2007). Reflecting the importance of this idea, the next two numbers after Knowledge in Supreme Mathematics were Wisdom (2) and Understanding (3). As a part of their mathematical system, these three concepts share the following associative relationships for Five Percenters:

- Knowledge + Wisdom = Understanding
- Knowledge + Understanding = Wisdom
- Wisdom + Understanding = Knowledge

The sum of that which can be known (Knowledge), plus experience (Wisdom), equals the ultimate form of comprehension (Understanding). Knowing (Knowledge) plus ultimate comprehension (Understanding) equals experiences (Wisdom). Adding Experience (wisdom) to ultimate comprehension (Understanding) is how Knowledge is “built,” in Five Percenter terms.

This notion of “building” permeated conceptions of knowledge expressed by the hip hoppers in the study. In “School,” Masta Killa rapped about approaching a group of gods (male Five Perceners) who are “building” while at school. They were in a cypher (represented by the number 0 in Supreme Mathematics), meaning they are standing literally in a circle, sharing wisdom and understanding with each other, in order to construct (i.e. “build”) knowledge. Five Perceners regularly use the phrase “build on” “or “building on,” which are synonyms for “constructing knowledge about” to describe this process. Students in a school may get into a cypher and “build on” their dislike of the teacher and the restrictive school environment, or they may simply be “building on” whose home they will visit when they leave school that day. Masta Killa never describes what his peers are “building on” specifically, but the context of the song implies that the gods have created a cypher as an oasis in which useful knowledge is built, in the midst of miseducation occurring in the school in general. In “Teach the Children,” Rakim implored hip hoppers to build on how to dismantle systemic structures that are causing poverty, violence, educational inequity, and lack of self-knowledge in urban communities. These examples demonstrate how hip hoppers in the study valued creating situations in which people could build, especially within environments that were perceived to be hostile. They also highlighted the underlying agency in conceptions of building knowledge. As Rakim indicated, understanding problems and having experienced their effects facilitates constructing counterhegemonic knowledge that can overcome those challenges.

These ideas help to further crystallize hip hop epistemology. Cyphers are conceived as collections of people, with recognizable rules for interacting, where useful knowledge is built. Because the origins of the cypher are in Five Percenter philosophy, it can be viewed as a semi-sacred space. Consequently, building knowledge is a revered act, further indicating its value in hip hop culture. In this conception however, the value of knowledge is defined in spiritual terms, rather than the material terms of “gems” or “jewels,” and the most divine purpose for knowledge is building, rather than destroying. Together these material and spiritual notions help explicate the nature, value, and utility of knowledge as they are understood in hip hop epistemology.

Educators can find commonalities between how hip hoppers employ building, and how constructivist practices function in STEAM education. Emery Petchauer’s description of how he learned DJing through an apprenticeship, during which he was led through a zone of proximal development by a more knowledgeable other. He gained an “Understanding” of the art and the science of DJing by learning basic turntable skills (Knowledge), and through sequentially more challenging experiences rocking parties (Wisdom). While this method of learning is a facsimile of the inductive way that scientific inquiry is conducted, it runs counter to the deductive way that science is often taught. The artistic element is also an important aspect to consider. Petchauer was not simply learning the science of moving records on turntables. He was tasked with the simultaneous goal of making these mechanics appealing to a wider audience. In hip hop parlance, the word “dope” is used to describe something or someone that is entertaining and stylistically appealing. As a DJ then, Petchauer had to learn to do more than just manipulate the records right mechanically, he had to be dope while doing it. STEAM educators can consider how to incorporate hip-hop conceptions of knowledge, wisdom, understanding and building in their own teaching practices. Data in this study indicate that having a more knowledgeable other

who guides students through experiences and understanding is an important way that pedagogy occurs in hip hop culture. It matches the constructivist ideas of learning theory Vygotsky (1978) posited, on which most STEM educators are trained in their preservice programs. The notions that knowledge is built, that it is most valuable when it has a visible purpose, and that building it fits a constructivist paradigm, have important implications for how STEAM teachers can effectively interact with hip hoppers. This is especially important considering the fact that most educators have minimal familiarity with hip hop culture. If they understand that hip hop epistemology has correlations with constructivism, they will have a basis for understanding and communicating with the hip hoppers they teach, that matches the foundation of how most of them are trained.

Hip Hop Science

The study began with the premise that “hip hop science” is a way to describe philosophical connections between a hip hop worldview and how hip hoppers live. One of the tasks was to use the data it generated to expand this idea, and elucidate a model that incorporates sciencemindedness into the philosophy, worldview, and praxis of hip hoppers. This model would be used to facilitate the incorporation of hip hop-funds of knowledge into STEAM teaching practices.

The foundations of hip hop science come from the pillars of hip hop culture. DJing the first pillar to develop, is the result of science-minded ingenuity, musicality, and a reduction in systemic resources vis-à-vis the elimination of music programs from public schools. Murs and Chang (2005) described how re-conceiving the turntable itself as an instrument, rather than as a method for playing recordings of instruments, gives insight into how hip hoppers value technical knowledge for its applicability to hip hop culture. For hip hoppers, the use of tools in ways other

than how they were originally intended, whether out of necessity or cleverness, is demonstrative of intellectual prowess. Early DJs like Kool Herc and Grand Mixer DXT who invented the merry-go-round, scratching, cutting, and fading techniques of turntablism are considered gods for their technical and creative contributions to hip hop culture (Chang, 2005). Mastering these unique usages of technology and creating new ones is a part of a constant competitive push that also drives science-minded intellectualism in hip hop culture. During her interview, Bettina Love repeatedly declared that hip hop-driven intellectual advancements are “the latest, greatest iteration of Black genius.”

Competition is also a hallmark of MCing, another hip hop pillar. Beyond writing raps to make songs, the distinctive style of verbal exchange that occurs in hip hop culture is influenced by this pillar. The students in the hallway cypher at Masta Killa’s high school were engaging in the same types of exchanges Christopher Wright talked about in his own experiences as a student and as a teacher. These cyphers often involve verbal critiques and signifying by the participants. But they were also spaces in which students vigorously debated each other, with Wright and his peers challenging each other’s knowledge of shoes, clothing, sports, and current events. As a science educator, Wright recognized the exchanges in these cyphers as consistent with the type of argumentation that occurs in scientific inquiry. They required observations, inferences, and drawing conclusions that would be challenged by immediate peer review. Emdin (2010) described these *cogenerative dialogues* as a functional learning unit for STEAM education. For hip hop science, the cypher as a site of argumentation and scientific inquiry gives further insight into how sciencemindedness is enmeshed in a hip hop worldview.

Hip hoppers in this study addressed complex intellectual undertakings, including methods for confronting oppression, clarifying philosophical concepts in Five Percenter teachings, and

pedagogy. In addition to “building,” they also used the term “sciencing out” and other language that invoked scientific inquiry. The use of these terms helps affirm an underlying premise that in hip hop science, a premium is placed on sciencemindedness in problem-solving. They also distinguish the commonly used hip hop phrases, “dropping knowledge” and “dropping science” from each other. “Dropping knowledge” was used when a person provided valuable information, while “dropping science” was invoked when a person provided rationale and understanding for that knowledge. Leshell Hatley talked about dropping knowledge in reference to her perceptions of old school rap lyrics and the importance in them of imparting information on Black history and defining hip hop culture. In the hook of “The Science,” Murs rapped, “Droppin’ this science / Murs is a scientist.” The song went beyond simply naming the challenges that plague inner cities, and defined the origins of those challenges, the reasons why they persist, and what must be done to counteract them. Similar to the intellectual and philosophical processes Allah and Abu Shahid of the Five Percent Nation used when they scienced out Supreme Mathematics (Knight, 2007), Murs scienced out the dire situations faced by urban communities. These connections between higher order thinking, understanding, and science further elucidate a model for hip hop science. They indicate the importance of being able to discern problems, explain their causes, and apply systematic and creative means for solving them. The incorporation of this deductive reasoning into a hip hop worldview further demonstrates how sciencemindedness is embedded in hip hop culture.

Hip Hop STEAM Pedagogy

The connections among the concepts in this study provide foundations for the theoretical model for Hip Hop STEAM Pedagogy. Because it is informed by hip hop culture, HHSP must be understood in the context of resistance to formal education and critiques of systemic

structures. It begins then with Christopher Wright's declaration, "If you are a science teacher, not only are you responsible for content, but you're also responsible for how your students see themselves as being potential scientists or their relationship to science." Bettina Love described how science has historically marginalized minorities and women, and how hip hoppers are a marginalized group as well. The consequent premises of HHSP are that it is a type of STEAM pedagogy that engages notions of sciencemindedness from hip hop culture, and that it actively challenges the fallacy that STEAM education is not for hip hoppers. The primary aspects of hip hop responsiveness in STEAM pedagogy include: valuing knowledge that has utility in hip-hop environments; the nature of knowledge as being constructed through sharing debating, critiquing, experiencing, and understanding; and conducting scientific inquiry involves higher order thinking, or sciencing out, for the purpose of creating new knowledge, wisdom, and understanding.

Learning that occurs in HHSP is grounded in acts of sciencemindedness that occur primarily in cogenerative dialogues known as "cyphers" in hip hop. The role of the STEAM educator is to participate in these dialogues as a more knowledgeable other, or to ensure that at least one more capable peer is a part of the cypher. Like the way Emery Petchauer learned turntablism, this socioculturally constructivist form of learning (Vygotsky, 1978) relies on others who are more capable or more knowledgeable to lead learners through a zone of proximal development. This process moves the learners from their existing knowledge base, to "sciencing out" more challenging concepts that they were previously incapable of understanding.

Petchauer's experience as an apprentice DJ and Jeff Arthur's experiences with designing hip hop-inspired jewelry showed the artistic implications for this method of learning. The history of performance and its value in hip hop culture emphasize style as well as functionality, and thus

Hip Hop STEAM Pedagogy places particular importance on the “A” in the acronym, ensuring that aesthetics and artistry are a part of scientific learning. These foundational aspects begin to establish the theoretical bases for designing curricula and creating classroom experiences that are hip hop-responsive in STEAM education. Further research needs to build a more comprehensive view of HHSP, and help teachers put theory into practice.

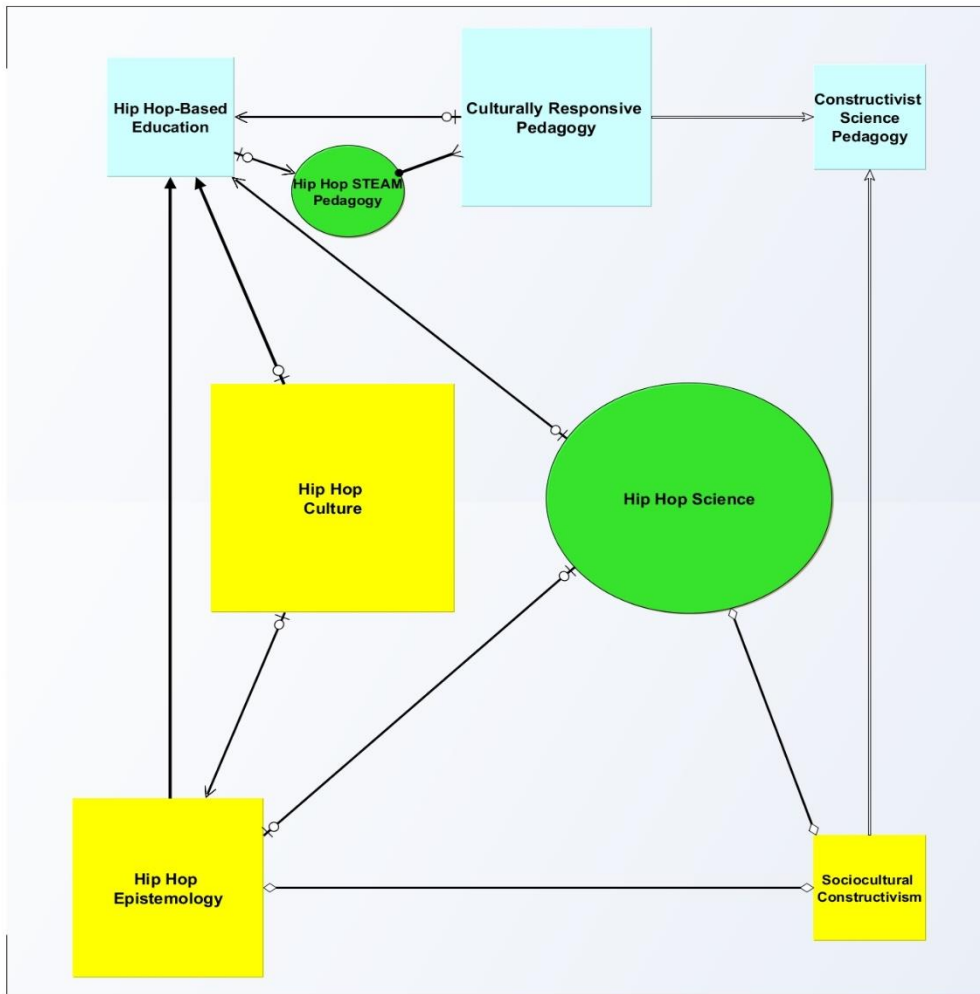
Revised Theoretical Framework

The original framework for Hip Hop Science and HHSP (**Error! Reference source not found.**) proposed connections between pedagogical and philosophical concepts, analyzed through a Critical Race Theory (CRT) framework, that would help uncover underlying models for Hip Hop Science and Hip Hop STEAM Pedagogy. These two theoretical models were centralized in that framework, and the connections between the concepts that informed them were indicated using coded connectors. After analyzing the findings from the data collected in this study, a new framework was created (Figure 2). It reflects a revised understanding of the connections among the concepts.

The first major shift is the inclusion of hip hop-resistance to formal education as a complementary analytical framework to CRT. Descriptions of how hip hoppers challenge school learning environments were present in nearly every aspect of the data, and the effects of that resistance influenced the way all of the concepts and connections in the framework needed to be analyzed.

A design change that was made in the final framework was the use of relative sizes of the nodes to indicate the frequency with which they occurred in the data. In the original framework, all of the nodes were the same size. After analyzing the data, using varying sizes to symbolize the prevalence of each concept in the study provided greater accuracy, and improved the

Critical Race Theory



Hip Hop-Resistance to Formal Education

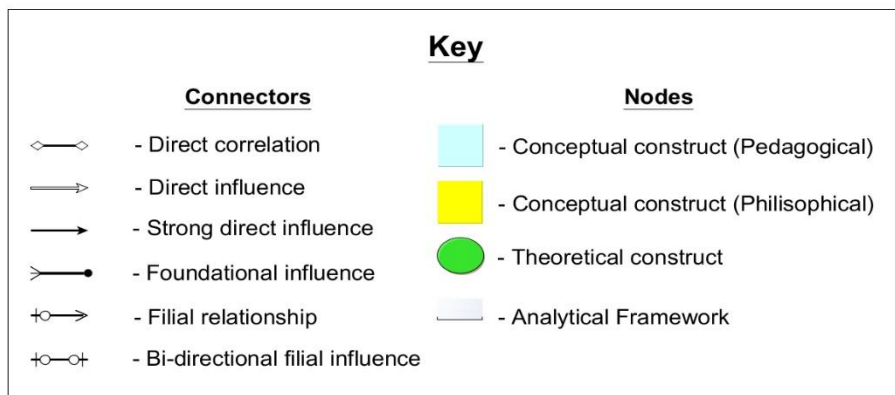


Figure 2: Revised Theoretical Framework

understanding of their implications for the theoretical framework. The two predominant concepts referenced in the data were hip hop culture and hip hop science. The presumed reasons for this pervasiveness are the fact that four of the six interviewees were science educators, all of whom were hip hoppers. Additionally, the hip hop texts were chosen for their references to science. The prevalence of these two concepts warranted placement in the center of the framework. This also reflected the fact that hip hop culture and sciencemindedness in a hip hop worldview had the highest amount of influence on other models, despite a greater number of connections between other concepts in the framework. This is indicated by the connectors in the figure, which vary in shape based on the type and direction of the influence between concepts. The connectors coming to and from hip hop science and hip hop culture show that they each have major influences on two other concepts in the framework. No other concepts had more than one major influence on any of the other ones.

Another significant outcome was uncovering a connection between hip hop science and Hip Hop-Based Education, which had not been predicted in the original framework. Initially, hip hop epistemology was proposed to have a foundational influence on HHBE. The data revealed, however, that the strength of this influential relationship was lower than anticipated; it was supplemental to the impact of hip hop science on HHBE. This occurred due to the data emphasizing the importance of sciencemindedness and scientific inquiry as parts of HHBE, making hip hop science a vital influence. For example, Christopher Wright's "Shoe game" lesson first applied hip hop notions of argumentation and sciencing out shoe knowledge as a part of including *street knowledge* and *street fashion* in HHBE. The second portion of the lesson connected those HHBE notions to specific concepts in science that included human anatomy and physiology.

The new connection between Hip Hop science and HHBE also had an effect on the perceived relationship between hip hop epistemology and HHBE. Considered foundational in the original framework, stronger connections were found between HHBE, hip hop culture, and hip hop science. References in the data to HHBE were more frequently informed by sciencemindedness in hip hop, rather than its epistemology. This was reflected in Bettina Love's example involving the symmetry in certain Black hairstyles. She described them in terms of the sciencemindedness needed to conceptualize and craft them, and how that could influence hip hop-based education. Connections like this one reduced the perceived influence of hip hop epistemology on HHBE, channeling it partially through its exceptionally strong and mutually influential relationship with Hip Hop Science.

The nature of other relationships between the concepts changed in the final framework as well, most notably between hip hop science and sociocultural constructivism, and between constructivist science pedagogy and hip hop STEAM pedagogy. It was originally proposed that ideas from sociocultural constructivism would form a significant part of the foundation of hip hop science. This came from the expectation that the hip hop-responsive educators interviewed in the study would describe knowledge construction in hip hop philosophy as having a foundation in the epistemological aspects of sociocultural constructivism. Instead, the data indicate that although there are corresponding principles between the two concepts, no directionality was suggested. There was no implied influence from one concept to the other.

The original framework connected constructivist science pedagogy to hip hop STEAM pedagogy through a relationship with Hip Hop Science, however, the data did not support this connection. Constructivist science pedagogy was the least referenced concept in the framework, and only appeared in the data in reference to how it was influenced by sociocultural

constructivism and aspects of culturally responsive pedagogy. The connectors used on the revised framework indicate the infrequency of this reference in the data.

The lack of a direct connection between Hip Hop Science and Hip Hop STEAM Pedagogy is also notable. This is reflective of how the references in the data to HHSP almost exclusively occurred as they related to HHBE and culturally responsive pedagogy. For example, Leshell Hatley declared the most important aspect of hip hop-responsive pedagogy in science to be, “teaching [hip hoppers] in a way that they understand.” Meeting students where they are culturally is a foundational aspect of culturally responsive pedagogy. Other descriptions of sciencemindedness as a part of HHSP were referenced first through how they inform hip hop-based education in general, and then how they could inform HHSP.

Limitations

This study had some design and conceptual limitations. One of the design limitations was the small sample sizes in the three sources. Using only five representative texts for content analysis has the benefit of narrowing the breadth of theories behind the conceptual models, but it leaves out a large amount of scholarship that could provide thicker data for analysis. Thus, the conclusions made about the conceptual models using traditional scholarship cannot be generalized to the body of knowledge at-large. These are inherent challenges in purposive sampling and content analysis, which focus on depth of analysis rather than breadth.

The sample size for the hip hop scholarship had similar challenges. The seven hip hop songs chosen for analysis are indicative rather than representative of the entire genre. Furthermore, the presence of the six keywords (i.e. education, knowledge, science, school, teach, or teacher) in the chosen songs did not guarantee that the content was actually about those subjects. For example, despite the number of times the word, “school” appears in the song “Old

School” by CunninLynguists, the lyrics are about the history of hip hop, and have little to do with conceptions of education. At the same time, songs that did not include any of those keywords could have contained relevant content, but were excluded by the selection process used in this study. Undoubtedly the songs selected for analysis did not include the total variety of hip hop views on education, teaching, knowledge, and science. This was somewhat mitigated by the researcher’s decision to include a song from the sample pool that did not make the top seven through purely quantitative analysis, but dealt significantly with the desired subjects.

This type of researcher intervention is emblematic of another limitation of content analysis methodology, which is the influence of the researcher as a research instrument. The map analysis of the three data sets—traditional scholarship, hip hop scholarship, and interviews—was performed by the researcher. This is no different from any other single-researcher study. However, the conceptual nature of this study depended entirely on the researcher’s interpretations. Combining established pedagogical and philosophical ideas with original analyses may have somewhat minimized this limitation. Still, the reliability of the study is inextricable from the ability of the researcher to subjectively interpret while minimizing biases, personal preferences, and distortion, presenting a conundrum.

The models for Hip Hop Science and Hip Hop STEAM Pedagogy presented here are preliminary and tentative. More comprehensive ones could be constructed through more research. While the data in this study revealed strong indications of how sciencemindedness and scientific inquiry function as part of hip hop philosophy, as well as how they can be incorporated into STEAM education, more research is needed to derive even broader conclusions about these two theoretical models.

Hip Hop Culture as Pathology: A Confounding Factor

While not a limitation of the study per se, a noteworthy potential challenge faced in the implementations of the findings from this study comes from widespread, negative views of hip hop culture. As reported in the literature review and iterated by the hip hoppers in the study, hip hop culture was began in the urban blight of the South Bronx by Black and Puerto Rican youths. Impoverished, urban, young people of color have regularly been described and defined in pathological terms in the United States. People in ghettos or barrios are considered purveyors of a particular culture of violence, poverty, apathy, and anti-intellectualism. Hip hop is often subsequently maligned as a subculture having those attributes as its primary values (Chang, 2005; Kitwana, 2002; Rose, 1994). In addition, the media are saturated with popular rap music that is misogynist, hedonistic, and violent, an aspect which increases negative opinions of the culture. The prevalence of this sentiment is problematic for studies such as this one, which posits hip hop culture as having robust philosophical and epistemological mores, rather than just debilitating pathologies. The premise that hip hop culture is a site of study for a knowledge construction paradigm could meet with significant resistance and bias that dismisses it out of hand. Although not inherent to the study itself, these perceptions and resultant resistance can limit its receptivity, altering its utility in implementation.

Educators subjected to these reductive notions of hip hop culture may engage in this resistance as well. The idea that STEM is a set of objective undertakings (unlike STEAM, which is inherently more subjective due to the inclusion of the arts) could make teachers even more reticent to consider hip hop culture as a compatible framework for teaching science and math. Although the STEAM educators and the hip hop texts in this study confronted negative aspects of hip hop culture and offered ways to diminish them, their critiques may not yet be persuasive

and compelling enough to convince teachers that the vitality of epistemological constructs in hip hop culture supersede prominent pathological descriptions of the culture.

Significance of the Study

As a study of a marginalized group, conducted by a member of that group, this investigation also adds to knowledge about conducting culturally responsive research with and within marginalized groups and minoritized communities. The common paradigm for research on these communities involves cultural sojourners from outside of the community, who come in as embedded observers, and then leave to publish the results of their studies using ways and in places that are inaccessible or difficult to access by the minoritized people. In this study, the figurative distance between the researcher and researched was reduced due to the researcher's identity as a hip hopper. While studies involving a researcher from the cultural group being studied occur regularly, the use of narrative inquiry as a methodology, by a hip hopper studying hip hop culture, is unique. The methodologies fit well with analyzing philosophical aspects of a marginalized culture in which narratives are a primary way it both investigates and describes its worldview. Narrative inquiry facilitated discourse in the study between the stories told by the hip hop educators, and the ones told by hip hoppers in their raps. Having a hip hopper interpret these connections through narrative inquiry optimized the ability to produce thicker and more authentic descriptions of the embedded philosophical and pedagogical constructs than would have been possible from a researcher who was not similarly invested in the culture of the participants and the issues studied. The successful matching of researcher, methodology, and researched demonstrated the utility of narrative inquiry in studying epistemology in hip hop, and in interpreting the cultural scripts of hip hoppers.

This study also makes a significant contribution to understanding hip hop culture. While

the amount of scholarly studies on hip hop is increasing, few have focused on analyzing philosophical and epistemological constructs within it. This research brings hip-hop ways of thinking, knowing, and understanding into traditional scholarship, and expands the body of knowledge on epistemologies in general. The findings on sciencemindedness in hip hop add further clarity to how hip hoppers reify the world, and the role of scientific inquiry plays in that understanding.

Another important aspect of this research is its emphasis on marginalized epistemology. Analyzing hip hop culture through different types of discourse, with hip hoppers as experts, prioritizes voices that are regularly silenced by pervasive views of their culture as detrimental. The insights contributed by hip hoppers in this study helped explain how and why resistance in hip hop is directed externally at systems of oppression, and internally as a part of reflexive critique. Incorporating the expertise of marginalized people into academic research contributes to diversity in a field that is, to a significant extent, demographically and ideologically homogenous. Because of this homogeneity, minoritized people engaging in scholarship about marginalized communities must be vigilant that they do not repeat hegemonic claims. Contrary to that type of replication, this study recognized and highlights some of the emerging diversity in the field of STEAM education as embodied by educators, ideologies, and pedagogies.

The goal of this study was to create a theoretical framework for connecting hip hop culture and STEAM pedagogy. A small group of STEAM educators in the United States have begun to sporadically incorporate hip hop in their teaching, some meeting with significant success, but most experiencing inconsistent levels of effectiveness. Research that informs these practices is likewise sparse, and have been created primarily by one researcher, Christopher Emdin. A major gap exists in scholarship that explains the philosophical constructs in hip hop

that make Hip Hop STEAM Pedagogy a viable concept. The model for Hip Hop Science presented in this study is an effort to address that gap by beginning to explicate the complex ways hip hoppers conceptualize science and mathematics. This model involved exploring the connections between the Five Percenter philosophy that undergirds hip hop culture and sciencemindedness. Another feature involved synthesizing the pedagogical expertise of hip hop-responsive educators, most of whom are in STEAM. This is a new undertaking in academic research that helps explain the sciencemindedness embedded in hip hop epistemology and praxis, and provides a foundation for educators to consider in hip hop STEAM pedagogy.

The data in this study are derived from sources that have previously been elided from STEAM education. Their contributions in this research enhance the field of STEAM education by providing new ways to connect epistemology and pedagogy. The data also include expertise on STEAM teaching and learning in informal environments. The definitions of sciencemindedness in hip hop have implications for understanding it as a general concept amongst students from other cultures as well. Expanding the scope of study beyond traditional classrooms improves that understanding by demonstrating its consistency across learning environments. This study thus increases the body of knowledge on how students conceptualize science in the classroom and in their lives in general, potentially improving how STEAM instruction occurs with students of all backgrounds, and across varied educational settings.

Recommendations

More investigations of hip hop epistemology and STEAM pedagogy can address some of the limitations in this study as part of advancing future research. One recommendation is to increase the amount and the diversity of the data collected. This can be done first by identifying and interviewing a larger group of hip hop-responsive educators, including those who work

primarily in PK-12 education, in counseling and administration, and in support roles as well.

Another important group to include would be hip hop-responsive educators who do not identify as hip hoppers. A larger group of interviewees with a greater variety of roles in education and cultural distances from hip hop would broaden the knowledge base of practices that are effective in Hip Hop STEAM Pedagogy. Because the vast majority of educators are not in higher education and are not hip hoppers, data collected from these proposed groups would strengthen the likelihood that the framework would be used by a greater variety of educators to make their school environments more hip hop-responsive.

A second way to further enrich the data set would be to create and implement a method for selecting hip hop songs that address educational, epistemological, and scientific concepts, but is not bound by the parameters of containing specific keywords. This would require a selection method that involved reviewing lyrics before the songs were chosen for inclusion in the research. Using songs selected in this manner would increase the validity of hip-hop conceptions of education, knowledge, and science advanced by the study.

Another consideration in the selection of texts is the variety of voices represented amongst the MCs. In this study, all of the songs were by Black American males between the ages of 35 - 50. Additionally, none of the primary authors of the scholarly texts were women, though there was racial diversity amongst them. Future studies could address whether the overwhelmingly male and masculine influences in hip hop culture affect the compatibility of its epistemology with non-male hip hoppers. They could also more accurately measure the influence of women in hip hop epistemology by purposefully selecting texts that prioritize the viewpoints of women. Including racial and ethnic diversity in the hip hop texts as well would further expand the understanding of hip hop epistemology. Increasing these types of diversity in

the data would assess whether prior research describing shared marginalization amongst those groups (Ochs, 1986; Solórzano & Ornelas, 2004; Q. Taylor, 1991) spans across how they engage with hip hop epistemology and STEAM education.

Conducting interviews with students, and young hip hoppers in particular would meet another need in future research. Hip hop has always been a youth-driven culture. The current generation of hip hoppers, because of the influence of technology, social media, and popular culture, have been referred to as the *hip-pop generation* (Wilson, 2013). The interviewed participants and MCs whose lyrics were used were all part of the *hip-hop generation* (Kitwana, 2002) that preceded the hip-pop generation. Conducting research with younger participants may reveal changes that have occurred in hip hop philosophy as the culture has evolved across time and constituent populations. Additionally, the primary goal of all research done in this vein is improving the effectiveness of STEAM teachers through increased understanding of hip hop culture. The hip-pop generation would be the primary beneficiaries of this improvement, so their perceptions of teacher efficacy and their own achievement, before and after the implementation of Hip Hop STEAM Pedagogy, are important issues to be examined.

A related recommendation would be to separate the analyses of epistemology and pedagogy into two different studies, or even a series of several studies. Research based solely on creating a robust understanding of hip hop epistemology could be conducted by philosophy scholars with expertise in explicating philosophical constructs from analysis of cultural texts. Such studies could improve understanding of hip hop culture in general, and of its epistemology in particular. Simultaneous studies by practitioner education researchers on how hip hop-responsive STEAM educators operate effectively could be joined later with findings from studies on hip hop philosophy. Increased understandings of both aspects could further delineate how

STEAM pedagogy can improve the engagement and performance of minoritized students in schools.

The findings of this study could also be used for future efforts to design hip hop-responsive STEAM curricula. The premise of this study was that the theoretical models it generated would eventually be used to inform conceptual models of teaching practices. Subsequent research could involve analyzing how sciencemindedness in hip hop is actualized in classroom practices within STEAM studies. A valuable and viable approach would be for teachers to conduct their own action research in addition to the traditional academic studies assessing the efficacy of these implementations. This kind of empirical evidence could be helpful in extending the discourse about the potentiality of hip hop pedagogy in general and in STEAM education specifically, moving it from theorized possibilities to classroom-performed practices. Subsequent related studies could include quantitative research that assesses the efficacy of these hip hop STEAM pedagogy practices across the broader spectrum of entire school districts and systems.

Final Statement

At the time this research was conducted, it was the only known one of its kind. The idea that hip hop is a culture with a discernible epistemology is still a novel conception, though studies have begun to explore it. So is the assumption that distinct connections can be made between sciencemindedness in hip hop and STEAM pedagogy. The research presented here is an initial attempt to begin to inform STEAM teaching practices using these two ideas. It occurred during a social climate in which urban areas of the United States, and the Black and Brown people who predominantly reside there, were often defined primarily by the disproportionate violence, poverty, and lack of educational opportunities affecting those

communities. The ever-present view of urban areas and urban cultural mores as based in pathology permeated the study and the responses of the hip hoppers in it. Their resistance to this characterization of their culture was pervasive enough to become a part of the analytical framework of the study.

When I first met Christopher Emdin, currently the most prominent advocate for advancing hip hop in STEAM education, we spent the day building on hip hop and science teaching. He helped me science out my fledgling ideas about how these two concepts connected, while schooling me on what he had learned in his own work and research. I told him that I would work on the theoretical and philosophical side of the issue, and we would combine our wisdom to improve science education for hip hoppers like us. He dapped me up and looked dramatically at his watch as we parted ways saying, “We’re gonna take over the world in like two minutes and thirty seconds, fam!” Chris’s hip-hop hyperbole notwithstanding, the research presented here breaks new ground in our understanding of how hip hoppers think, how hip hop culture informs their understanding of science, and how their learning experiences in STEAM education can be improved.

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Appendices

Appendix A: Interviewee Consent Form**UNIVERSITY OF WASHINGTON
CONSENT FORM****Hip Hop-Responsive Pedagogy in STEAM Education**

Researcher: Mr. Maurice E. Dolberry, PhD Candidate
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Researchers' statement

We are asking you to be in a research study. The purpose of this consent form is to give you the information you will need to help you decide whether or not you will participate. Please read the form carefully. You may ask questions about the purpose of the research, what we would ask you to do, the possible risks and benefits, your rights as a volunteer, and anything else about the research or this form that is not clear. When we have answered all your questions, you can decide if you want to be in the study or not. This process is called "informed consent." We will give you a copy of this form for your records.

PURPOSE OF THE STUDY*Background information:*

The study of multicultural education and its implications for K – 12 schooling has grown to include many aspects of pedagogy (a term that means all aspects of teaching from lesson planning, to classroom instruction, to rules and discipline, to how testing occurs). Arguably, the most important of these aspects is teaching in ways that are relevant and responsive to the cultural backgrounds of all students. This goal is essential for ensuring that every child in our schools receives a quality education.

STEAM education, which combines **Science, Technology, Engineering, Arts, and Mathematics**, is a relatively new area of focus for this idea of culturally responsive teaching. While a lot of research has been done on how to make sure every student's culture is responsibly reflected in social studies and language arts classes, the same is not true yet for science classes.

Purpose:

The purpose of this study is to learn how STEAM educators can become increasingly responsive to students' cultures in their practices. We are specifically looking at potential connections between hip hop and culturally responsive STEAM education in order to create a new field we are calling "Hip Hop STEAM education". To help define Hip Hop STEAM education, we are interviewing experts in the fields of education and teacher training, science, and hip hop. You are being asked to participate in this study because you have been identified as someone with expertise in one or more of these areas.

STUDY PROCEDURES*Before the interview:*

The interviews in this study will be conducted one-on-one through ClickMeeting web conferencing software. Once you've chosen to participate in this study, you can email this consent form back to the researcher in the accompanying envelope (it is already addressed and the postage has been paid). Next, you will be contacted by the researcher, Maurice E Dolberry, to set up a day and time for your online interview. You will then receive an email from him that contains confirmation of the day and time, the equipment requirements for participating in the interview, and instructions for how to login securely to the ClickMeeting site. Note that you will not have to make any purchases to participate in the interview, and the researcher will help you find an appropriate site (i.e. a public or campus library) that has the required computer, web access, and webcam combination.

On the day of your interview:

At the confirmed date and time, you will follow the instructions you've been given to login to ClickMeeting. The researcher will join you online, and will explain the procedure and the possible risks of your participation (see below). Once you are ready, the interviewer will begin recording the interview, which will probably last between 30 - 45 minutes. If want to impose different time constraints, you may set them before the questioning begins. During the interview, you will be asked approximately eight to ten (8 – 10) questions about your fields of expertise – science, education, and/or hip hop. The questions will also ask you to share experiences you may have had with these three fields interacting together in your life.

The most sensitive questions will involve your recalling challenges you've faced in your professional life as they relate to the overall research topic, and in your experiences as a child in science classes. At any point during the interview, you may refuse to answer any question or questions.

At the conclusion of the interview, you will be reminded of the process for accessing the recording of the interview, and you may ask the researcher any further questions about how your interview responses will be used.

RISKS, STRESS, OR DISCOMFORT

The risks involved with participation in this study are no more than one would experience in regular daily activities.

You will maintain access to the audiovisual recording of your interview, though you will not be able to edit the interview once it has been recorded. You may, however, request that specific

information within it to be withheld from use in the study. The recording may be kept for further use in future studies, but will be removed from its online storage space within one (1) year of the interview date. If your interviews are used in later studies, they will only be ones conducted by Maurice E Dolberry, and the confidentiality of your question responses will be maintained.

BENEFITS OF THE STUDY

Ideally this study will illuminate connections between the fields of hip hop, science, and STEAM education. As an expert in one or more of these fields, having more research on how interactions between them can benefit each other may help your future work. We want to use this study to improve our knowledge about how certain kids – predominantly ones in urban settings – learn and how we can properly prepare teachers to teach them, and the results from this research may help us begin to do so.

CONFIDENTIALITY OF RESEARCH INFORMATION

To maintain confidentiality, you are requested not to share your access information for your online interview, nor interview footage itself. Because you will be recorded, your responses to questions cannot be anonymous. However, you will not be identified in the reporting of the research beyond your field of expertise (e.g. “One of the interview subjects, an *expert in science education*, described their experiences as a high school student...”). Your specific interview answers will not be linked to any other personal information.

Government or university staff sometimes review studies such as this one to make sure they are being done safely and legally. If a review of this study takes place, your records may be examined. The reviewers will protect your privacy. The study records will not be used to put you at legal risk of harm.

OTHER INFORMATION

You may refuse to participate and you are free to withdraw from this study at any time without penalty or loss of benefits to which you are otherwise entitled.

Printed name of study staff obtaining consent	Signature	Date
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Subject's statement

This study has been explained to me. I volunteer to take part in this research. I have had a chance to ask questions. If I have questions later about the research, I can ask one of the researchers listed above. I will receive a copy of this consent form.

Printed name of subject	Signature of subject	Date
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Copies to: Researcher Subject

Appendix B: Interview Template

Hip Hop-Responsive Pedagogy in STEAM Education

I. Pre Interview

- a. Introductions
- b. Review of the consent form
- c. Begin recording
- d. Begin the interview

II. Interview Questions

- a. Demographics
 - i. What is your name?
 - ii. What is your profession?
 - iii. How would you describe your race/ethnicity?
 - iv. How would you describe your gender?
 - v. How would you describe your age?
- b. How would you describe your expertise in terms of these three concepts: hip hop, education, and science?
 - i. How do you define each of the terms:
 1. Hip hop
 2. Education
 3. Science
- c. What does the phrase “hip hop culture” mean to you?
- d. How would you describe a “hip hop worldview”? Do you have another way you’d describe that phrase? What is it and why?
- e. Do you see connections between hip hop and education?
 - i. If so, what are they and how would you describe them?
 - ii. Do you have any personal connections to hip hop and education?
 1. If so, how would you describe them?
- f. Do you see connections between hip hop and science?
 - i. If so, what are they and how would you describe them?
 - ii. Do you have any personal connections to hip hop and science?
 1. If so, how would you describe them?
- g. How would you describe your experiences as a student in science classes (grades K - 12)?
 - i. If there was a camera in the classroom, what would we see happening?
 - ii. Tell me about a day you remember in particular.
- h. If you could talk to your old science teachers now, what would you say to them about your experiences?
- i. What relationship do you have now with science?
- j. Is there anything else you’d like to tell me about any of the topics we’ve discussed?

III. Post Interview

- a. End recording
- b. Ask them if there is anything they would like to include off-record for the benefit of the research
- c. Remind them of the protocol for viewing their interview online
- d. Thank them for their time

Appendix C: Methodology for Hip Hop Text Search

By Maurice E Dolberry & Nicholas Hunt-Walker

The list consisting of 105 artists was loaded into a Python (programming language) script, reading the file line-by-line, and cutting the resulting set down to 102 since there were a few doubles in the list. The researcher added three MCs from personal knowledge, bringing the total number back up to 105. One of the songs, “Malcolm X (A Song to Me)”, ended up being by this MC¹.

For each name in the artist list, a query was set up for <http://allmusic.com> of the form:

"[http://www.allmusic.com/search/artists/\[full\]+\[artist\]+\[or\]+\[group\]+\[name\]](http://www.allmusic.com/search/artists/[full]+[artist]+[or]+[group]+[name])"

That query was submitted. The results returned in the form of an HTML page, from which the link for the top search result was taken. That link was followed to the artist’s discography, and links to each listed album were collected. Finally, the track listing for each album of each artist was saved.

This process created an initial sample of 16,173 songs. This unfiltered set of songs included every album’s intro, outro, skit, interlude, and various untitled tracks. These non-songs were filtered subsequently out.

The ultimate goal was to be able to interact with the <http://www.genius.com> website (formerly Rap Genius) without having to manually search for, load up, and download the lyrics page for each song. As such, the guidelines set forth by <http://www.genius-api.com> were used, in conjunction with another Python script. To avoid errors, redundancies, and unsearchable

¹ Because the researcher has a professional relationship with the artist, David Banner, and had collaborated with him in an educational environment previously, this addition fits well within the parameters for inclusion. It also increases the confidence with which the researcher can interpret the song lyrics.

tracks, all untitled tracks, interludes, skits, intros, outros, and instrumentals were excluded. A total of 474 tracks were removed for this reason.

Next, all censored song titles were uncensored to maximize the search yield. From this yield, each top search result for the song URLs was compared to a general URL format of "http://rap.genius.com/[artist]-[name]-[song]-[name]-lyrics" to ensure that, for example, searching for Young Jeezy's "White Girl" didn't return Shy Glizzy's "White Girl". This procedure was done in lieu of leading with the aforementioned song URL format, ensuring that each song search had a result, instead of querying for a lyrics page that did not exist. Of the songs searched, 188 had no search results.

Once all of the links to the lyrics pages were saved, the lyrics pages were retrieved, saving only the content explicitly marked as "lyrics". This was done to eliminate lyrics, user-supplied lyric explanations, and other information genius.com pages include, which are not relevant to this study. A total of 8,300 songs with lyrics were retrieved, of which 472 returned blank files due to the pages being outside of the aforementioned format. The attrition here is due mainly to Server errors on the genius.com website, 502 Bad Gateway errors, or ambiguous syntax errors which prevent obtaining a given page.

The final word count was made by concatenating all of the lyric files into one large text document. A word search was then performed for the key words: "science", "knowledge", "teach", "teacher", "education", and "school". The final list was subsequently compiled, and the top seven songs were ultimately chosen for analysis in the study.

Appendix D: Data Coding

Code	Framework
CsP	Constructivist Science Pedagogy
CRP	Culturally Responsive Pedagogy
HBE	Hip Hop-Based Education
HC	Hip Hop Culture
HEp	Hip Hop Epistemology
SC	Sociocultural Constructivism
HSc	Hip Hop Science
SP	Hip Hop STEAM Pedagogy
CRT	Critical Race Theory
HvE	Hip Hop vs Education

Table 2: Data Codes for Frameworks

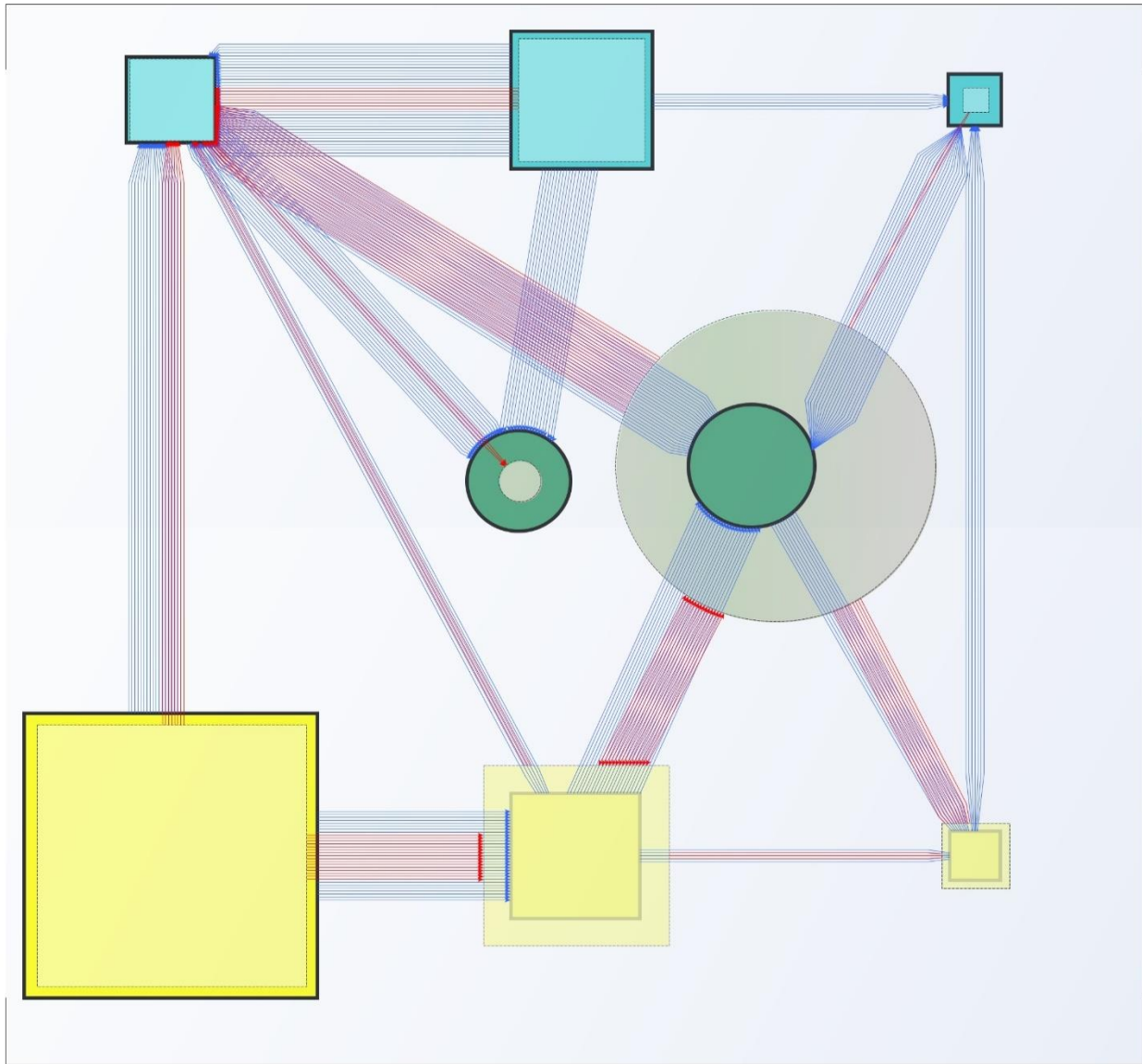
Code	Framework Connections
HC $\leftarrow\rightarrow$ HBE	Hip Hop Culture - Hip Hop-Based Education
HC $\leftarrow\rightarrow$ HEp	Hip Hop Culture - Hip Hop Epistemology
HEp $\leftarrow\rightarrow$ SC	Hip Hop Epistemology - Sociocultural Constructivism
HEp $\leftarrow\rightarrow$ HBE	Hip Hop Epistemology - Hip Hop-Based Education
SC $\leftarrow\rightarrow$ CsP	Sociocultural Constructivism - Constructivist Science Pedagogy
CRP $\leftarrow\rightarrow$ CsP	Culturally Responsive Pedagogy - Constructivist Science Pedagogy
CRP $\leftarrow\rightarrow$ HBE	Culturally Responsive Pedagogy - Hip Hop-Based Education
CRP $\leftarrow\rightarrow$ SP	Culturally Responsive Pedagogy - Hip Hop STEAM Pedagogy
HBE $\leftarrow\rightarrow$ SP	Hip Hop-Based Education - Hip Hop STEAM Pedagogy
HEp $\leftarrow\rightarrow$ HSc	Hip Hop Epistemology - Hip Hop Science
SC $\leftarrow\rightarrow$ HSc	Sociocultural Constructivism - Hip Hop Science
HSc v Ed	Hip Hop Science vs Education
HSc $\leftarrow\rightarrow$ HBE	Hip Hop Science - Hip Hop-Based Education

Table 3: Data Codes for Framework Connections

In coding directionality, the connectors \rightarrow or \leftarrow were used to represent one-way influence. A $\leftarrow\rightarrow$ was used to represent mutual influence, and – was used when there was a correlation, but no influence.

Appendix E: Map Analysis of Interviews and Hip Hop Text Data

Critical Race Theory



Hip Hop-Resistance to Formal Education

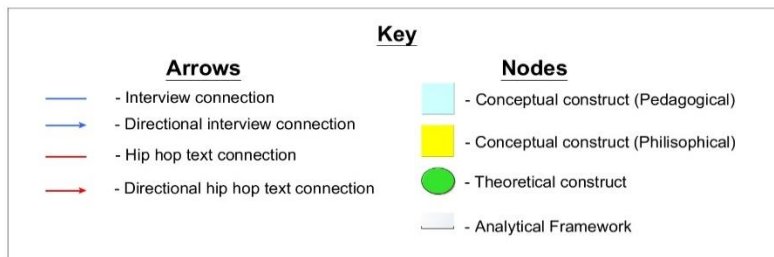


Figure 3: Map Analysis of the Interview and Song Data

Curriculum Vitae

Maurice E Dolberry

Education

University of Washington *August 2015*
Seattle, WA
Ph. D. – Multicultural Education
Dissertation – “From ‘They’ Science to ‘Our’ Science: Hip Hop Epistemology in STEAM Education”
Chair – Dr. Geneva Gay

University of Washington Simpson Center for the Humanities *June 2013*
Seattle, WA
Certificate in Public Scholarship

Florida Atlantic University *August 2010*
Boca Raton, FL
M. Ed. – Multicultural Education

Howard University *December 1997*
Washington, D.C.
B.S. – Biology
Minor – Allied Sciences

Research Areas

Curriculum Design; STE(A)M Education; Hip-Hop Pedagogy; Public Scholarship; Teacher Preparation; Culturally Responsive Pedagogy; Critical Race Theory; Critical Media Literacy

Teaching and Administrative Experience

Highline College *January 2015 - present*

- Taught DGS 137: African American Experience, a course on the history and culture of African Americans in the Department of Diversity and Globalism Studies

University of Washington at Bothell *January 2012 - present*
Bothell, WA
Instructor

- Designed and taught BEDUC 391: Hip Hop and Education, an undergraduate course in the College of Education on how and why hip hop culture influences learning
- Taught BEDUC 230 Culture, Knowledge, and Education, an undergraduate elective on epistemological constructs in multiple American cultures

Seattle University *September 2012 – December 2012*
Seattle, WA

Instructor

- Taught EDUC 520: Social Justice for Professional Practice, a prerequisite College of Education graduate course in multicultural educational praxis for practitioners

John F. Kennedy Middle School

August 2008 – January 2009

Riviera Beach, FL

8th Grade Science

- 8th grade science teacher in an urban Title I school
- Began creation of an integrated curriculum model by combining culturally responsive pedagogy, constructivist, and Understanding by Design philosophies

The Benjamin School

August 2003 – August 2008

Palm Beach Gardens, FL

Director of Diversity

- Administrative-level position with part-time teaching duties at a P – 12 school with two campuses
- Devised and initiated implementation of a four-part approach to enhancing diversity at Benjamin through student, faculty, and curricular support
- *High school courses taught:* Genetics, Anatomy & Physiology, General Biology, Honors biology, and Chemistry

The Blake School

July 2001 – July 2003

Minneapolis, MN

Grade Dean

- Responsible for counseling, discipline, scheduling, and high school and college preparation as a Dean of Students for the class of 2005 while working with grade deans of the three other high school classes in a modified vice principal system
- *High school courses taught:* General Biology and Algebra I

Capital Breakthrough at Ravenscroft School (formerly Wake Summerbridge)

June 1998 – July 2001

Raleigh, NC

Director

- Managed and organized the program, which was an official collaboration between Ravenscroft School, Wake County Public Schools, AmeriCorps, and North Carolina Teaching Fellows
- Responsible for devising and managing a \$125,000+ budget
- *High school courses taught:* General Biology

The Langley School

July 1996 – May 1998

McLean, VA

Middle School Science and Math Teacher

- *Middle school courses taught:* 6th grade Environmental Science; 7th grade: Algebra I and Physical Science; 8th grade Life Science
- Intern 1996-1997 as a part of the Multicultural Alliance Minority Teacher Development Program

Research and Consulting

Northwest Evaluation Association
Portland, OR

January 2014 – present

Educational Assessment Consultant

- Review proposed STEM problems for standardized tests to determine grade-level appropriateness, cultural sensitivity, and overall quality
- Review proposed English/Language Arts passages for essay questions on standardized tests to determine cultural sensitivity, bias, and fairness

GEAR UP Educator Development Initiative

May 2014 – June 2014

Seattle, WA

STEM Teaching Consultant

- Train STEM teachers in Washington State on classroom-level implementing the Next Generation Science Standards and the Framework for K-12 Science Education
- Created and facilitated workshops as well as post-institute academic support

Education Pioneers

June 2011 – August 2011

Washington, DC

Curriculum Design and Teacher Training Specialist

- Trained Washington, DC Public Schools (DCPS) middle and high school science and social studies teachers in curriculum design to meet Common Core State Standards for literacy in their subjects in a culturally responsive manner
- Designed and implemented the first professional development day for 300+ DCPS science and social studies teachers
- Conducted workshops on culturally responsive science and social studies pedagogy
- Wrote 11th grade physics curriculum for teaching scientific literacy using constructivist and culturally responsive, and critical pedagogies

Assistantships

UW College of Education Office of Minority Recruitment & Retention
Seattle, WA

August 2011 – June 2012

Graduate Assistant

- Organized the active recruitment of students of color to the UW College of Education
- Worked with applicants through the entire process of applying, visiting, and matriculating in the College of Education

UW Center for Multicultural Education

September 2010 – June 2011

Seattle, WA

Research Assistant

- Conducted research on how multicultural education is practiced in the United States and in other countries throughout the world
- Organized campus-wide events to promote multicultural education
- Editorial assistant for the Sage Encyclopedia of Diversity in Education which includes 700 worldwide submissions

Conferences and Selected Presentations

How to "Go There": Facilitating those Challenging Discussions as a Social Justice Leader – (2015)

Universal Leadership Conference

Workshop Facilitator

Roles for Asian and Asian American Allies in Black Lives Matter and Similar Movements – (2015)

Summer Youth Leadership Program, Seattle

Workshop Facilitator

Becoming a Hip Hop-Responsive Teacher... Whether or Not You Know Anything about Hip Hop! – (2013)

Northwest Teachers for Social Justice

Workshop Facilitator

Culturally Responsive Pedagogy in High School Science Using a Hip Hop-Based Epistemological Model – (2012)

American Education Research Association Conference

Panelist and Presenter

Effective Leaders of Diverse Populations – (2011)

University of Washington

Workshop Facilitator

Foundations of Education in a Multicultural Society – (2011)

Texas A&M University

Guest Lecturer

Improving academic outcomes for under-represented students – (2011)

Environmental Ed. Association of Washington/Washington Science Teacher Association

Panelist

Women in Leadership – (2010)

Florida Atlantic University

Panelist Reporter

Professional Affiliations

American Education Research Association

Education Pioneers

National Association of Multicultural Education

National Science Teachers Association

Scholarships and Honors

Selected student speaker for UW College of Education graduation – (2014)

UW Simpson Center for the Humanities: Certificate in Public Scholarship Fellow – (2011 – 2013)

Elected Executive Officer: UW College of Education Educators for Social Justice – (2010 – 2011)

Graduate Opportunities-Minority Achievement Program (GO-MAP) GOP Top Scholars – (2010 - Present)

Thomas J. Fleming Memorial Scholarship – (2009 – 2010)

A.P. Marshall Life Skills Scholarship – (2009 – 2010)

Phi Kappa Phi – (2010 – present)

Who's Who Among American High School Teachers – (2006)