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MAN UP:
Implementing Critical Pedagogy for Social Justice in a STEM-Focused 6th-8th grade After School Program for African American Males

By

Jeremiah James Sims

A dissertation submitted in partial satisfaction of

the requirements for the degree of

Doctor of Philosophy

in

Education

in the

Graduate Division

of the

University of California,

Berkeley

Committee in charge:
Professor Jabari Mahiri, Chair
Professor Glynda Hull
Professor Rodolfo Mendoza Denton

Spring 2016

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in a STEM-Focused 6th-8th grade After School Program for African American Males
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Abstract

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Professor Jabari Mahiri, Chair

Abstract:

STEM education has been reliant on axioms and purported facts that for far too long have been delivered in a banking or absorption model that is, arguably, anti-critical. Unsurprisingly, this pedagogical approach to STEM education has failed large segments of students; and, this is especially true of African American males. This study investigated the potential inroads and vistas of a Saturday Science, Technology, Engineering and Math (STEM) program, Male Aptitudes Nurtured for Unlimited Potential (MAN UP), designed to foster interest and competence in STEM subjects by middle school African American males. Critical pedagogical perspectives were central to the program's design and implementation as was the intent to increase their STEM competency in conjunction with developing STEM identities that are informed by social justice perspectives. Data collection covered the implementation of this program with first year MAN UP students for two or three Saturdays per month for a full academic year. Data included pre and post and focus group interviews with the entire first year cohort, participant observation in a focal class, classroom observations of the cohort's two additional STEM classes, video tapes of cohort students' project presentations, their online reflective journals, as well as interviews with their STEM instructors along with the instructors' online learning designs and reflections. This study significantly illuminates and documents viable approaches to increasing the interest in, competence with, and potential for socially just applications of science, technology, engineering, and math by students who are often marginalized in these subjects.

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Preface

"No one cares what you do in junior high, Jeremiah; you'll eventually be socially passed." These words were spoken to me by my middle school guidance counselor (who would later become principal). If my memory serves, I was once again in trouble for talking out of turn in class. This was a common theme during my first year in middle school as I worked diligently to carve out a "cool" identity for myself. I won't soon forget this moment, however, because it's when I began to see both school and myself differently. This counselor had given me license to free myself from academic struggle, which I didn't know at the time, was analogous to freeing myself from academic growth. This was especially true where math was concerned. After excelling in elementary school, middle school brought struggles that I was ill-prepared for, none more so than in math. I got stuck and never got unstuck because according to my counselor, I didn't have to.

Sadly, this story is all too familiar for many young, low-income, urban African American males, and especially so in STEM. And, more often than not we, or our parents, or our culture are blamed for our struggles in STEM. In truth, structural and institutionalized racism, which result in stultifying, low expectations for perhaps the most educationally marginalized group in this country, African American males, is the real culprit. Fortunately, as an adult I had people in my life who encouraged and assisted me in pushing forward with my education. However, this is not always the case for far too many young men who grew up like me: poor, black, and enmeshed within a violent, unrelenting environment.

I'm not oaky with this "reality"; I never will be. In time I was presented with the opportunity to create a program that would begin to address and hopefully ameliorate this saddening reality. Despite the reticence that my own math-phobia induced in me, I felt I had no choice but to move forward in developing a STEM focused program for predominately low-income, urban African American males.

With the guidance of my graduate advisor, Prof. Jabari Mahiri, and with the individual and collective brain power of my colleagues and brothers: Sepehr Vakil, Kenyatta Weathersby, Pierre Tchetgen, Dr. Fred Moore, Dr. Jarvis Sulcer, and T. Geronimo Johnson along with my little "brother" Gideon Morikang and my little "sisters" Stephania Vielma and Zoe Tamaki, the MAN UP program was born. This program was innovative in that it was designed as a space where urban, predominately low-income African American middle school males could learn, identify with, explore, excel in, and do STEM for social justice without having to check any aspect of their culture at the classroom door. This study is the story of a group of young men that strengthened their agentive voices in MAN UP -- voices that were never lost, rather, this is the story of voices that finally had an audience of committed listeners.

Chapter 1: Canaries in the Mineshaft

African American Males and STEM Education

According to Skinner (2008) a community's health can be gauged by how well black men and boys are doing within it. That is to say, black males represent the proverbial canary in the mineshaft. If Skinner's claim is accurate—we are all in trouble. According to Noguera (2008):

> Black males in America are in trouble. With respect to health, education, employment, income, and overall well-being, all of the most reliable data consistently indicate that Black males constitute a segment of the population that is distinguished by hardships, disadvantages, and vulnerability (2008:11).

Noguera's troubling observation is, sadly, yet unsurprisingly, supported by report after report, year after year. For example, the 2012 Level Playing Field Institute (LPFI) report on STEM Educational Inequality (Scott and Martin, 2012) found that there are still glaring inequalities in our state's educational outcomes. This is especially true for African American males, especially when the level of specificity for the data collected is disaggregated for STEM-related educational preparedness and attainment. The stark reality is that our schooling of African American boys does not foment the nutritive educational space that all children need (Marsh, J. H., Mendoza-Denton, R., & Adam Smith, J., 2010); instead, they normalize and reify the pressures, pejorative stereotypes (Steele, 2010; Leonardo, 2010; Duncan Andrade & Morrell, 2008), and academic failings of African American boys. Far too often (purportedly oppositional) culture, ethnicity, community, pigment, parenting and or comportment of black boys are used to obfuscate or elide authentic and potentially transformative conversations about the systemic, institutionalized racist apparatuses at the root of the educational underperformance of black boys.

According to reports from the Level Playing Field Institute (Scott, 2010; Scott and Martin, 2012), the STEM opportunity gap for African American students is profound. For example, just 43% of African American students reach proficiency in 5th grade science compared to 80% for Asians and Whites. By 6th grade with respect to math proficiency, 46 percentage points separate African American (35%) from Asian students (81%). Throughout middle and high school, proficiency rates in math and science continue to decline insuring that African American students are less likely to access and be successful in rigorous college preparatory coursework in these subjects. Predictably, very few graduate from college with degrees and career opportunities in STEM, the fields with seven of the top ten fastest-growing occupations between 2010 and 2020 (Scott & Martin, 2012).

These statistics are troubling for African American students generally, and though not disaggregated by gender, they are even more problematic for African American males who have the highest school dropout rates of any demographic category. For example, data on black males and public education in all 50 states in the U.S. indicate that they remain at the bottom of high school graduation rates in all but 13 states, and in those 13 states, Latino males are on the bottom (Scott & Martin, 2012). Clearly, there is a need to dramatically change the language, curriculum, and pedagogy utilized for learning STEM as well as other academic subjects as a human right in education for African Americans and, ultimately, for all students.

In 2011 I took charge of developing a unique, out-of-school education program aimed at transforming the language and pedagogy of curricular approaches to learning STEM in order to counter some of the problematic constraints on African American male academic achievement in these subject areas and related careers. The program featured three core classes – math, Computer Science and Mobile Apps (CS), and the Rhetorical Analysis of manhood (RAM).

These three classes were taught on two Saturdays each month throughout the school year to African American males in each of the three grades of middle school (i.e., 6th, 7th, and 8th grade).

Hosted and funded by a neighborhood-based non-profit organization located in the San Francisco Bay Area, after an application process that required transcripts, letters of recommendation and standardized test scores as well as phone and in-person interviews, I selected the participants, which were mainly drawn from under-resourced, under-performing public schools in several Northern California, urban municipalities. The acronym of the program, "MAN UP," stands for Male Aptitudes Nurtured for Unlimited Potential. With origins in African American vernacular, MAN UP has several meanings. One is to rise to the occasion to complete a task. Another is to take care of one's responsibilities. A third is to prepare oneself for a fight. The team of instructors led by myself (Mr. J) for the RAM class, Mr. K for the Math class, and Mr. S for the CS/Mobile Apps class implemented the program to leverage all three meanings, in part, by seamlessly incorporating African American language, culture, and daily life experiences into STEM learning. Within this framework we designed learning experiences that uniquely nurtured the participants' aptitudes – their innate or acquired capacities and talents – for STEM and, then, in turn worked diligently to encourage, empower, and equip them to use, or apply, their STEM knowledge and talents for social justice at the local, national, and even global level.

The educational team consciously and collaboratively instituted a critical-reality pedagogical approach as a deliberate way to develop the students' identities with and competencies in STEM as well as their capacities to conceptualize, develop, create, and test socially just applications of STEM. In line with this approach, we saw the linguistic, theoretical, and discursive components of Rhetorical Analysis as a tool kit that was central to the students' development because it afforded them with critical perspectives to not only absorb STEM, but to cognitively wrestle with the applications and ethics of STEM knowledge and skills. Although RAM classes were key to this approach, critical pedagogical practices were woven throughout the teaching and learning of all three courses.

During the second year of this program, I decided to formally study the impact of this critical pedagogical approach for learning and making identity connections to STEM for the young African American male participants during the 2013-14 academic year. Although MAN UP served a total of 43 students in 6th, 7th, and 8th grades, I focused on the 17 students in the first year of MAN UP (fourteen 6th graders and three 7th graders) to capture how they responded to and developed through the program during their first year of participation. Therefore, the guiding question for this study is:

> What are the impacts of a critical-reality pedagogical approach to the learning of STEM subjects on 6th and 7th Grade African American male students' competency in, identity with, and understanding and development of socially just applications of STEM?

Data collected on the first year MAN UP cohort included pre and post surveys, individual and focus group interviews with the students; interviews with the instructors of the science/technology and math classes; participant observation, video recordings, and field notes on class activities and field trips.

The Problem is Larger than STEM Access and Achievement

In developing MAN UP, the instructional team was fully aware of the reality that the young men we were endeavoring to work with, low-income (as determined be eligibility for Free and Reduced Lunch), urban, middle school African American males, faced a slew of

circumstances that are specific to them, but due to no fault of their own. Contrary to the negative stereotypical depictions promulgated in mass media and in K-12 education, nationally, we were convinced that there exists no innate or intrinsic cultural and/or cognitive deficits in the young men we planned to serve. We were also convinced that much of the low educational achievement of this group, the so-called achievement gap, is in fact based on structural and institutionalized, long-standing racist apparatuses (Leonardo, 2010; Delpit, 2012), which inform all aspects of their lived experiences.

Interrogating White Supremacist-based Racism's role in Perceptions of African American Maleness

Racism, which is predicated on a delusional and perverse notion of white supremacy (Roberts, 2011; Roediger, 1991), rests upon a pernicious, manufactured and patently false dialectical relationship with whiteness positioned as the *thesis*, and, blackness, seemingly forever positioned as its *antithesis*. This dialectical relationship was overt, violent, and ubiquitous and accepted—both socially and juridically—for much of American history. However, more recently whiteness has transmogrified. The overt hatred characterized by the peculiar institution of American Chattel Slavery, the three-fifths compromise, lynching, Jim Crow Laws, Separate But Equal Laws, segregation, and personified by the KKK, are no longer palatable for the general populace. So racism has become less overt, in many respects (Leonardo, 2010). Young black men can no longer be lynched by groups of whites with impunity; unless, of course in place of a noose, there is a gun, and in the place of angry white mobs there are uniformed law enforcement officers or overzealous pseudo-peace officers like George Zimmerman. Black youth culture has been forcibly and dangerously conflated with macro-level societal ills like violence and crime (Mahiri & Conner, 2003). This recriminatory strategy, which blames those victimized by white supremacy for their injurious relationship to it, employs ideological state apparatuses (e.g., schools, media, etc.) in the place of the more expensive and resource-intensive repressive state apparatuses (e.g., KKK, militia groups, police, military, etc.) it once relied heavily upon, in order to ensure the continued promulgation of the white supremacist agenda (Althusser, 1971; Leonardo, 2010)

Media is one of the most affective and, therefore, effective ideological state apparatuses. Ultra-conservative voices like DiIulio (1995) and Bennett (2005) along with a host of other conservative "pundits" have vilified black boys born to single mothers in impoverished communities for decades. This ethos is captured in DiIulio's (1995) "Superpredator" theory. Scholarship in the vein of DiIulio's tenuous theory serve to promulgate fear, racial profiling, and a deadly reification of negative, Black (I use the term Black interchangeably with African American throughout this study) male stereotypes, which is why purported claims of fear for one's life, when face to face with an unarmed Black man in the minds of people who accept these problematic stereotypes, somehow, allows for juridically sanctioned murder of unarmed Black boys and men. This negative reification of Blackness is convenient for white supremacists capitalistic endeavors as well: Black males are grossly over-represented in the multi-billion dollar prison industrial complex (Alexander, 2010). This is Chattel Slavery, reformulated. According to Sabol, West, and Cooper (2010), the Bureau of Justice statistics data showed "an estimated 4.8% of Black men were in prison or jail, compared to 1.9% of Hispanic men and .7% white men." In reality, the incarceration rates of African American people have been on the decline from 41.3% in 2000 to 38.6% in 2006 (Sabol et al., 2010); however, this is not the popular narrative because this narrative has the potential to begin unraveling the web of inconsistencies that white supremacy necessitates for its continued existence and prominence.

Still, Black males are more than six times as likely as White males to be incarcerated in this country (Alexander, 2010).

Entrenched structural and institutionalized racism carry the negative potential to adversely affect, seemingly, every facet of African American males' personhood, from identity formation and development to material advancement opportunities and actual, legal freedom (Alexander, 2010). The realities of limited access to equitable, STEM education for African American males functions as a microcosm for this macro-level reality. Thus, this study represents an inquiry into the efficacy of a STEM focused program, predicated on critical-reality pedagogy, on the identification, competency, and socially just applications of STEM for a group of 17 urban, predominately low-income middle school African American males.

Overview of Dissertation

Chapter 2 "Situating Critical Pedagogy-Reality Pedagogy in STEM Education," the literature review chapter, reviews literature on the inclusion of critical and reality based pedagogical practices in STEM education. I discuss literature that speaks to the root causes of underperformance in STEM for African American males: white supremacist-centered notions of Black inferiority and the pedagogical practices that are predicated on the erroneous, stereotypical depictions of African American males that have been normalized by the apparatuses wielded by this very same white supremacist agenda. In order to paint this picture, I discuss literature that perniciously positions African American males as threats and thugs who, irrespective of their age, are not afforded the notions of child-like innocence that buttresses the lived-experiences of the European American (i.e., White) counterparts. Next, I review literature that works to deconstruct white supremacy and the undeniable role it plays in catalyzing and promulgating negative stereotypes of African American males in in education generally and in STEM specifically. After this, I review the work of scholars who have discussed the negative effects of stereotyping on African American males' learning and identity. Then, wanting to move the conversation forward, I transition into an analysis of the literature that speaks to the potential benefits of a critical-reality pedagogical approach to STEM education of urban, middle school African American males by using Freire's (1997) conception of problem-posing education as the frame for the critical MAN UP pedagogical approach. Lastly, this chapter concludes by introducing, defining, and operationalizing two terms that are central to this study: the critical contextualization of STEM, and socio-academic synergy.

In Chapter 3, "Research Design", I delineate the design of this study including describing the site where the intervention took place as well as more detailed demographic information regarding the focal cohort. I also discuss the data collection procedures and data analysis procedures, and I discuss both the limitations of the research as well as my varied role as the researcher.

In Chapter 4, "Discussing the Focal participants' Developing STEM Identities", I present the analysis of and findings from my data by analyzing the focal cohort's math pre-and post-test scores, their shifts in their Manhood Development Concept Inventory, shifts in their Rhetorical Analysis Concept Inventory, as well as shifts in their CS/Mobile Apps course: Technology for Social Justice Concept Inventory (CS), respectively. As a result my analysis of the pre-survey data, three categories of participation came to the fore. In this chapter I highlight five students as case studies for the larger focal cohort in order to demonstrate the shifts in STEM identity experienced by these particular students as microcosms of the overall shifts experienced by the entire focal cohort. Following a discussion of these case studies, I return to a discussion of the

entire focal cohort. Additionally, I investigate how students began to identify as applied STEM practitioners; that is to say, drawing on data, I seek to uncover what contributes to and or the limits positive development of STEM identities for the focal students.

In this chapter, Chapter 5: "Developing Competencies in STEM and Beyond," I analyze the focal cohorts' shifts in STEM competency as captured by both their pre-post CS and Math concept inventories. In addition to working to facilitate MAN UP student's development of a positive STEM identity, this program also focused on developing specific STEM competencies required for college and careers. And, I chronicle the focal cohorts' shifts in STEM competency as well as their shifts in competency in their non-STEM RAM course in order to speak to the ways in which their increases in STEM identity contributed to their demonstrated increases in competency vis-à-vis the courses offered at MAN UP. That is to say, I work to illuminate the potentially powerful connection between the intentional development of a positive STEM identity—as an applied STEM practitioner—to their confidence and demonstrated ability to excel in the STEM course content covered in MAN UP (Brown, 2006).

In this chapter, Chapter 6: "Creating Socio-academic Synergy for the development of Socially Just Applications of STEM," I discuss how the intentional atmosphere developed and curated at MAN UP facilitated and/or contributed to the focal cohorts' desire, willingness, and ability to apply their increased STEM knowledge for social justice as well as their self-directed applications of STEM for social justice, which, when present, presents evidence that students had begun to critically contextualize STEM. This chapter also looks at the effects of synergizing atmosphere that worked diligently to include students' voices and their lived-realities into the curriculum as well as the overall ethos of this program. This chapter also speaks to the importance of centering critical-reality pedagogy in STEM and understanding the power of student agency via application, and why it is that a critical-reality based STEM pedagogical approach is a matter of social justice. And, I discuss surveys that students completed that speak to their relationship with MAN UP vis-à-vis their own home schools and draw implications regarding what, if any, elements of MAN UP's atmosphere contributed to student increases in the considerations described in this studies' guiding question. I conclude this chapter by making the argument that the critical contextualization of STEM was in fact taking place and was evidenced by the focal cohorts' positive shifts in STEM identity, competency and in their socially just applications of STEM. I also underscore the innovative nature of the MAN UP program. And, I speak to the importance of MAN UP's philosophical-pedagogical and material setting insofar as the role of this program's positioning played in catalyzing a nutritive educational atmosphere that worked to ensure socio-academic synergy between students' real lives and the course content.

In Chapter 7: Discussion of the pedagogical setting fostered at MAN UP, I discuss and further amplify the findings that precede this the penultimate chapter of this study. This chapter will assess the pedagogical atmosphere that characterized this program and how it created and curated a nutritive educational space that afforded the focal participants the opportunity to become applied STEM practitioners by realizing the critical contextualization of STEM. And in doing so, I reiterate the primary position of this study: i.e., that a critical-reality pedagogical approach to STEM education was integral to the creation of just such a positive, transformative atmosphere because it carved out a space for the realization of a socio-academic synergy, which, then, encouraged students to envision themselves as applied STEM practitioners as evidence by their demonstrated critical contextualization of STEM.

The eighth and final chapter, Chapter 8: "Now what? Implications for Educators,"

concludes the discussions raised in this study and draws implications for on-going teacher perspectives, STEM pedagogy and curriculum development as well as future research and educational policies that need to be conducted to better understand the importance of creating an educational climate, classroom by classroom if necessary, where hyper-marginalized students can begin critically contextualizing STEM so that they will experience increases in their STEM identity, competency, and demonstrated ability to apply STEM for social justice.

Chapter 2: Literature Review: Situating Critical Pedagogy-Reality Pedagogy in STEM Education

What's the Problem with Black Boys in STEM?

Much has been written about the problems of a digital divide between African Americans and others, and similar considerations also attend to STEM disparities. In this section, however, after an analysis of the issue that contribute the above-mentioned scholastic divides, I review scholarship that offers perspectives and prospects for ameliorating these issues through more comprehensive understandings of effective ways to build on the cultural and intellectual assets of African American youth. These understandings of STEM come from research and scholarship from the social sciences, from multicultural education, and from critical pedagogy. In combination, they offer counter considerations to the pathological framing of African American males in education, in society, and in the media.

Academic performances of African Americans and other marginalized groups can be characterized in terms of opportunity gaps rather than achievement gaps. Since opportunities in a society are selectively constructed and socially structured, they can be re-constructed through a more culturally connected language of instruction and designs of curriculum that make educational achievement a right for all students. In line with this, scholarship reviewed in this section reveals ways that African American students develop identities with and competencies in STEM subjects when exposed to pedagogies that are linguistically and culturally relevant and that connect STEM learning to socially beneficial applications

We know that African American males are tragically underrepresented in STEM. This is true of African American males throughout their educational journey, from kindergarten through higher education (if they make it that far). The number of African American males who excel on STEM-specific standardized tests, enroll in STEM advanced placement courses, complete STEM degrees, and hold employment in STEM related fields is disturbingly low.

What is more, the culture of African-American males, as though it is a unitary, essentialized reality, is often times dismissed, denigrated, or eradicated in traditional schooling (Nasir, 2011; Leonardo, 2010; Mahiri & Conner, 2003). Therefore, the goal of MAN UP was to engender a space for students to develop a positive cultural identity by connecting the work that they are doing in STEM to the contemporary and historic contributions, from African-Americans, as well as inviting their present, situated real-life concerns into this educational space—so that the work they do in this program is contextualized and relevant. Ultimately, the MAN UP instructional team was interested in facilitating the psychosocial growth of students who are strongly rooted in their home languages, cultures, communities and at the same time, able to appropriate what they need, in this case STEM competency, understanding, and a STEM identity, in order to survive and thrive in the dominant culture (Darder, 1998; Delpit, 201; Ladson – Billings, 1995**)**. Ladson-Billings names this cultural competence, i.e., when students are able to maintain their cultural integrity while succeeding academically (Gutstein, 2006).

To be clear, STEM barriers are not unique to African American males. The United States produces fewer White STEM professionals compared to past years. And, other traditionally marginalized groups like women and Latinos continue to lag behind European-American men with regard to STEM degrees, and consequently STEM careers, according to the National Center for Education Statistics. That said, the situation is far more pronounced, and far more exigent for African American males. According to the National Center for Education Statistics (http://www.huffingtonpost.com/2011/10/24/stem-education-and-jobs-d_n_1028998.html):

- Black people are 12 percent of the U.S. population and 11 percent of all students beyond high school. In 2009, they received just 7 percent of all STEM bachelor's degrees, 4 percent of master's degrees, and 2 percent of PhDs, according to the National Center for Education Statistics.
- From community college through PhD level, the percentage of STEM degrees received by blacks in 2009 was 7.5 percent, down from 8.1 percent in 2001.
- The numbers are striking in certain fields. In 2009, African-Americans received 1 percent of degrees in science technologies, and 4 percent of degrees in math and statistics. Out of 5,048 PhDs awarded in the physical sciences, such as chemistry and physics, 89 went to African-Americans – less than 2 percent. (National Science Board report, 2010: http://1.usa.gov/nwHbku)

According to the article that the above-mentioned data comes from "several factors are cited by scientists, educators and students" that shine light on why this gap has remained persistent. One is a self-defeating perception that STEM is too hard, which can be attributed to, among other things, racist stereotyping and stereotype threat (Steele, 2010). Also mentioned is a lack of role models and mentors, which delimits these students ability to fully develop a STEM identity as well as socioeconomic pressure to earn money quickly because of impoverished living conditions, and discouraging academic environments, like inequitable, subpar schooling. These "discouraging academic environments," according to Freire (1997) are the direct result of the alienating, disempowering, and stultifying banking model of education. The counter to the banking model of education which is purposely anti-critical is critical, emancipatory pedagogical practices which center students' real life experiences (Gutstein, 2006). The oppressive pedagogical practices that Freire and Gutstein are seeking to disrupt exist and have become ubiquitous and entrenched for African American males due in large part to both the perceived academic/cognitive deficiencies in African American males and their purported penchant for criminality.

The Transmogrification of Black Males: Thugs and Threats

The word "thug" has become synonymous with African-American male. There is no discernible difference in either words usage by many of the people who report on the murders of unarmed African American Males. For them, the two words seem to be interchangeable. This, of course, is an issue of framing. During slavery, the Negro was depicted as a happy-go-lucky pickaninny, who was wholly reliant on the slave master to provide for him; this was a justification for the peculiar institution of American chattel slavery (Fanon, 1968). This image changed during Jim Crow (Alexander, 2010): the happy-go-lucky Negro was transmogrified into the black Brute (as a new justification for the abject violence that was visited upon African-Americans by whites, and a justification for segregation). This is illustrated by the willful discursive shift from the term Negro to that of the dreaded nigger. No longer was the Negro a peaceful, God-fearing oaf akin to some semblance of a farm animal; instead, he became a rapacious, licentious nigger who was only interested in defiling the "virginal" white woman (Lott, 1993). This is the imagery, with the requisite caricatures, that has won the day at the present time. And, because of this, African-American males have been permanently positioned as a threat; and, in many instances reactions to them are based on this positioning. Homicide becomes "justifiable" when one feels as though their life is in danger and that there is no way to avoid bodily injury. This is especially true when law enforcement is accused of wrongdoing.

That is to say, the notion of justifiable homicide, when exercised on an African American male—armed or not, requires decidedly less justification.

So, then, it follows that if people have been led to believe that African-American males, all African-American males, are threats irrespective of who they are individually, then, the rationale for justifiable homicide and the burden of proof for justifiable homicide is much lower. This is the result of the masses having been coerced into believing, over many years, that all African-American males represent a real and present danger—a threat. This is not only true of police officers, this is also true of the people who would serve as jurors on a potential grand jury or any case that brings charges against an officer who has been charged with violating an African-American male's civil rights.

And, the sad reality is for many Americans is that this makes perfect sense. That is to say, these travesties of justice, when unarmed African American men, women, and children are gunned down in interactions with law enforcement, are viewed as instances of justifiable homicide precisely because African-Americans have been positioned as a threats, irrespective the presence or absence of threatening behavior, or a weapon, or whether or not they are adults capable of making adult decisions. Now to be clear, this is not a recrimination of police. The vast majority of police officers, White police officers, do not kill unarmed African-American males. That is not something to be applauded, mind you—but it is true. The fact that that this statement needs to be uttered, or in this case written down, speaks volumes. But, I am of the opinion that instances of police shooting unarmed African American males like Michael Brown and Tamir Rice (a twelve-year old child, playing with a toy gun in an open-carry state) is informed by both the non-conscious and conscious (erroneous) conflation of African American male and threat. This problematic (and patently false) association on the one hand informs police officers interactions with African American males and, simultaneously, supersedes any one interaction between white police officers and African American males. That is to say, the idea that all African American males are threats and must be subdued is present whether or not a particular African American male is in fact a threat (Miller, 2011). This is true in our school system as well (Ferguson, 2001).

Back to this idea of threat, the most telling part of it is that this correlation only works one way. An African-American male would be able to say that he killed a white man out of fear, based on the real history of atrocities visited upon him by European Americans in this country. But, this is essentially the primary thesis that supports arguments around justifiable homicide in relation to purported fear-based murders of African American males by European American police officers (and in far too many cases, citizens as well).

Switching gears, oftentimes conversations around the killing of unarmed African-American males by people by white men especially by white male police officers, comes up questions around fratricidal violence within the Black community, i.e., Black on Black violence, are brought to the fore. This is, undoubtedly, an exigent matter. Rates of Black on Black violence are heartbreakingly high (Miller, 2011). This is not due to some intrinsic criminality, some innate disregard for lawfulness by African-American males. Rather, it has much more to do with structural and institutionalized inequity that is made manifest by the lack of opportunity for well-paying jobs, academic success, access to health and wellness resources, and the negative effects of pernicious stereotyping (Alexander, 2010). And, what's routinely left out of these conversations is that fratricidal violence is not the exclusive domain of African-American males. The greatest threat to White males as far as murder is concerned is other White males; this is also true of Brown (i.e., Latino/Chicano/Hispanic) males.

I am not dismissive when it comes to conversations around fratricidal violence within the African American community. A loss of life is tragic no matter whom the perpetrator is. This is especially true when the lives that are prematurely snuffed out are of preteens and teenagers who irrespective of whatever mistakes they may or may not have made are disallowed the opportunity to learn from them and move on to become more reflective and more thoughtful people, as a result.

The Problematic Framing of African American Males in Mass Media

Conversation around the purported criminality and lack of educational success for African American males is decontextualized. It has become common practice to turn a blind eye to the macro-level problems that catalyze the disproportionate rates of crime in predominately African American communities (Alexander, 2010; Miller, 2011): deeply entrenched structural and institutionalized racist practices and apparatuses in all aspects of African American males lives, e.g., in the workforce, in education, legally, etc. Instead, conversations about the innate, intrinsic pathology of poor, urban African American communities seems to be the narrative that informs much of the conversations, specifically in mass media (Alexander, 2010), around what happens in predominately African American enclaves throughout this country. Fox News, the number one news outlet in the United States, speaks about the deaths of unarmed African American men as though they happen in a pseudo atemporal vacuum. This purposeful framing elides potentially transformative conversations that may serve to demystify the outrage of the African American community when one of its members is murdered, in cold blood, by real or pseudo-agents of law and order (Fanon & Sartre, 1965).

The Adultification of African American Males

African-American males are not allowed to make mistakes. I have been alive long enough to know that young people make mistakes. Much of my professional life is spent working with young people (specifically, African-American males), and, sometimes preteens and teenagers do things without weighing the implications or possible consequences of their actions. And while many people are aware of the fact that young people sometimes act on impulse, rather than forethought and planning, African-American males are not afforded the same benefit of the doubt that non-African-American males, or more specifically European American males are afforded especially vis-à-vis interactions with law enforcement.

For example, a widely-circulated (viral) video of a young man in a police station wrestling with several police officers was brought to the fore during the news coverage of the indignation and unrest that the deaths of Michael Brown, Trayvon Martin, and Tamir Rice (among others) unearthed. The young (European American) male in this video can be seen fighting with police officers for a few minutes, and at one point he was able to grab a police officer's holstered weapon and actually fire off a shot in the police station, thereby qualifying him as armed and dangerous, i.e., as a real threat. However this young man, this European American young man, was not shot. When this story broke, this young man was never described as thug. Instead, it was made very clear that this young man was on drugs and was "not himself." We were led to believe that he simply made a mistake, an egregious and dangerously illegal mistake; however, he is still very much alive. The officers involved were applauded for their restraint. African American males are much less likely to receive the protections afforded to people who are perceived as inherently innocent (Goff, DiTammaso, et al., 2014).

Unlike the European male described above, this was not the case for Trayvon Martin or Michael Brown. Both of their characters were impugned. They were, essentially and successfully put on trial for their own murders. They were not afforded the benefit of the doubt. But, instead, were depicted as Bigger Thomas-esque (Wright, 1940) thugs who were potential threats that needed to be neutralized, permanently. (Obviously, these two cases are not identical. George Zimmerman, to the credit of police forces everywhere, was never allowed to wear a police badge.) This is the unfortunate reality that far too many African American males face, and instead of providing safe haven from these exigent and dangerous realities, schools that are made up of predominately low-income African American students often reproduce these constant aggressions (Sue, 2010).

This should come as no surprise according to Duncan Andrade and Morrell (2008): they argue that our national education system was designed to underserve (or in their words, fail) hyper-marginalized students. Racism is far from dead in this country (Leonardo, 2010). If there is doubt, one need look no further than the ever-increasing achievement gap, which is due in large part to racist educational policies (Kozol, 2005; Giroux, 2011; Leonardo, 2010), poorly-prepared urban teachers (Delpit, 2012), and the prevalence and over-determination of deficit-model thinking (Valencia, 1997).

It goes without saying that in today's hyper-competitive, technological economy, graduating from high school and subsequently obtaining a postsecondary degree can mean the difference between a lifetime of poverty and a secure economic future. However, in the United States, high school graduation and college-readiness rates are alarmingly low, particularly among students of color. The numbers for African-American male students are especially disheartening: less than 47 percent of African-American male students graduate from high school within four years; and of the ones that do, fewer still are adequately prepared with the necessary skills needed for college admission (and ultimately, college success).

Many researchers here in the United States have investigated and theorized on the root causes of the long-standing "educational gap" (or more specifically, an educational gulf) between poor minority students, especially African American and Latino students and higher socio-economic status Whites and Asians, respectively. Despite the corpus of research and subsequent reforms and policy changes which purportedly seek to bridge this gap, very little has actually changed. Poor Brown and Black students still do far worse on standardized testing; also, Brown and Black students continue to be grossly underrepresented in college enrollment and alarmingly overrepresented in our Nation's multi-billion dollar prison industrial complex. To this point Steele (2010) argues that year after year, African American students fall further behind their European American counterparts.

This is especially true with regard to outcomes in STEM, there are glaring inequities in educational attainment: By the 6th grade, only 35% of African-American students in California performed at grade level in mathematics, compared to 67% of White students and 80 percent of Asian students (Scott, 2010). Just 16 percent of African-American students enroll in Algebra II, which is required to meet eligibility guidelines to apply to attend a public university in California. Of these students who enroll in Algebra II, only 14% of African-American students mastered the content and reached proficiency. In 2009, only 1,551 African-American students were enrolled in a STEM discipline across all UC campuses. This represents just 2% of all STEM undergraduates (ibid.). However, seven of the top ten fastest-growing occupations over the next ten years are in STEM fields (Bureau of Labor Statistics, 2009), which, again is a consideration, but is not, necessarily, the impetus for this program. The impetus of this program

was to provide low-income African American male middle schoolers with the opportunity to learn and excel in STEM while carving out a STEM identity as young people who are encouraged, equipped, and empowered to use their STEM knowledge to uplift their communities.

Exclusionary Nature of Traditional STEM Education

STEM pedagogical practices throughout K-12 education in this country have been and, sadly, for far too many underrepresented minority students, continue to be characterized by what Friere (1997) termed the banking model of education, wherein students are viewed as empty receptacles or sponges whose sole purpose, academically, is to receive the (deposited) knowledge that their benevolent teachers see fit to bestow upon them. Linn and Eylon (2011) later termed the stultifying, anti-critical educational paradigm the absorption model of education. The old adage that likens or even equates children to sponges is the byproduct of this educational paradigm. This is problematic because this approach obviates any consideration of what it is that these students bring to their respective classrooms precisely because the ability to create knowledge, in the form of rote, decontextualized facts (Gutstein, 2006), is viewed as the exclusive domain of the adult knower. This top-down pedagogical approach disallows students to question the knowledge they receive and it disallows them from devising ways to critically contextualize and therefore connect and apply STEM to their own lives in a meaningful way (Gutstein, 2006; Brown, 2006). So, then, STEM—for many of these students—is decontextualized. This is why the way that STEM education is conceived is an issue that inheres around opportunity and not simply achievement. Emdin (2010), Nasir's (2011), and Gutstien's (2006) respective work demonstrates the clear benefits of connecting students' lives outside of the classroom to the STEM course content. However, for the majority of low-income, underrepresented students of color, the opportunity to engage in rigorous, relevant STEM course work is scant (Scott, 2010). More likely than not these students will be forced to endure STEM course work that is decontextualized, disempowering and, perhaps, worse yet delivered by under qualified or even wholly unqualified teachers (Darling-Hammond, 2010). And, according to Leonardo (2010) this form of structural and institutionalized inequity, which is made manifest in the STEM educational attainment (i.e., grades, AP courses, degrees, graduate degrees, and careers) of underrepresented students of color, instead of addressing the real issue of delimited education opportunity instead works to recriminate the victims of this by making it seem as though their academic struggles are endemic and or innate due to their ethnicity, culture and or socio-economic status. This is especially true where low-income African American males are concerned. More simply put, the chasm between the opportunity to receive and engage in quality, critical STEM education as opposed to the staid traditional (banking) approach to STEM education is a much more reliable predictor of STEM educational attainment (Darling-Hammond, 2010)—not intrinsic and or innate drive, intelligence, and ability, as the term achievement connotes.

The Opportunity Gap

According to Duncan-Andrade and Morrell (2008) this is not a nation of opportunity in the truest sense, which has caused many to rename the long-standing achievement gap, replacing it with the appellation: the opportunity gap. In truth, outcomes are rigged; they have been for a long time. Schools are, according to Althusser (1971), ideological state apparatuses that function to inculcate and repress any perceived threat to the status quo. In this sense, schools are not

failing—if Althusser is correct, they are an overwhelming success. According to Gramsci (1971) proletariat (i.e., working class/poor) education should endeavor to make students critical consumers of all information so that they are equipped to become critical producers of counter-narratives and counter-measures. MAN UP was interested in this goal as well, i.e., to interrogate and disrupt problematic metanarratives around African American male academic struggles by equipping MAN UP students to use their STEM knowledge to challenge their forced subaltern positionality. However, the majority of African American males that populate the under-resourced schools that characterize urban enclaves throughout this country do not receive this kind of critical STEM education (Darder, 1998); instead, we have a problematic one size fits all educational approach. This one size fits all approach problematically assumes that all students learn in the same way. They do not. Educators, as much as possible, need to be sensitive to differential learning styles. Instead of questioning our own ideological predispositions or cultural understanding, far too often, educators subscribe to hegemonic stereotypical associations that inform the ways in which we interact with students that come from cultures different than our own. This is incredibly problematic precisely because hegemony naturalizes the process by which mainstream inequity is made to appear normal, endemic or worse, innate, because of the purported intrinsic deficiency within marginalized people (Althusser, 1971; Leonardo, 2010). If unchallenged stereotypical understandings and associations based on white supremacist, hegemonic depictions of African American males positions these young men in an uphill, life-or-death struggle for not only recognition of their personhood, potential, and talent—but their very freedom as well. In fact, Toldson and Snitman (2010) found that "All of the problems related to the school-to-prison pipeline disproportionately affect black males (2010: 2). Likewise in a 2008 study of "4, 164 black, white, and Hispanic males" the authors found that "59 percent of black males reported that they had been suspended or expelled from school, compared to 42 percent of Hispanic males, and 26 percent of White males [respectively] (2010: 5)." This is especially problematic because the same study, unsurprisingly, revealed "disciplinary referrals are […] associated with negative attitudes and dispositions toward school […] (2010: 5)."

So, then, because I was aware of the psychological vicissitudes that many urban African American males face simply by virtue of the families that they were born into, through a combination of scholarly literature, independent research, and lived experience as a urban African American male, the core tenets of MAN UP reflected my desire to provide African American male students with a robust, critical STEM-focused educative environment. And, in doing so, my goal was and continues to be to disrupt subtractive schooling practices that produce a false binary between urban non-white students and students of color. As a result of this ubiquitous yet altogether false dichotomy African American males must either choose to stay true to their home environ, identity, etc., or opt to get out (Fordham & Ogbu, 1986). This is a difficult proposition for adults: just imagine how it can weigh on a young person. This difficult proposition becomes unbearably arduous, according to Steele (2010), when marginalized students are faced with course material, especially STEM material, which has been stereotypically (and erroneously) positioned as beyond the scope of their cognitive abilities.

Stereotype Threat

Steele's work confirms that traditionally marginalized African American boys internalize this untrue and altogether troubling narrative (Burrell, 2010), i.e., that they are intrinsically unable to excel in STEM and in life due to innate, intrinsic cognitive and or cultural deficiencies. Philip (2011a) argues that because of its seemingly endless promulgation, this lie has reached

axiomatic status. This is, obviously, disconcerting on many levels, as is the overall lack of response to the exigency of African American male students' inequitable educational opportunities and resultant educational outcomes. Make no mistake: poor African American males are in a crisis in this country (Noguera, 2008). However, instead of addressing the structural and institutional inequities that catalyze this problem, our society has committed an egregious non sequitur: rather than working to create educational spaces that will truly reach African American males, which should be the logical response, our Nation has created entire prison industries out of African American male misery (Alexander, 2010). That is to say, instead of working to ameliorate inequitable educational policies and practices that lead to African American male academic underperformance, the response has been to create jails to house young men who were, essentially, pushed out of school as the result of racist, oppressive structural and institutionalized inequity. And, if in spite of all this, African American males are able to stay in school, they must do so in the face of widespread (erroneous) negative stereotypes regarding their inherent intelligence, culture, drive, work ethic, and family life. This, then, results in cyclical psychological violence because students who feel that they are being negatively stereotyped, traditionally, perform poorly on standardized test, which by their very nature bring questions regarding inherent ability to the fore. According to Steele and Aronson (1995), this is especially true of African American students. As far as this, they note that:

> Since the publication of our initial report [on stereotype threat] a decade ago, nearly 100 studies on stereotype threat have been conducted, both by us and by researchers around the world, showing that stereotype threat is a significant factor in the achievement gap […]. These studies shed considerable light on how stereotypes suppress the performance, motivation, and learning of students who have to contend with them (http://www.ascd.org/publications/educational-leadership/nov04/vol62/num03/The-Threat-of-Stereotype.aspx).

Working to disconfirm pernicious stereotypes, even at the non-conscious level, for far too many bright African American students robs them of their full cognitive ability because they must continually use far too much of their computational power to focus on non-essential tasks like refuting stereotypes (Aronson, J., Fried, C., & Good, C., 2002). According to Aronson (2004):

> Research indicates that African Americans are well aware of their group's negative reputation. Indeed, some research suggests a tendency for African Americans to be hyperaware of the negative expectations about their group and to considerably overestimate the extent to which the mainstream sees them as less intelligent and more likely to commit crimes and live off welfare […]. Thus, when black students are in an evaluative situation—being called on in class, for example, or taking a test—they experience an additional degree of risk not experienced by non-stereotyped students.
> (http://www.ascd.org/publications/educational-leadership/nov04/vol62/num03/The-Threat-of-Stereotype.aspx).

Undoubtedly, much needs to be done around the overall, holistic social welfare of the urban poor; and, this is perhaps especially true in poor, predominately African American enclaves that are besieged by abject rates of unemployment (Alexander, 2010), wanton violence, inequitable access to quality health care and quality education. Access to quality education is a key component for upward mobility for hyper-marginalized people (Wacquant, 2008). According to the Intercultural Development Research Association's (IDRA) website:

> Education has been and is a way out of poverty, especially for minority students. Students with a college degree have fared far better (even during the last recession) than those who either left school before graduation or earned only a high school diploma. (http://www.idra.org/IDRA_Newsletter/January_2013_Fair_Funding/Education_as_Pathway_Out_of_Poverty/#sthash.CHg6x1DW.dpuf)

Of course, conceptions of quality education differ throughout K through 12 education here in the United States. What is understood, however, is that whatever conceptualization of education ultimately becomes normative or more specifically standardized, STEM education will take center-stage. So it follows that it is within conversations about STEM education where potentially transformative dialogues—regarding shifting extant educational paradigms towards a pedagogical approach that centers critical pedagogy and is impelled by notions of social justice—begin to become more meaningful. As I discuss further, below, the banking model of education (Freire, 1997) that characterizes our current educational milieu in test-centric, under-resourced urban schools has proven to make the (so called) achievement gap even more protracted for hyper-marginalized African American male students. So, consequently, it behooves equity-minded educators, especially those interested in the plight of African American males, to begin participating in conversations around STEM education, like Bob Moses (Moses & Cobb, 2001) in his work in the Algebra Project, as an issue of social justice.

Circling back to one of the primary tenets of MAN UP, which was to afford students a space to be who they are, urban middle school African American males, (without sacrificing their academic identities), this program was impelled by a curricular focus that was aligned with course content that encouraged MAN UP students to do STEM just as they were by connecting STEM to issues that were in some cases specific and in others simply important to them as urban African American males (Ladson-Billings, 1995). One of the goals of this approach was to help MAN UP students develop and strengthen their own academic identities. Nasir's (2011) research on the vicissitudes of African American students' vis-à-vis math education has underscored the importance of positive academic identity development (Burke & Stets, 2009) as a constitutive part of academic success for traditionally marginalized African American students. Studies find that there is a positive reciprocal correlation between positive academic and cultural identity development and increased math performance (Nasir, 2011; Gutstein, 2006).

Because of this MAN UP's curricular and pedagogical approaches sought to equip, encourage, and empower middle school African Americans boys to disrupt the negative stereotypes that have been sutured to them so that they can forge new available identities as critical, socially just scientists, technologists, engineers, and/or mathematicians. In order to accomplish this lofty goal, the MAN UP STEM focused curricular approach centered and was framed by critical pedagogy.

STEM Education Can and Should Center Criticality

Moses and Cobb's (2001) work in the Algebra Project served to position access to quality math instruction as a civil rights issue. We know from Brown V. The Board of Education (Bell, 2004) that access to equitable educational opportunity is in fact a civil right, with deeply political implications and potential ramifications. Moses and Cobb's work acknowledges this whilst simultaneously narrowing the level of specificity by perspicaciously identifying math, and algebra in particular, as an educational bulwark that has been used to serve the interest of and maintain a hegemonic (Gramsci, 1971) status quo that relies, in part, on an oppressive (and

compulsory) educational approach in order to perpetuate and ensure its continued dominance (Drew, 2011). Ultimately, what Moses was up against was the pedagogy of the oppressed, which is built upon the oppressive, stultifying banking model of education (Freire, 1997).

For Freire (1997), the pedagogy of the oppressed is predicated on what he termed the banking model of education. The banking model of education is built on a false dichotomy, according to Freire. It juxtaposes teachers, diametrically, vis-a-vis the students they serve. This is problematic because the teacher student relationship, by and large, here in the United States is nestled, comfortably, atop an asymmetrical power relationship, where teachers are the knowers and the students are positioned as unknowing blank slates, with little or nothing to contribute.

To counter this Freire (1997) argued for a universal consciousness, or what he termed, conscientization, wherein the oppressed could be re-positioned such that they can begin questioning the apparatuses, institutions, and structures that are responsible for their oppression. For Freire, this called for a move away from an oppressive pedagogy to an emancipatory pedagogy, founded on problem-posing, which he argued would equip oppressed people to realize their ontological vocation: that is, to be fully human.

Freire's (1997) point is that this coercive pedagogy, the banking of education model, further vitiates the already waning spirits of the oppressed. It serves to make their unequal treatment more palatable, precisely because it is classified under a veiled, and consequently, more insidious nomenclature: curriculum. The students who are marginalized are taught to acquiesce. Freire writes, "The 'humanism' of the banking approach masks the effort to turn women and men into automatons—the very negation of their ontological vocation to be more fully human (1997: 55)."

While Freire's work has been immensely influential in many educational circles, the oppressive pedagogy he sought to deconstruct and ultimately eradicate is still the rule and, sadly, not the exception. The ever-expanding achievement gap and disproportionality of African American males in high school honors classes as well as enrollment in higher education and college graduation, among other statistics proves that this stultifying model of education is still as damaging and pernicious as it was in Freire's day.

To be clear, Freire was writing, primarily, about literacy education. Like the work of Eric Gutstein (2006), which applied Freirean conceptions of emancipatory education to math instruction—in the same spirit—this study applies Freirean conceptions of emancipatory education to aspects of science, technology, engineering and math. Because according to Gutstein, (2006) instead of a math education that empowers students to use math as a tool for equity, students are made to anti-critically ingest and then regurgitate whatever information their teachers feeds them. Students measured ability to employ rote memorization techniques in order to regurgitate the information that they are fed is purported to be proof of their ability to not only succeed academically, but also to learn, cognitively. Linn and Eylon (2011) term this model of science education the absorption model of education.

Furthermore, students are often made to feel as though their lives outside of their "sanitized" classrooms spaces hold no value and are therefore taboo in the educational spaces they spend the majority of their waking hours within. This is especially true of STEM content. Criticality, if allowed, is often relegated to the humanities or the "soft" sciences (Giroux, 2011). Indeed, there are spaces where youth's epistemological curiosities regarding STEM content are stoked, developed, and curated. However, African American males, arguably as much as or more than any other group, have been traditionally and routinely disallowed to participate in these kinds of critical, empowering educational milieus (Darder, 1998). According to Freire (1997), "When teachers engage students in reading and writing the world regardless of the subject they

are enacting problem posing pedagogy's (1997: 48)". Freire wanted to move is beyond a pedagogy that stultifies hyper-marginalized students, by positioning them as empty receptacles suitable only to be filled by knowledgeable teachers, precisely because they are viewed as devoid of agency, expertise and valuable input. This is not happenstance. The pedagogy of the oppressed serves to delimit the possibilities for hyper-marginalized (Freire, 1997) students because it disallows students to question, critique, and ultimately challenge the systemic forces that catalyze and ensure their oppression. Instead, far too often, these students are duped into believing that they are innately and intrinsically (as well as culturally) unable to excel in school in general, and in STEM in particular (Leonardo, 2010).

Therefore, in response to this and in order to create a safe space for urban, low-income middle school African American males to develop their STEM identities, while becoming more competent in STEM and in applying STEM for social justice, MAN UP instructors devised ways to employ many aspects of culturally relevant teaching (Ladson-Billings, 1995):

1. *Identity Development:* MAN UP Students are encouraged to explore and employ STEM as urban, middle school African American males. They are not forced to, explicitly or implicitly, repudiate their identity in order to become fledgling STEM practitioners. Quite the obverse is true: MAN UP students are encourage to connect STEM to their lived experiences as African American males by using their STEM mastery to address inequity within their own respective communities.
2. *Equity and Excellence:* MAN UP Instructors are unwavering in their belief that all students can learn, and more acutely, that all MAN UP students will learn. We will not settle for less.
3. *Teaching the Whole Child:* MAN UP centers the lived experiences of middle school African American males in STEM, and in doing so, we focus not only on the intellectual development of our students, but their psychosocial development as well.
4. *Student Teacher Relationships:* MAN UP instructors, via their own experiences alloyed with eight hours of professional development on critical pedagogy, realize that the teacher-student dichotomy that permeates K-12 education here in the United States (Freire & Macedo, 1987) is patently false.

My goal as the Founding Director of this program was to encourage the STEM instructors to remain malleable by reinforcing the fact that in addition to being facilitators of learning (Ballou, 2012), knowledge creation, and meaning co-construction, we were students as well. Nevertheless, while the above stated principals of CRT proved invaluable in developing MAN UP's curricular approach and pedagogical frame, it was my belief that CRT as a pedagogical approach lacked one crucial element: a focus on activism. CRT, when properly employed, undoubtedly contributes to a more equitable and inviting educative space, which is phenomenal and necessary for marginalized students. However, for me sans the activist focus that critical pedagogy is predicated on, it can potentially fail to foment real agentive, transformative societal change *by* students—not just *for* students.

In CRT, educative spaces are transformed for students by benevolent teachers and/or administrative staff. The curriculum becomes culturally diverse and therefore more inviting; however, it is not the students themselves who are necessarily working to transform their educational reality, or, to re-create their respective worlds (Fanon, 1968). MAN UP students were encouraged to be agentive, that is, to be prepared to demand positive social change, not by simply marching or more overt forms of protest, but also by deconstructing the stereotypes that have caused them to internalize both educational and STEM failure, and, by doing (applying)

STEM to address problems that they themselves identified. I wanted MAN UP students to not only feel comfortable in their classes because there were pictures of Reverend Dr. Martin Luther King, Jr., on the wall. While this is important, I also wanted them to know that there is much work to be done and STEM is, perhaps, the primary medium in which they could begin to repair the broken neighborhoods and cities that they hail from. Critical pedagogy is founded on just this type of transformative action (Duncan Andrade & Morrell, 2008).

The Need for Critical-Reality Pedagogy in STEM Education

Clearly, there is room for criticality in STEM. Students should be encouraged to question naturalized axioms (Philip, 2011a) as well as their own positionality and subjectivity within their specific socio-political, socio-historical, and socioeconomic realities (Freire, 1997). This is why the MAN UP instructional team sought to implement components of critical pedagogy in our instructional practices. Critical pedagogy is decidedly Marxist in that it is concerned with alienation and exploitation (Giroux, 2011; Freire, 1997) and, it is simultaneously postmodern precisely because its ontological vocation is deconstruction (Derrida & Caputo, 1997). That is to say, critical pedagogy seeks to re-empower traditionally oppressed students by presenting them with the necessary tools to come to consciousness so that they can begin to exercise their power to deconstruct the ideological and juridical bulwarks of inequity that wreak havoc on and in their lives. More specifically, it works to provide students the means to think meta-cognitively about their own ideological predispositions (Althusser, 1971; Leonardo, 2010; Apple, 2004) as well as the unmistakably Eurocentric, Western-centric ideology that pervades their social reality (Fanon, 1968; Leonardo, 2010). The goal of this kind of critical interrogation is that students would begin to question the assumptions and limitations that they have placed on themselves as a result of the sadistic ubiquity and proliferation of the negative stereotypes, which have been, seemingly, sutured to their identities as urban African American males.

The impetus of critical pedagogy (Duncan Andrade & Morrell, 2008; Giroux, 2011), then, according to proponents and practitioners is to equip oppressed students with a critical framework that will afford them the means to extricate themselves from a pedagogy that has continuously repressed and oppressed them, educationally, socially, and consequently culturally (Freire, 1997; Baugh, 1996). Furthermore, critical pedagogy seeks to facilitate this transformation by encouraging, equipping, and empowering students to develop their agentive voices so that they can begin to transform their worlds by deconstructing the seemingly axiomatic Eurocentric meta-narratives that animate Western culture (Philip, 2011a), both nationally and globally. By centering critical pedagogy, the goal of MAN UP's curricular approach was to emancipate students from STEM education that is predicated on uncritical, rote memorization and regurgitation, i.e., the absorption model, so that students would begin to identify as change agents capable of breaking this cyclical educational inequity by making STEM their own, by contextualizing, appropriating, and subsequently applying STEM in the remediation of societal issues that are important to them. More simply put: MAN UP students were encouraged to be critical producers of STEM, not merely passive consumers of it. Paulo Freire's work was indispensable in conceptualizing the way that MAN UP sought to alloy critical pedagogy and STEM education. Reality pedagogy (Emdin, 2010) argues that students' lived-experiences need to be valued and incorporated, not unlike critical pedagogy; however, Emdin (2010), in defining reality pedagogy, argues that it is perhaps most useful specifically within STEM educational context. Thus, the pedagogical approach that MAN UP instantiated was a combination of critical-reality pedagogy because I felt that this approach provided the optimum

way to engage MAN UP students as individuals full of potential, promise, concerns, and expertise vis-a-vis the rigorous STEM work that this program featured.

According to Freire (1997), the pedagogy of the oppressed disallows intellectual discourse between the student and teacher, teacher and student, in favor of a monologue, or worse, dictation. Furthermore, Freire contends that the pedagogy of the oppressed functions to maintain the hegemony that exists in a given oppressive society. He writes: "If people, as historical beings necessarily engaged with other people in a movement of inquiry, did not control that movement, it would be (and is) a violation of their humanity (1997: 66)."; he goes on to say, albeit, in much more pointed words, "Any situation in which some individuals prevent others from engaging in the process of inquiry is one of violence…to alienate human beings from their own decision-making is to change them into objects (Freire 1997: 66)." To this point, I feel a pellucid quote from Frantz Fanon (1968), a noted racism and anti-colonial theorist, reflects perfectly Freire's own polemic against the oppressive nature of the banking of education that educational humanism espouses:

> In capitalist societies, education, whether secular or religious, the teaching of moral reflexes handed down from father to son, the exemplary integrity of workers decorated after fifty years of loyal service, the fostering of love for harmony and wisdom, those aesthetic forms of respect for the status quo, instill in the exploited a mood of submission and inhibition which considerably eases the task of the agents of law and order (Fanon, 1968: 3).

The "agents of law and order", the elites, are the ones who determine what knowledge is, and, what knowledge should be disseminated (Kuhn, 1970). Consequently, what is taught concretizes the social arrangement that educational humanism simultaneously presupposes and promotes: i.e., that there is a knower, who by virtue of her or his knowledge is societal elite, and one who does not know, who, conversely, is marginalized due to her or his lack of knowledge. For much of our Nation's history, African American people and more specifically African American males have been forced to assume this obsequious position—the non-knower (Leonardo, 2010). As Fanon (1968) writes, this inequitable, White supremacist based positioning makes the maintenance of the status quo, speciously, in the name of "order", much easier to infuse and indoctrinate into the subordinate class, i.e., the oppressed. What is more, this hegemonic relationship purposely leaves no room for critical inquiry: the knower knows, and his knowledge is unquestioned.

This is how STEM is positioned in K-12 education (Emdin, 2010). If these conditions are accepted, criticality is discouraged in the student. If Fanon is correct, this is a controlling mechanism. The marginalized groups 'learn' or more precisely, they are inculcated with the "virtue" of living out a subservient existence according to the auspices of the "social institutions…that embody the fruits of civilization (Fanon, 1968: 31)." Freire warns that any attempt to re-order this dynamic will greeted with bitter opposition: "to resolve the teacher-student contradiction, to exchange the role of depositor, prescriber, domesticator, for the role of the student among students would be to undermine the power of the oppressor… (1997: 56)." However, this ambitious and potentially contentious goal was the goal that impelled the development of MAN UP's pedagogical approach.

Deconstructing this reality was (and is) crucial precisely because the persistence of the hackneyed banking model of education (Freire, 1997), in general and in STEM education specifically, continues to oppress and stultify African American males. According to the traditional model of STEM education, mastery necessitates a kind of rote, passive acceptance.

MAN UP was designed to move away from this anti-critical model so as to reinvigorate the tension between criticality and STEM by creating a program that first encourages, empowers, and equips, then, requires students to critically (and meta-cognitively) interrogate and subsequently employ STEM in order to better not only their own lives but also the lives of members from their local, national, and global community/ies. For the MAN UP instructional team, this is a matter of social justice.

Social Justice and STEM Education

Gutstein's (2006) analysis of math education is a microcosm of STEM education writ large in that math has, traditionally, been viewed as the a gatekeeper that wards off hyper-marginalized students and precludes them from achieving academic success at comparable rates to their European American and Asian American peers (Gutstein, 2006; Moses & Cobb, 2001). Gutstein argues for a version of math education that affords hyper-marginalized students a nutritive educational space where they can not only learn math, in the canonical sense, but also where they can agentively apply math to issues that inform and affect their sociopolitical and socioeconomic realities. He argues that this has not been the impetus of math education, traditionally:

> The goal of increasing equity within mathematics education does not explicitly position teachers and students is having the transformative power to rectify fundamental structural inequalities through their participation in civil society, both within and outside of educational remiss. In this sense, it does not connect school into the larger sociopolitical context of society (Gutstein, 2006: 31).

Furthermore, Gutstein (2006) argues that by canonizing a form of depoliticized math education that serves to maintain an inequitable status quo, the National Council of Teaching Mathematics is contributing to an exploitative capitalist endeavor that necessitates the positioning of the poor and uneducated as mechanistic workers upon whose backs capital can be accrued:

> Thus, in analyzing the sociopolitical context of mathematics education, my contention is that (a) mathematical literacy, as a form of functional literacy distinct from critical literacy, serves the needs of capital accumulation in the United States; (B) the NCT M, as the major organizational force within the mathematics education community, has frame mathematical literacy largely from the perspective of US economic competitor to this in the global order and has avoided discussions of whose interest is served; and (C) mathematical literacy from various groups of students in a stratified labor market, unfortunately, has divergent meanings for different social groups. A reconceptualization of the purpose of mathematics education is needed – one that includes envisioning mathematical literacy as critical literacy for the purpose of transforming society, in its entirety, from the bottom up toward equity and justice, for all students whether from dominant or oppressed groups (Gutstein, 2006: 28).

To this point Barton (2001) writes: "...marriages between capitalism and education and capitalism and science have created a foundation for science education that emphasizes corporate values at the expense of social justice and human dignity (2001: 847)" She goes on to argue that this dynamic is especially prevalent and especially pernicious in urban educational settings, which is why MAN UP sought to immerse students in STEM education and curriculum that encouraged them to make connections between STEM and their real lives so that they could transform the seemingly static bulwarks of structuralized race-based inequity that inform their

lived-experiences as low-income, urban, African American males. In order to position them as young people who were attuned to the varied manifestation of social injustice that characterized their lives as urban, (predominately) low-income African American males in addition to our critical-reality based pedagogical approach, course content regularly inhered around and was derived from matters of social justice and social injustice.

Social justice, as an educational framework, is impelled critical pedagogy (Giroux, 2011; Smyth, 2011; Gorski, Zenkov, Osei-Kofi, Sapp, Stovall, 2013). It functions to empower, encourage, and equip hyper-marginalized students to use their agentive voices so that they are armed with and have the propensity to employ critical theoretical lenses, which are necessary to disrupt the inequitable milieus that students are forced to navigate. These milieus can be social, political, civic, and/or educational. And, the inequity that social injustice engenders, and consequently ensures, can inform all of these spaces, simultaneously. In MAN UP, we were especially interested in the educational spaces where social justice is routinely enacted. However, this is not to say that we turned a blind eye to the other areas that inform MAN UP students' lived-experience as African American males within a National milieu that has been (and continues to be) inhospitable and traditionally fearful of African American males (Noguera, 2008). According to Gutstein emancipatory, critical math education should disambiguate: "underlying ideologies and begin to understand how mathematics can be used to reveal or hide injustice" by using "statistical examples that draw students attention to social inequalities such as how poor people pay taxes they cannot afford while the rich use loopholes to avoid taxes (Gutstein, 2006: 3)."

One of the goals of an emancipatory, critical math education should be to ensure that "students understand mathematics and the political nature of knowledge whose knowledge is, and is not, valued, as well as how mathematics is often used to hide social realities (Darder, 1998: 24)."

There is, unequivocally, a certain degree of plasticity regarding working definition of social justice framework. However, in developing the MAN UP pedagogical approach, I along with the STEM instructors, Mr. K and M.S, adhered to a straightforward criterion that we agreed our particular social justice frame must adhere to: (1) It has to work to disambiguate false metanarratives (e.g., meritocracy, melting pot metaphor, etc.); (2), In addition to this, it must work to disrupt the banking model of education (Freire & Macedo, 1987); and, contiguously, (3), if it is to be an efficacious social justice oriented frame (and curriculum), it must be vitally concerned with empowering agents to exercise self-determination and realize their full potential; and, (4) it must seek to equip students to deconstruct oversimplified explanations for societal injustice and inequity; (5), and, it must seek fair (re)distribution of resources, opportunities, and responsibilities, while (6), building social solidarity and community capacity for collaborative action.

The (peculiar) institution of compulsory, K-12 public education, from its inception here in the United States, has been a tool or ideological state apparatus (Althusser, 1971) that has been employed so as to mechanically reproduce a certain type of purportedly normative student (Giroux, 2011). To be more precise, schooling here in the United States is, essentially, a factory that reproduces a definite Eurocentric, middle class aesthetic (Leonardo, 2010). This is why our schools have failed many African American male students (Noguera, 2008; Duncan Andrade & Morrell, 2008). The reality is that, according to Toldson and Snitman (2010), 80 percent of America's teaching force self-identifies as European American (this term is interchangeable with white in this study). And, what is more, more that 65 percent of all teachers are in fact European

American women. Make no mistake: I am not arguing that these statistics are not inherently problematic. European American teachers, whether female or male, are not unable or incapable of teaching African American males simply by virtue of their differential ethnicity (Howard, 2006). Nevertheless, the reality for the vast majority of African American male students is that they will encounter very few teachers who come from where they come from, and very few teachers who look like them (Ladson-Billings, 1995) in their respective educational careers.

Understandably, many instances of cultural dissonance arise because of this dynamic. This program, MAN UP, was created—in addition to educational preparation—as a space where the issues that spring out of this cultural (and gendered) mismatch can be addressed, and ultimately redressed. I was convinced, in developing the pedagogical plan for this program, that a focus on critical-reality pedagogy, as the pedagogic and curricular vehicle, held the potential to begin ameliorating this mismatch—precisely because a critical education is, in fact, a matter of social justice (Smyth, 2011). And, practically, it should work to prepare MAN UP students to begin thinking through ways to use STEM for societal uplift. Far too many hyper-marginalized students, especially poor, urban African American males are not exposed to critical, socially just, relevant curricular material in school in general, much less in their STEM coursework (Delpit, 2012). This is perhaps more pronounced in regards to STEM education, precisely because STEM education, according to scholars like Barton (2001) and Gutstein (2006), is routinely taught in a depoliticized and decontextualized manner that functions to further strengthen the United States' multibillion dollar Military Industrial Complex. According to Gutstein (2006), this anti-critical approach to STEM education runs counter to a social justice educational agenda:

> From a social justice perspective, there is a significant problem with framing mathematical literacy from the perspective of economic competition. In essence, this positioning places the maximization of corporate profits above all else. This is fundamentally in opposition to social justice agenda that instead places the material, social, psychological, spiritual, and emotional needs of human beings, as well as other species of the planet, before capital's needs. (Gutstein, 2006: 24)

The goal of the MAN UP pedagogical approach involved a constant unveiling of reality, which strived for the emergence of conscious, critical contextualization of STEM by MAN UP students. In this study I define the critical contextualization of STEM thusly: The critical contextualization of STEM (see Figure 1) is evidenced by students beginning to appropriate and critically apply STEM as a tool to redress issues or problems, which are connected to students' lives that inhere around notions of equity/inequity and or social justice. This approach sought to increase the opportunities for MAN UP students to critically interrogate and intervene for socially just individual and collective outcomes.

Flipping the Script: Connecting Cultural-Linguistic Identities and STEM Competencies

Steele's (2010) work on individual and group stereotype threat provides an expansive lens for viewing how identity contingencies and other socially constructed obstacles work to mitigate the academic achievement of African Americans. Stereotype threats are felt in specific situations in which stereotypes associated with one's individual or group identity are prevalent. Mere awareness of the stereotype can be distracting enough to negatively affect a person's performance in the domain connected to it.

Negative stereotypes of African Americans' academic achievement in STEM subjects can be debilitating, but their affects can also be circumvented by a variety of interventions. One mitigating approach that has been identified is providing critical feedback along with

opportunities for analysis of the larger societal context and structures that motivate stereotypes (Steele, 2010). In this regard, research is also beginning to show how some African American students are achieving in STEM by developing abilities to better manage or "flip" the negative impacts of stereotype threat (McGee & Martin, 2011). Another approach extends from how teachers can work to foster feelings of identity safety in how classroom discourse and culture are constructed to access rigorous curriculum content (Mahiri, 2011). Additionally, important research (Emdin, 2010; Gutstein, 2006; Nasir, 2011) argues that there is indispensable value in incorporating students' authentic lived-experiences into the overall learning of STEM (Emdin, 2010). These approaches, approaches that have in common a valuation and integration of marginalized students' individuality, culture, language, and real life experiences in and out of school, represent a necessary paradigm shift in the way that teaching and learning in and of STEM, especially for hyper-marginalized students, must be reformulated.

Many scholars have shown the importance of connecting positive academic identities to the cultural-linguistic identities and lived experiences of students themselves. For example, Nasir (2011) and Tate (1995) demonstrated ways that positive academic identity development is at the root of academic success in math for African American students. Nasir's (2011) research found a positive reciprocal correlation between positive academic and cultural identity development and increased math performance for African American students. Lee (2005) illustrated the importance of attending to specific English dialects of urban students to directly build on their cultural-linguistic competence for learning curriculum content. Lee (2005) further showed the significance of accessing cultural identity to effectively teach African American students by synthesizing findings from numerous research studies supporting critical connections between language, identity, and learning.

Essentially, linking learning to students' cultural-linguistic diversity and competences is the cornerstone of approaches to multicultural education (Banks & McGee & Banks, 2004) and culturally relevant pedagogy (Ladson-Billings, 1995). Banks (et al) noted, "The more we know about a student's level of identification with a particular group and the extent to which socialization has taken place within that group, the more accurately we can predict, explain, and understand the student's behavior in the classroom" (2004: 27). Similarly, the central idea of culturally relevant pedagogy is that if learning structures and stimuli are grounded in a cultural-linguistic context that is familiar to students, there will be greater potential for cognitive expansion and knowledge growth (Allen & Boykin 1992; Ladson-Billings 1995). Gay (2000, 2010) and Delpit (2012) expanded upon the framework of culturally relevant pedagogy by delineating methods of culturally responsive teaching that specifically used cultural characteristics, experiences, and perspectives of ethnically diverse students to increase their learning. Five essential components of this approach are developing a knowledge base about cultural diversity, including diverse curriculum content, demonstrating caring and building learning communities, cross-cultural communication, and cultural congruity in instruction. In working to build the African American middle schoolers' identification with STEM, which is, undoubtedly, a matter of social justice the MAN UP instructors employed each of these components throughout the program.

Connecting STEM Learning and Social Justice for African American Males

Social justice as an educational framework is integral to critical pedagogical approaches to teaching and learning (Gorski et al, 2013; Giroux 2011; Duncan Andrade and Morrell 2008; Smyth 2011). These approaches attempt to equip marginalized students with the theoretical

lenses necessary to disrupt the inequitable conditions they face and work to navigate. Extending from the work of Freire (1997) and further informed by scholars like Giroux (2001) and McLaren (1994), critical pedagogy seeks to facilitate this transformation by empowering students to locate and develop their own critical, agentive voices and productive capabilities. A central goal of critical pedagogy is to disrupt the "banking model" of education – the positioning of learners as empty vessels to be filled with ideas and information that continues their oppression.

Limitations of the banking model outlined by Freire have been addressed in STEM subjects as the "absorption" model. Linn and Eylon (2011) noted hallmarks of the absorption approach in science instruction as requiring students to listen to lectures, read textbooks and complete exercises, and conduct experiments or investigations following step-by-step procedures. Fundamental aspects of the absorption approach do not build on individual interests and intuitions or cultural-linguistic backgrounds and competencies of learners. Linn and Eylon argued that when these constraints are circumvented by a more active and agentive knowledge integration approach, then "everybody can learn science" (ix).

Proponents of critical pedagogy argue, however, that opening access to STEM subjects and careers to everybody, by itself, is not enough. They feel that though access to high quality STEM instruction is a civil and human right, a larger critique of the positioning and roles of STEM in the very processes of oppression and marginalization must accompany increasing access to STEM content. They argue against attempts to limit these kinds of critiques to the social sciences and humanities and advocate that these perspectives are just as imperative to the learning of STEM subjects. Blikstein (2008), for example, suggested that knowledge and use of digital technology, and particularly the design of new digital devices, derived from math and science are necessary tools for fulfilling Freire's vision of humanization and societal transformation.

Studies conducted in after school contexts (Vakil, 2014) and within school contexts (Norris, 2014) found significant ways that critical pedagogical approaches enhanced African American and Latino middle school students' social justice perspectives in conjunction with their learning STEM subjects. Moses and Cobb's (2001) work with the Algebra Project earlier connected these kinds of efforts to the socio-political implications of how math (and algebra specifically) is both a gateway to and gatekeeper of STEM content and careers.

African American males more than any of group have been marginalized the most by these systemic forces in education generally and in the learning of math specifically (Darder 1998). To counter this, Gutstein's (2006) argued for a version of math education that affords hyper-marginalized students a nutritive educational space where they can not only learn math, but also where they can learn to apply math to issues that inform and affect their socio-political and socio-economic realities in the larger societal context. In this regard, Gutstein noted, "mathematical literacy, as a form of functional literacy distinct from critical literacy, serves the needs of capital accumulation in the United States" and further that "A reconceptualization of the purpose of mathematics education is needed – one that includes envisioning mathematical literacy as critical literacy for the purpose of transforming society, in its entirety, from the bottom up toward equity and justice, for all students whether from dominant or oppressed groups" (2006: 28).

The first premise of MAN UP was: it is vitally important that students begin to apply STEM for issues that are germane to their lived-experiences as urban African American males, for outcomes that they deem important. To this point, Freire (1997) pointed out: "problem posing

education does not and cannot serve the interests of the oppressor. No oppressive order to permit the oppressed to begin to question (1997: 67)". To be clear, the MAN UP instructional team was not simply interested in identifying and talking through problems that we felt students should be made aware of; rather, we used the students' interests as points of connection for larger discussion of socially just, humanitarian issues that have the potential to be redressed (at least in some small measure) by our students' applications of STEM. Of course, this approach made curriculum development more difficult for instructors, precisely because, students' lived-experiences functioned as anchors for our curricular focus instead of a preformed scope and sequence of content topics. Thus, instructors could not come in with a one-size-fits-all curricular approach. Instead, instructors had to be willing to be flexible, to be malleable, and to, most importantly, participate in co-generative dialogic and co-constructed meaning making alongside the students being served (Emdin, 2010).

More specifically, we sought to position students vis-à-vis STEM in a way that would positively affect their self-image and would, consequently, help them re-envisage themselves as potential STEM majors and STEM professionals, by first engendering a space for positive academic identity development. Of course, these are middle school students whose self-images will change numerous times. So, we were not seeking to pigeon hole them. Black males in STEM are a rarity. This is significant because our economy is positioned toward technological and informational technology, which means the best paying jobs will be STEM focused. Nevertheless, the goal of MAN UP was never to merely work towards producing a group of African American male technocrats that un-problematically adhere to our Nation's technocratic, capitalist ethos (Gutstein, 2006). This was not the measure of success for this program; rather, we were interested in facilitating the development of African American males who applied STEM not only for base gain, but also for the overall improvement of their respective communities. Our goal was commensurate with Tate's (1997) view of mathematics pedagogy; she argues that the primary purpose of math pedagogy should be: …to empower students to critique society and [to] seek changes based on their reflective analysis (1997: 169)." And, by doing this we were convinced that these students would begin to identify as (social justice oriented) applied STEM practitioners, who as a result of their new STEM identities, would begin to grow more competent in the STEM subjects covered and in their critical applications of STEM for social justice.

(Re)Conceptualizing Rigor

Webster's Dictionary defines rigor thusly: extremely thorough, exhaustive, or accurate. This definition is in need of re-articulation. Therefore, the instructional team at MAN UP (Mr. K, Mr. S, and myself) worked to define rigor differently, and we argued, more expansively. The goal of the MAN UP pedagogical approach, which centered a blend of critical-reality pedagogy, was to redefine rigor by situating it within students' diverse socio-political contexts. Inequity is an age-old problem, which, despite many passionate, intelligent, and careful ameliorative attempts, continues to grow at an alarming rate. Surely, this problem necessitates rigorous analysis in attempts to begin to eradicate it. Inequity, based on race, socioeconomic status, gender, etc., will not be remedied simply. Therefore, MAN UP's pedagogical approach, which was anchored by MAN UP students' real lives, was designed to help our students begin identifying paradigm-shifting questions, and perhaps solutions, for issues or problems that were important to them.

Traditional conceptions of rigor necessitate a divorce between students' real-life experiences and the purported objective truths of STEM (Gutstein, 2006). That is to say, traditional conceptions of rigor require students to accept the de-contextualization of STEM as normal and even axiomatic (Philip, 2011b), such that it becomes incredibly difficult (or abnormal) for students to situate their learning within a STEM context (Bang & Medin, 2010). This delimits (and sometimes disallows) students' ability to identify as critical, applied STEM practitioners. Research (Nasir, 2011) supports the argument that positive STEM identity development is necessary, especially for hyper-marginalized students, in order for their academic success in STEM to increase. My presupposition is in line with Nasir's findings: that is, when students are encouraged to apply STEM, critically, to issues that they deem important—as opposed to passively receiving and regurgitating decontextualized facts—their ability to shift their critical, contextual understanding and application of STEM increases such that their identification with, understanding of, and competency in STEM also increase. This situated, contextualized approach to STEM pedagogy is far more rigorous than its obverse: decontextualized, rote memorization and regurgitation of STEM-based facts, precisely because it requires students to apply STEM critically and rigorously to long-standing, seemingly intractable social conundrums.

So then, the goals of the MAN UP pedagogical approach was to encourage, empower, and equip MAN UP students to:

- Situate their STEM learning within a larger socio-political context based on solidarity with other MAN UP students as well as other hyper-marginalized people locally, nationally, and globally.
- Develop ways to situate students' STEM learning within real-life (socially just) sociopolitical context.
- Help students make tangible connections between students' lives—outside of the classroom—and STEM course content.
- Re-conceptualize rigor and situate rigorous STEM learning within a larger socio-political context so that students' conceptual understanding of STEM in application increases.
- Facilitate students' growth regarding the development of student's identities as critical, applied STEM practitioners.
- Invite students to co-create meaning with them within their shared classroom.

More simply put, the MAN UP pedagogical approach was arguing for a conception of rigor that incorporated and intertwined content and process. (For example, critical dialogic discussions about the sociopolitical context of mathematics.) Rigor is much ballyhooed in STEM educative circles, however, though necessary, it is not the solitary goal; instead it is but one constitutive part of a critical and empowering educational triumvirate (i.e., relationships, relevance, and rigor). This three-pronged approach, which was built upon a cornerstone of respectful, reciprocal and empowering relationships between students and educators, was integral. When alloyed with curricular material that demonstrates relevance to students' lived-experiences—by asking them how it is that they can apply STEM to issues they deem important—this approach should encourage, empower, and equip students to learn and apply STEM critically and agentively to begin to deconstruct and, hopefully, redress social inequity.

As I discuss in detail in subsequent chapters, these processes were arrived at by combing through the important literature delineated in this chapter. These terms, which I will argue are mutually beneficial, are also mutually constitutive in that an educational atmosphere that was

predicated on socio-academic synergy set the stage for students to being critically contextualizing STEM. In the following chapter, Chapter 3: Research Design, I discuss the research design as well as data collection and data analysis procedures.

Chapter 3: Research Design

I used qualitative methods for collecting and analyzing data guided by the work of Denzin and Lincoln (2003). I also utilized the work of Spradley (1979) with respect to conducting interviews with the students and their instructors. In addition to interviews, I made audio/video recordings, and took field notes on the study participations' various learning activities during their Saturday classes and fieldtrips. I also provided opportunities for the first year cohort to express considerations about their learning and social experiences as African American males in STEM. The pedagogical approach of MAN UP represents a union between discrete, yet similar educational approaches. This amalgamated pedagogical approach alloys critical pedagogy with reality pedagogy, henceforth critical-reality pedagogy. Critical Pedagogy (Giroux, 2011) takes the first position that education should tool not only for upward mobility but also for emancipation from the oppressive pedagogical practices that many hyper-marginalized students are continuously subjected to. Reality pedagogy (Emdin, 2010) argues that students' lived experiences need to be valued and incorporated, specifically within STEM educational context; and, anchored instruction seeks to position students as real world problem solvers. This conjoined pedagogical approach was designed to engage the focal students in rigorous STEM content such that their learning of, identification with, and competency in developing socially just applications of the STEM significantly increased.

I collected and analyzed data on the 17 African American students in their first year of MAN UP. The study followed the focal students for an entire academic year, from September 2013 until June 2014. In this study I was seeking to identify instances when students begin to (re)envisage themselves as applied, critical STEM practitioners, capable of using their STEM learning to affect positive, socially just societal outcomes by wielding STEM as a tool for change (Bogdan & Bilken, 2003). It was my presupposition that the MAN UP pedagogical approach to STEM education should encourage, equip, and empower students to demonstrate, through rigorous, comprehensive socially just applications of STEM, a positive shift in their learning regarding the STEM subjects taught at MAN UP as well as with regard to the ways in which they either identified or dis-identified with STEM. Consequently, the central question guiding this research is:

> What are the impacts of a critical pedagogical approach to the learning of STEM subjects on 6th and 7th grade African American male students' competency in, identity with, and understanding of socially just applications of STEM?

Site: MAN UP

During this study MAN UP served a total of 43 African American male students divided by each of the three grade levels of middle school. Although every student attends a middle school in the general area of the site for the program, it met in a rented space of a local middle school. However, there was no formalized affiliation with the middle school site. Instead, MAN UP is part of a larger non-profit organization. The program took place every other Saturday from September 2013 to June 2014 for a total of 22 sessions. Once for each of the two semesters, there was an additional Saturday session devoted to a field trip. Each session was a five-hour block from 9:30am to 2:30pm in which the cohort had a total of three classes, each about 75 minutes in length: Computer Science (CS), Math, and the Rhetorical Analysis of Manhood (RAM). Infused in the content, each class incorporated social justice applications for the learning. The three courses took place simultaneously. For example, when 6th graders were in Rhetorical Analysis

of Manhood from 10:00am-11:10am on a given Saturday, 7th Graders were in Math, and 8th graders were in Mobile Applications so that during the course of each Saturday session the 6th graders, 7th graders, and 8th graders received instruction from the teachers of each of the classes.

The Focal Cohort

Although there were 43 students in the program across the three grade levels, the focal cohort for this study were the 17 students in their first year of the MAN UP program grade along with their instructors. The first year cohort was selected to explore the impact of the program during their first year of participation. A key demographic characteristic of these 17 first year students was that 80% qualified for free or reduced lunch and thus considered to be from low-income families. Eighty percent also attended Title 1 public schools. Sixty percent were from single parent homes, and 60% had parents or guardians that did not have a college degree. The average GPA of cohort was 2.99 because the program's selection process focused on students who were already achieving some measure of success in school.

The instructors for the three Saturday classes were men. Mr. J, an African American who directed the program and taught the Rhetorical Analysis of manhood (RAM) classes, was also a doctoral student in education. The instructor for the Computer Science and Mobile Apps (CS) classes, who the students called Mr. S, was Iranian and also a doctoral student in education. Additionally, he had a master's degree in engineering. The instructor for the math classes, who the students called Mr. K, was an African American who was also a public school math teacher. The focal class for this research was students in their first year in the program. Their demographic breakdown was as follows:

- Eighty percent of the focal class qualified for Free and/or Reduced Lunch and are thus considered low-income.
- Sixty percent of the focal cohort is from single family homes.
- Eighty percent of focal cohort attend Title 1 public schools.
- Average CST Math score for focal group is 400/600 (Proficient).
- Average GPA for focal group was 2.99.
- Sixty-six percent of focal cohort' parent/guardian's do NOT have a college degree.

Shakers, Makers, and Takers

From the pre-survey, which asked MAN UP' students to answer questions pertaining to why they wanted to join this STEM focused program; I identified three discrete categories of participation. The three archetypes that became manifest were: students whose answers seemed to suggest that they were desirous to use STEM as a way to benefit either their respective local communities and/or their macro-level identifiacatory groups, primarily, young and/or urban African American males. This group that I identified as the "Shakers" represented the ideal because their answers on the pre-survey suggested that they were interested in shaking up the current, inequitable status quo by using STEM as a tool for equity. The students involved were unaware of this appellation.

Data Collection Procedures

For the 10 months that data was collected from September 2013 to June 2014, there were 22 sessions of the program. There were two sessions per month with the exception of October 2013 and March 2014 when there was a third session designated for a field trip. Also, the final month of June 2014 featured only the year-end celebration in which students presented their final group

projects. The following data collection procedures were implemented during the specific months and sessions noted below across the two semesters of this research project.

Data included pre-post surveys, pre-post concept inventories, pre and post focus group interviews, pre and post individual interviews, participant observation, and audio-video recording of the entire focal class as for at least one of the two regular sessions each month. Additional data included: reflective online journals, and videotapes of students' project presentations from all three classes. Finally data collection completed with the sixth grade math assessments and interviews with the remaining two STEM instructors.

- **Pre-Survey:** September 2013: In session 1, the focal class took a pre-survey to assess their identification with STEM, through questions that asked them whether or not they saw themselves as current or future STEM practitioners and or professionals, and that asked them to draw an engineer or computer scientist. This survey also sought to assess students' aspirations regarding STEM college majors and potential STEM careers (Appendix A).
- **Post-Surveys:** May, 2014: There were a total of two post-surveys: the initial STEM Identification in Session 21 (May 2014) students re-took the initial survey to determine any changes with their identification with and aspirations toward STEM majors and careers. The second survey, the Program Satisfaction Survey, like the STEM Identification survey, was an electronic survey. This post-survey asked the focal cohort to complete questions that elicited their responses to questions that sought to gauge the efficacy of MAN UP; this survey had no pre component. In addition to questions about the efficacy of the overall program, this survey asked students to rate the overall effectiveness of MAN UP instructors, both collectively and individually. All surveys were completed by all 17 on the focal cohort
- **Pre concept inventories:** October 2013, Session 3: Each Course Inventory was conducted in the same way, with grade-specific cohorts placed in separate classrooms to complete concept inventories for Rhetorical Analysis of Manhood and Mobile Apps, respectively. The pre/post concept inventory for students' Rhetorical Analysis of Manhood course asked them to identify elements of rhetorical triangle, social justice, and to answer questions around how they felt manhood generally, and Black manhood specifically, is, should, and can be defined—and by whom (Appendix C). For Technology for Social Justice, the pre/post course inventory was designed to gauge students' familiarity with esoteric mobile computing terminology as well as more perfunctory terms, e.g., the Internet, email, etc. The Math pre/post course inventory, which is derived from the Common Core Standards, was a traditional math assessment (Appendix E).
- **Post Concept Inventories:** May 2013, Session 20: Pre-individual interviews: October 2013. All 17 students in the focal class were interviewed individually. The questions featured in these interviews sought to elicit background information on students' familiarity with STEM generally. Here, I sought to ascertain both students' a priori conceptions of what STEM is and possible uses of STEM at both the individual and collective level. And, contiguously, I attempted to gauge students' familiarity with and knowledge of social justice, especially with regard to STEM access and outcomes for African American males (Appendix B).
- **Focus group interviews: December 2013, Session:** Interviews of students in the focal class were video recorded. They were prompted to speak regarding their conceptions of

the following course topics: social justice, community, equitable/inequitable schooling, and STEM education vis-à-vis race. The same questions were asked in focus group of approximately five students as well. In addition to these questions, focus group interviews asked students to answer questions about the black male experience in STEM and in larger society.

- **Participant Observation of Focal Students' Homeroom Class:** October 2013-June 2014. I developed and taught the RAM course for all three grade-specific cohorts. However, for the focal cohort only, this course represented their homeroom class, which meant that for them, this was their longest course on a given Saturday and that their final, year-end project would emanate from and be commensurate with the themes of this course (i.e., deconstructing stereotypic depictions of black manhood and understanding the difference between the roles of consumer and producer). Of the 20 regular sessions that this course met, I was present for 19 sessions. I took field notes for all of the sessions I attended.
- **Audio/video recordings of STEM classes**: October 2013, Sessions 3 and 4; November 2013, Sessions 5 and 6; December 2013, Sessions 8; January 2014, Sessions 8 and 9; February 2014, Session 10; March 2014, Session 13; April 2014, Session 15; May 2014, Session 17; June 2014, Sessions 22: Focal students were recorded in their STEM courses (i.e., non-Manhood/Rhetorical Analysis) order to capture shifts in understanding and/or identification with STEM subjects, as evidenced by whether or not students began to see themselves as applied STEM practitioners, and to assess whether or not focal students were beginning to critically contextualize STEM.
- **Student online reflective journals:** November 2013, Session 6; January 2014, Session 11; February 2014, Session 13; March 2014, Session 16: Student reflective journals, in the form of electronic Google Documents, were due prior to each session. These journals were treated as homework. Students must answer one prompt per week in between MAN UP sessions.
- **Students' project presentations:** June 2014, Session 22: Each cohort along with their homeroom instructor was responsible for developing a course-specific year-end project. Students presented these projects during the last day of MAN UP to their classmates and parents as well as the larger MAN UP community, which featured members of the NPO that housed this program as well as local educators and activists.
- **Math Assessment for all cohorts**: Pre-assessment, September 2013, Session 1; Post-assessment, May 2014, Session 21: For the math assessment, each cohort entered an assigned classroom. Instructions were given for five minutes and scratch paper was made available. Then, once instructions were complete, students had 55 minutes to complete the math assessment.
- **Interviews with their STEM instructors:** January, April, and July 2014: I conducted interviews with two STEM instructors on three occasions in order to capture data around STEM competence as well as scholar's overall performance in MAN UP. These interviews were audio recorded (with instructor's' permission).

Data Analysis Procedures

Across all data sources I looked for evidence of the focal cohorts' developing identification with, competencies in, and critical application of key aspects of STEM that were taught in their three courses and the other activities of the MAN UP program. When these three

components congeal, it is the realization of what I have termed the critical contextualization of STEM. Consequently, the fundamental approach of this study was to analyze the entire range of data sources through the overlay of these three categories of identification, competencies, and critical applications. Since I wanted to see the students' initial and on-going development in these three categories with respect to STEM, I analyzed for each category through the various data sources collected during the first and second semesters. Therefore, I was able to identify, code, and analyze evidence of development of the focal cohort in all three classes across the entire academic year of the study.

Competency, Identification and Socially Just Applications of STEM

Competency was determined by pre/posttests and/or concept inventories in each course offering. Additionally, though not assessed in the same way as the pre-post concept inventories, students (audio-video recorded) ability to create ways to apply STEM in the amelioration of social injustice was also considered demonstrative of their competency in not only understanding the concepts of the STEM courses they took, but also, perhaps, going one step further to critically apply their STEM learning for societal uplift. This data is derived from individual and focus group interviews, classroom observations and interviews with their STEM instructors. I was also looking for the focal participants' demonstrated ability to shift their socio-political understanding or context such that they could begin to address societal issues that bear some similarity to, but were not identical with an issue that they themselves have faced and/or addressed. In other words, I was looking for the extent to which the students could extend their context and reveal and even operationalize abstract terms like equity/inequity, equality/inequality, justice/injustice and the role that STEM can be made to play in addressing and/or redressing the very same issues that they identified. Additionally, student shifts in identification were determined by students pre-post identification surveys answers as well as individual and focus group interviews, the yearend program satisfaction survey (YPSS) and via their participation in their final projects, and classroom observations, and participant observation. STEM instructors were also asked to speak to any shifts in identification they witnessed taking place in the focal cohort of students in one-on-one interviews.

Analysis Procedures

Semester One: September 2013-January 2014

- **Analytical Procedure I,** September 2013: *Introductory (pre) interviews and Pre-Survey*. This round of interviews elicited background information on students' familiarity with STEM generally. Here I sought to ascertain both students' a priori conceptions of what STEM is and possible uses of STEM at both the individual and collective level. And, contiguously, I attempted to gauge students' familiarity with and knowledge of social justice, especially with regard to STEM access and outcomes for African American males. Students were required to complete a questionnaire that was designed to elicit their preconceptions on who does STEM and what these people look like.
- **Analytic Procedure II (October 2013):** *Course Concept Inventories*: Students were required to complete course inventories for the three courses offered at MAN UP. I reviewed all data in order to determine students' exposure to and familiarity with the respective courses' concepts, and whether or not they saw themselves as potential practitioners and producers of STEM independent of their involvement with MAN UP. I

analyzed the data for all 17 members of the focal cohort in order to determine whether or not categories of participation began to arise.

- **Analytical Procedure III (November/December 2013):** *Review of the focal students' Journals:* Students were prompted to write in their journals. There were questions that students were required to address in their journals, and, there were opportunities for free writes as well. Journals as well as recorded classroom conversation in each of student's focal classes were analyzed to look for instances of students connecting STEM course content to both their individual and collective life experiences. Also, I looked for instances of students contextualizing course content, making it their own; and, I looked for student recognition of their current positionality socioeconomically as well as socio-politically and the ways in which they began to be agentive in seeking to redress or reconfigure their positionality by using STEM as a tool or lever. Again, I analyzed the data for all 17 sixth graders receiving the intervention in order to determine whether or not categories of participation began to arise.

Data Analysis Semester Two: January 2014-June 2014

- **Analytical Procedure IV (January 2014-May 2014):** *Classroom Observations and Instructor Interviews*: During this phase I completed classroom observation forms, (filling out a MAN UP-specific classroom observation form for each observed class). These forms were shared with instructors. I also conducted interviews with instructors, which sought to assess whether or not my observations were in line with their own.
- **Analytic Procedure V (January, February, and May & June 2014)**: *Individual and Focus Group Interviews:* I interviewed students individually and in focus groups in order to gain information around the variegated impetuses for the semester-long projects they decided to undertake in their respective homeroom courses. More precisely, I attempted to determine whether or not their student-directed projects, in fact, reflected a move toward employing STEM course content for social justice, as defined by community (local, national, and/or global) transformation.
- **Analytical Procedure VI (January-May 2014):** *Continued Classroom Observations and Reviews of Students' Work toward Final Project completion*. Prior to this analytical procedure, students were grouped into project teams. Each team presented their project idea and its planned implementation to MAN UP staff and invited guests. During this time, I endeavored to determine whether or not and how students articulated the ways in which they had critically contextualized MAN UP's STEM curriculum as well as the ways in which students had designed their projects to critically employ STEM for social justice. These sessions were recorded and transcribed.
- **Analytical Procedure VII:** *Focal participant focus group:* This procedure was administered three times: during the second session of MAN UP, October 2013, at the logical (though not chronological) midway point of MAN UP's academic year (December 2013), and finally, at the close of MAN UP (June 2014). The focal cohort completed a focus group interview, which sought to determine whether or not they were beginning to see themselves as potential applied STEM practitioners and what this potential paradigm shift meant for them, individually, as well as whatever larger community they identify with
- **Analytic Procedure VIII (May 2014)**: *Final classroom observation, post-observation interviews, program satisfaction survey, and post-assessments including course concept inventories and the post-identification survey*: Following preliminary analysis, additional

classroom observation and interviews were conducted in order to ascertain the ways in which students employed their critical STEM knowledge for social justice as demonstrated by their post-questionnaire, post course inventories and final projects. Follow-up interviews were conducted with instructors in order to temper my observations vis-à-vis their own. And final grades, which spoke to students' familiarity with social justice (among other things) were collected. I then had final interviews with instructors around the grades that they meted out in order to assess their perceptions of students' innovation with regard to employing STEM critically in the interest of a more socially equitable, a more socially just local, National, and/or global society.

All of these analytical procedures were designed to illuminate my primary research goals, i.e., to identify instances of critical contextualization of STEM as evidenced by the focal cohorts increases in STEM identity conjoined with increases in both STEM competency as well as their demonstrated ability to apply STEM for social justice, and to gauge the role it may have played in students' learning of and identification with the STEM subjects taught in MAN UP.

Limitations

The various limitations of this program were many. First and foremost, this program was funded in its entirety, in year one, by a gentlemen who did not view education in the same way that the MAN UP instructional team did. His stated goal was to increase the standardized test scores of African American males in middle school. Therefore, his hope was that MAN UP would function as a test prep type of educational program. However, for the MAN UP instructional team, this was never our sole intent.

MAN UP was housed within a larger nonprofit organization's umbrella of educational programs. The initial goal of MAN UP, according to this non-profit, was to serve as a pipeline program for African-American male middle school students, functioning as a bridge into a high school STEM focused program, which this nonprofit also runs. This was perhaps the only thing that all three principles agreed on. For the instructional team at MAN UP, we were committed to creating a space for African-American males to critically contextualize STEM, i.e., to begin to apply STEM to issues that are germane to their lived experience, so that they can see themselves as 21st century learners, and, simultaneously, potential agents of positive social change who could apply their STEM knowledge to better their lives as well as the lives of other hyper-marginalized groups. Of course, this is an educational program, so, there were metrics involved. For the abovementioned funder, math competency was, seemingly, the sole measure of success for this program. This was important to us as well, but we wanted to encourage students to wrestle with their epistemological understanding of education, STEM education, and even their STEM knowledge and the applications thereof. The obverse seem to be true for the funder: his only consideration seemed to inhere around how to accomplish and codify improvements in standardized test scores. And, again, while this was important to us as well, we maintained that the holistic (psychosocial, intellectual, emotional) development of MAN UP' students should be the central focus and that any increases in standardized test scores should be the byproduct of this holistic approach.

More on the funder, he is someone who has given considerable amount of money to programs that serve African-American males. He attributes his desire to better the educational African-American males to the racial atrocities he witnessed, firsthand, growing up as a white Southerner. In truth, his heavy-handed insistence on an educational approach that has not produced positive educational outcomes for African-American males, served as the greatest

limitation for this program. He is a former executive in a multinational corporation; and it became increasingly clear that he felt that this program should be predicated on business principals and not extant critical pedagogical literature and theory. So, while functioning as both MAN UP's Founding Director, co-creator, and instructor for the RAM course, much of my energy was exhausted in attempts to strike a balance between what it is that we were trying to accomplish educationally vis-à-vis his insistence on the implementation of his anachronistic views of education. (Because of this, perhaps unbeknownst to him, he came across as a kind of messianic figure who seemed to believe that he is the only person capable of saving black boys. It was odd to say the least.) Far too often, we would be asked to adjust content and or scheduling based on the funder's (ill-informed) requests. And, he often proved dismissive, condescending, and intrusive during his site visits.

Another limitation was time. With input from instructors as well as students and parents, I tinkered with the schedule several times over, ultimately arriving, in year two, at what we all felt to be most effective for the young men that this program served. Meeting on Saturdays presented problems. Many of our young men competed in extracurricular sports activities. Often, these sporting events took place on Saturdays, which would sometimes wreak havoc on attendance for a given session. Concomitantly, because this is a Saturday program, and because we did not want to overwhelm our students, we decided to meet only two Saturdays per month (with a third Saturday for a fieldtrip twice per semester). We decide to meet every other Saturday instead of two Saturdays in a row. We felt that every other Saturday gave us the best chance to maintain momentum from session to session. Still, it proved very hard to maintain moment across sessions because we only met twice per month.

Role of the Researcher

"Why do I have to learn this stuff, [Mr.] Sims? I'm going to play baseball when I grow up!"
Desmond, Sixth Grade MAN UP' Student

For far too long, whenever one of my students would ask a questions in this vein, I would respond, mechanically, by offering a pragmatic (and in retrospect somewhat cold) response: you need to learn math and science so that you can get into college, so that you can get a job. I told my students that whether or not they pursue a college degree should be their decision to make, and that a lack of preparedness robs them of that decision. While this response is not incorrect, per se, an adequate response requires more nuance. And, most importantly, I was failing to first recognize, then, subsequently address my students' real question: what does this (STEM) have to do with me as an individual? What does it have to do with my life? And, most urgently, how can it be made meaningful for me? MAN UP was my attempt to begin to think through and, hopefully, develop/devise ways, alongside the MAN UP' instructional team and students, to make STEM more meaningful for the students being served.

In truth, I wore far too many hats in this program. I was the founding director, an instructor, responsible for professional development, the extrinsic face for this program for both the primary funder and the larger nonprofit organization that this program is situated within, the primary contact for parents, the "disciplinarian" as well as a researcher (and husband and father to three vibrant little boys). Even with all of these roles, each one exhausting in its own right, this program functioned as a safe space for me. I was able to think through and work on the educational philosophies that I along with the MAN UP instructional team developed together. The progress that we seemed to be making as a unit was very encouraging for me; however, the

joy of working with the MAN UP instructional team and MAN UP students was often abated by the realities of the other roles that I was asked to play. The funder clearly did not understand the educational approach that we were seeking to undertake. And, somewhat surprisingly, the larger nonprofit organization, by and large, did not or could not understand it either. This is indicative of our approach. Criticality has been relegated to the humanities; we were seeking to reposition criticality within STEM education. For many in the larger non-profit organization, it proved very difficult for them to conceptualize the ways we were re-conceptualizing STEM education for social justice.

Ultimately, because of this, after much internal deliberation, I decided to step away from MAN UP. Everything was taking an emotional toll of me. I have strong relationships with the instructional staff as well as with each of the young men that I personally selected for this program. However, the resistance proved too great, and, over time the enthusiasm that working through this educational approach fomented in me began to wane. I could no longer placate the funder. His requests were becoming increasingly absurd. And, his involvement was becoming more and more intrusive.

All that said, I am very appreciative of the opportunity I had to work with and on MAN UP. As an African-American male, who is a product of inner-city schools, I remember vividly the cultural dissonance (although this particular term was unbeknownst to me at the time) of school in general and in STEM courses specifically. I always felt as though I had to check my culture at the door, if I wanted to be successful educationally. I believe that in MAN UP, I have contributed to atmosphere that allows African-American males to be exactly who they are and still succeed educationally. I am eternally grateful for this opportunity.

Chapter 4: Focal Participants' Developing STEM Identities

The subsequent chapters 4, 5, and 6 will look at the three components of the research questions individually, while simultaneously illuminating the intersectionality of STEM identity, STEM competency, and the socially just application of STEM by arguing that when these three components coalesce, this is the instantiation of the critical contextualization of STEM. In the penultimate chapter, Chapter 7, I will then move towards an analysis of the MAN UP atmosphere, predicated on socio-academic synergy, and how all of this analysis culminates in the realization of the critical contextualization of STEM.

MAN UP's curricular focus and pedagogical approach was built on a foundation that emphasizes critical, reality-based pedagogical approach to teaching STEM. The goal of this approach, in the first instance, was to create a space (both philosophical and actual) for students to begin critically contextualizing STEM: that is, to bring STEM into their real life concerns, issues, struggles, aspirations, etc., by applying their STEM knowledge to address issues that are important to them.

The term "the critical contextualization of STEM" arose out of a need to adequately describe the focal cohorts' shifts in positive STEM identity, STEM competency, and subsequent socially just applications of STEM. This term was created partially in response to a common complaint that MAN UP students shared regarding the STEM instruction they routinely received at their home schools: i.e., that it was disconnected from their lives, or decontextualized. The concomitant pedagogical and curricular aim of MAN UP was to do the obverse, that is, to create a space where African American middle schools males could critically connect (i.e., contextualize) STEM to their lived-experiences as individuals and justice-oriented community members. The goal of analyzing this phenomenon was to assess whether or not the critical contextualization of STEM was taking place. If so, the question was whether or not and how it informed students' levels of competency (as measured by pre-post course concept inventories) in, understanding of (confidence in applying STEM to difficult social realities), and identity (i.e., instances where students began to re-envisage themselves applied STEM practitioners and, perhaps, later as potential STEM majors and STEM professionals) with STEM.

In order to achieve this goal, MAN UP sought to both create an atmosphere where students could not only learn STEM, but also begin to appropriate STEM, make it their own, and as they saw fit apply it to situations that they felt they had the power to address. This is what I termed: socio-academic synergy. Socio-academic synergy is a synergistic relationship between students' lives outside of educational settings and the curricular goals, course content offered at MAN UP, and the pedagogical approach employed by MAN UP instructors. Curating a positive, educationally-nutritive, and empowering atmosphere—which included an emphasis on building positive and trusting relationships between instructors and students—was integral to this endeavor. We provided examples of STEM being applied for socially just causes both locally and nationally, and even globally on occasion. We challenged students to think through ways that they could apply STEM to age-old, complex societal problems in, perhaps, novel ways. The intended message was that even though they were only 11 years old, they had the power within them to appropriate STEM and apply it to amelioration of the myriad issues they faced based on their skin color and socioeconomic status. This is what I termed the critical contextualization of STEM. So, to be precise the goal of socio-academic synergy was create an educative space where these students felt encouraged, equipped, and empowered to begin developing their positive STEM identities, growing more competent in STEM, and devising ways to apply STEM

for social justice, i.e., enacting the critically contextualizing STEM such that they arrived at the realization that they had the power to affect positive change for themselves, for their community, and potentially, for the world.

Critical Contextualization Explicated

The definition of critical contextualization is as follows: critical contextualization is the process in which students understand and critically analyze the sociopolitical and socio-historical dynamism of their given context such that they are equipped and empowered to competently extend their critical contextual understanding to both familiar and/or altogether new social milieus.

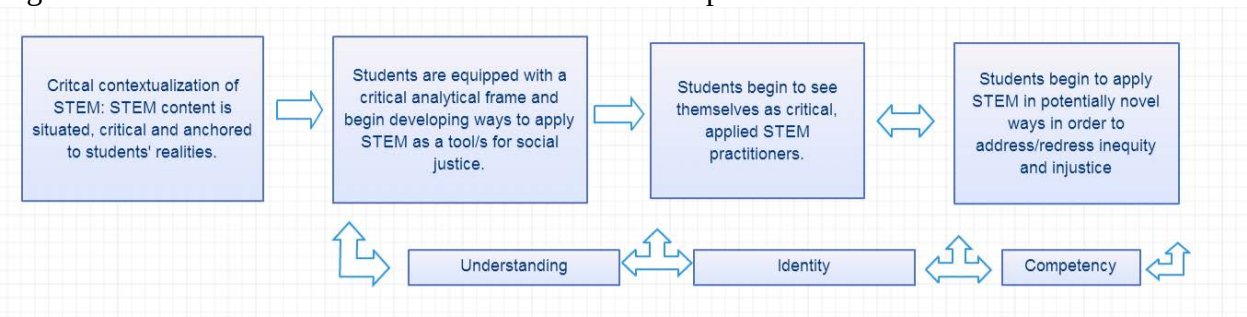
Constitutive Phases of Critical Contextualization: These three phases are not necessarily incremental. That is to say, they can happen both concurrently and/or simultaneously. These phases are both mutually constitutive and mutually beneficial. The delineation below is an ideal rollout of each of the three contiguous phases.

- **Phase 1:** During Phase 1, intentional work must be done to engender, ensure and curate a positive, critical and empowering educative atmosphere by inviting students to co-create and co-develop the behavior, cognitive, and affective norms of the given educational space.
- **Phase 2:** Predicated on and contiguous to Phase 1, during Phase 2 work to develop supportive relationships, which are centered on student input and student voice, must be the primary focus. These relationships must be emancipatory and liberatory in nature. That is to say, they must be dialogic as opposed to monologic; and, they must seek to build a community of co-constructive meaning makers.
- **Phase 3:** During phase 3, content should be interwoven into the atmosphere. This content must be anchored. That is to say, it must connect to students lived experiences. And, it must be germane to them in some way. The best way to ensure relevancy is to consult students, have them participate in the meaning making process, and afford them space to comment on the way that the content is delivered space (i.e., pedagogy).

This triumvirate must coalesce, eventually becoming triune, i.e., three in one. The "one" in this study is MAN UP the program, which is made up of the abovementioned constitutive phases. Each of these independent phases required intentional and purposeful cultivation. This is key. The atmosphere, in many ways, is directly informed by the relationships; and, the inverse is also true. Essentially, the way that pedagogy and content are received is wholly dependent on both the atmosphere and the relationships between community members.

The Critical Contextualization of STEM: is the process in which students understand and critically analyze the sociopolitical and socio-historical dynamism of their given context such that they are encouraged, empowered, and equipped to competently extend their critical contextual understanding to both familiar and/or altogether new social milieus as demonstrated by their ability to apply their STEM knowledge in the interest of amelioration of socially unjust milieus. The critical contextualization of STEM was evidenced by students beginning to appropriate and critically apply STEM as a tool to redress issues or problems, which were connected to students' lives d that inhered around notions of equity/inequity and or social justice.

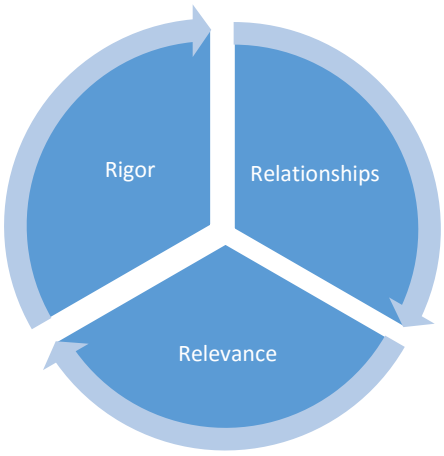
Figure 1: The Critical Contextualization of STEM as a process



Ultimately, the critical contextualization of STEM in an educational program, like MAN UP, should begin to resemble and even function as a fluid, dynamic concentric circle:

Figure 2: Socio-academic synergy

Socio-academic Synergy



Socio-Academic Synergy:
Connecting the Course Content to The lived-experiences of our Scholars

- This term (perhaps a neologism) ***denotes a concomitant relationship between the academic programming and the politicized, racialized lived-experiences of our scholars.***
- Scholars were never asked to repudiate their identities as urban African American males; instead, they were ***encouraged to explore, traverse, and apply STEM as urban African American males.***
- ***We sought to meet our scholars where they were*** so that they began to see themselves as co-constructors of and contributors to the meaning making process.
- ***We created spaces for them to contextualize and therefore connect material from each course offering***, meta-cognitively, so that they could begin to determine the role/s that this newfound knowledge could (potentially) play in their lives as young men and, later, as adults.

The work that was going on at MAN UP necessitated the creation of these two terms in order to adequately describe both the atmosphere and pedagogical aim of this program. In working through these definitions, I came to realize that the term "rigor" was in need of analysis as well precisely because its standard definition did not quite capture the critical work that these young applied STEM practitioners were endeavoring to do. In an attempt to identify instances of critical contextualization of STEM, I coded for instances where students' critical contextualized understanding and applications of STEM became apparent.

Emerging Critical Contextualization

- Demonstrated a working knowledge of socio-historical, socio-political, and socio-economic processes as they relate to critical global and local issues and how they inform societal injustices.
- Used understanding of equity, inequity, and justice as a frame when discussing and/or writing about one's lived experience as an urban African American male in the United States, and used their lived experiences as a catalyst to higher level empathy when discussing the plight of other marginalized groups both locally and globally.
- Could reassess, reorganize and restructure assumptions, ideological predispositions and knowledge based on new information (metacognitive).
- Critically and comprehensively analyzed new information, taking into account the cultural context, implicit and explicit motivations, and underlying assumptions of the source.
- Demonstrated an understanding of the usages of the design process and how to use it to understand and potentially redress societal injustices.

Evidence of Emergent Critical Contextualization of STEM:

- Could see himself as a current or emergent change agent, equipped to use STEM for socially just outcomes.
- Used STEM as a tool to address injustice in their own communities and beyond.
- Proposed ways to use STEM in novel ways or in ways that are new to the students.
- Began to see themselves or speak of themselves as applied STEM practitioners.
- Demonstrated understanding of STEM education as inherently political.
- Began to think of ways to use STEM as a tool to address issues that are important to a given student or group of students.
- Shifted their "frame of reference" to critically analyze problems and perspectives; and, can conceptualize ways to use STEM to address the problems identified.

It was entirely possible for students to understand and demonstrate evidence of critical contextualization without also developing and or demonstrating evidence of the critical contextualization of STEM. In most cases, critical contextualization preceded the critical contextualization of STEM, but this was not always the case. Some students developed and demonstrated elements of both conceptions, simultaneously, while others developed and demonstrated understandings of these two conceptions independently or in the obverse order. However, when students began to demonstrate competency in designing and, subsequently, developing social justice oriented STEM applications, this meant that they were functioning as shakers (i.e., applied STEM practitioners), ready, willing, and able to apply their STEM knowledge for local, national and even global equity.

Shifts in Students' STEM Identities

The findings on the focal students in the MAN UP program are reported in the three central categories that were delineated in the research question for this study. Over the course of the 2013-14 academic year, I found that the focal cohort had developed significant increases in their personal identification with STEM subjects and careers as well as increases in key STEM competencies. Additionally, the data uncovered substantial increases in their understanding and implementation of socially just applications of STEM. Evidence for these findings came from all of the data sources, and five of the main sources were the pre and post identification and program

satisfaction surveys, the pre and post concept inventories, focal group interviews, interviews with the math and CS instructors, and the participants' work on final projects in each of their three classes that was documented with videos. In addition to these five sources, I assess the focal students along the lines of three categories of participation that emerged in order to further illuminate the shifts made by the students over the course of this study.

Developing Identification with STEM

The MAN UP instructional team felt that creating a space for the students to develop a positive STEM identity was not only exigent, but also a prerequisite for increases in STEM competencies. And while opportunities for positive STEM development were intentionally created in all three courses, the Rhetorical Analysis of manhood (RAM) course was a primary space for conversations around African-American male identities vis-à-vis STEM education. So, in conjunction with the data sources noted above, I used the manhood course both to develop and assess shifts in the focal students' identification with STEM as evidenced in part by their confidence in applying STEM to important issues, their expressed desires to major in STEM, and, ultimately, their increased interest in pursuing STEM careers. I also indicate how these young men began seeing themselves as capable of using STEM for social amelioration. The groundwork for my analysis of the focal cohorts' shifts in STEM identity began with the pre-post STEM identification survey.

Pre and post STEM identification surveys. A pre-survey was administered during the program's first session in September of 2013, and a post-survey with the same questions plus additional ones on cohorts' satisfaction with the program was administered during the final academic session in May of 2014. The first prompt on these surveys asked students to "Please draw a scientist, technologist, engineer and/or a mathematician. (Please label your drawing)." On the pre-survey 14 of the 17 focal students drew a balding, bearded, middle-aged European American male in a white lab coat. None of the respondents drew a person of color. One student drew a European American woman, and the remaining two drew extraterrestrial aliens. On the post surveys, 16 of the 17 focal students drew STEM professionals that were clearly African-American males. Only one drew a picture of a balding, bearded, middle-aged European American male in a white lab coat. In fact, eight of the students drew pictures of themselves. This is quite significant, because when alloyed with the data that demonstrates students' aspirational shifts regarding their desire to pursue STEM majors and STEM careers, these data suggests that this process was both concomitant and even, perhaps, linear. More specifically, this data, in the form of revisionist drawings, seemed to suggest that members of the focal cohort that began exhibiting growths in their STEM identities by pictographically "becoming" applied STEM practitioners. By drawing themselves or people who looked like them, they were beginning to re-envisage the role that they could play in STEM and the multiple roles that STEM could potentially play in their futures. This re-positioning was based on the focal cohorts' confidence in applying STEM to issues that they deemed important as well as their expressed desires to pursue both STEM majors, and ultimately, STEM careers. Initially, STEM was limited to middle-aged white men. These revised pictographic representations of STEM professionals clearly demonstrated the focal cohorts' work to challenge the stereotypes that, initially, caused them to limit their own entry into STEM while, simultaneously, devising ways to break down the real barriers to STEM access they face simply by virtue of who they are. By changing the face of STEM, these young men created spaces in STEM that they could fill. This is poignantly captured by one member of the focal cohorts' response to why he changed his drawing:

> Well, at first, I kinda felt like only white men could be scientists. That's all I ever see—even on cartoons. I now know that there's a reason for that—that those types [of representations] are based on and support stereotypes. I changed my drawing to a picture of me in order to challenge the stereotypes that say I can't be a STEM professional or be a STEM major. I know I can. That's why I changed my [drawing] to a self-portrait.

The pre-survey also asked students whether or not they saw themselves as future STEM professionals, and only three of the 17 students from the focal class agreed. On the post-survey, 16 of 17 agreed that they saw themselves potentially as STEM professionals. For example, they indicated considerable increases in their aspirations for pursuing STEM in high school, college, and careers in the post-survey in contrast to the pre-survey. This shift was evidenced by the fact that during the pre-identification survey, only three members of the focal cohort agreed or strongly agreed that they wanted to pursue STEM as a career. Conversely, as mentioned above, during the post-identification survey all but one of the members agreed or strongly agreed that not only could they see themselves as STEM professionals but that they also wanted to pursue STEM in college as well as for a future career. Clearly, as evidenced by the focal cohorts' initial renderings of their conceptions of STEM professional, the focal students initially held rigid conceptions of what STEM practitioners looked like, but over the course of the program, their perceptions dramatically changed to seeing people who looked like them, including actually picturing themselves as STEM practitioners. In addition to this survey, which was geared specifically to assess students' shifts in STEM identification, the Yearend Program Satisfaction Survey (YPSS), which sought to elicit students' feedback on the overall efficacy of MAN UP, provided valuable data regarding the focal cohorts' shifts in STEM identity.

Yearend Program Satisfaction Survey (YPSS): In response to survey questions regarding the overall satisfaction with the program, 15 of the 17 members of the focal cohort indicated that their abilities to identify with STEM subjects and careers was highly impacted by having instructors who were themselves role models of STEM practitioners. For example, one student responded, "I benefited mentally seeing role models of my color skin." Another noted how important it was "getting help from teachers who inspired me and were my role models." A third respondent wrote on his post-survey that "they helped me see myself as someone who could do well in math and science." The focal cohort also indicated satisfaction with their own perceptions of having increased their identification with STEM through completion of the program and "getting together with kids my age and race to do this work." According to the yearend program satisfaction survey (YPSS), 16 of 17 students from the focal cohort agreed or strongly agreed that they are confident that they could use their STEM knowledge to make their local, national, and global communities more equitable. The realization, for them, that they were becoming or in fact had become applied STEM practitioners was predicated on and indicative of the their developing STEM identities—not just as young men who were becoming more competent in STEM—but, perhaps more importantly, they were identifying as young men who were also competent in applying STEM for equitable societal change (i.e., for social justice). The sentiment expressed by the focal cohort on the YPSS was echoed by the MAN UP instructors during the STEM Instructor Interviews.

STEM Instructor Interviews: The two STEM instructors were interviewed on two separate occasions: at the midpoint of the academic year (late December 2013) and at the end of the academic year (June 2014). The instructors further reinforced the focal cohorts' identification with STEM by intentionally calling them "applied STEM practitioners" throughout the program.

Interviews with Mr. S, the CS instructor, and Mr. K, the Math instructor were conducted by Mr. J at the close of the 2013-14 academic-year. Mr. K felt that positioning and referring to the cohort as applied STEM practitioners was important to their identity shifts. "I feel like this approach worked," he said in his interview. "They responded to it and tried to own up to the responsibility of their titles of applied mathematicians…. They were owning their math identity." The developing STEM identities that Mr. K was speaking to were constantly and continuously under construction.

According to Mr. K, MAN UP Math instructor, this approach worked in part because students responded to the appellation, applied STEM practitioner. For him, this was evidence of a positive shift in students' STEM identities:

> Yes, I feel like this approach worked. It wasn't perfect, but I do think we reached these young men. How do I know? These young men, who described feeling singled out and picked on far too often, really responded to and tried to own up to the responsibility of their titles of applied mathematicians in my class. They would even check me from time to time: If they felt that I was lecturing them, and just giving them facts, they'd stop me to inquire how this information was applicable to them. For me, this was evidence that they were owning their math identity. It was like there were saying, look, I'm a mathematician, too; you can't just tell me stuff without providing space for me to push back and question of this applies to my life and how I can apply it to my life. It was beautiful. Not only were they taking ownership of their education, they were taking a measure of ownership over math! It's when they began to see themselves as applied STEM practitioners that they started really engaging and, and consequently, really beginning to understand the material [as evidenced by 16 of 17 of the focal students improving from pre to post on the math assessment].

Mr. S spoke to a similar shift in his course. He noted that students, initially, felt as though the entirety of the help that they could provide was to devise ways for people in need of help to find people or organizations willing and able to help. However, over time, students began to see themselves as the help. For him, this shift in identity as a socially conscious, applied STEM practitioner was proof that this approach was working.

> Yes, I agree that this approach is working. We're still working it out, of course, but our foundation is solid. I am convinced it's working because I'm seeing transformations, from the beginning of the year until now, in these young people. Initially, these students were reticent to or unwilling to, or perhaps, unable to empathize with oppressed people outside of their immediate locale. When we started talking about providing help to poor people negatively affected by the typhoon in the Philippines, students asked me why they should care about people thousands of miles away when their city had so many problems. Of course, this is a great question. My role was to help them see connections and how the very existence of oppression and inequity threatens people everywhere. Over time, these same students, because they were beginning to see themselves as young people capable of making positive societal changes, began to develop concern for the people they described as their brothers and sisters in the Philippines. At this point there was a shift: instead of a remove, wherein they tried to locate help for people, they began to see themselves as the help. They decided to begin developing an app that would lead people to drinkable water and shelter. They were becoming

> socially-conscious or their social consciousness was expanding and along with it their identification with STEM as a tool for social uplift. When they began to see themselves as capable of using STEM for important issues, they became more confident.

The individual assessments of these two MAN UP STEM instructors are bolstered by the evidence presented above: data bears out that there was, indeed, a positive shift in the first year MAN UP students' identification of STEM. The focal cohort began to see themselves not only as young men who could do well in STEM in the present as well as moving forward; they also began to see themselves as young men who could "do" or apply STEM to make the world a better place. And, according to their STEM instructors, these shifts were instrumental in the focal cohorts' increase in competency with respect to their STEM courses. In order to develop a deeper understanding of the shifts in identity that took place within the focal cohort during the academic year, under investigation, I use the data that percolated up from case studies of five representative members of the focal cohort.

Shakers, Makers, and Takers

Based on responses on the pre-identification survey, three categories of participation rose to the fore. Returning to the three components under measurement in this study as delineated in the research question, these categories of participation are informed by the respective components under investigation in this study. More precisely, students that only begin to develop a STEM competency in the interest of securing financial stability in order to purchase the material accouterments that they desired, yet did not demonstrate an increased identification with STEM—as young people who can both learn and do STEM—were categorized as takers. I chose takers as the appellation for this group because their association with STEM was predicated on STEM as a commodity capable of being a possession and/or investment that would "pay off" in the form of individual financial success as demonstrated by their ability to purchase the clothes, shoes, and videogames that they longed for. That is, based on their responses, they wanted to take in all available STEM knowledge so that they could transform their knowledge into scholastic success that would pay future dividends insofar as college majors and ultimately high paying STEM jobs were concerned. And, while this positionality is totally understandable as these are predominately low-income students who have seen their parents struggle for even the most basic needs, unlike both the shakers and makers, the takers rationale for pursuit of monetary success was wholly individual. That is to say, unlike the makers, who wanted to excel in STEM in order to achieve monetary success to take care of their families, or, shakers, who wanted to excel in STEM in order to challenge inequity and social injustice, respectively—takers simply wanted to buy clothes and video games for themselves.

The maker category is similar to the takers in that makers are also interested in learning STEM, or becoming more competent, so that they too can earn high salaries in their future careers. The major difference, however, is that makers see themselves as familial caretakers whereas takers seemed to be concerned only with fulfilling their own, immediate, material desires. The shakers, based on their responses to the pre identification survey seemed to suggest that they were desirous to use STEM as a tool to benefit either their respective local communities and/or their macro-level identifiacatory groups, primarily, young and/or urban African American males. This group, the "shakers," represented the ideal because their answers on the pre-survey suggested that they were interested in shaking up the current, inequitable status quo by using

STEM as a tool for equity. Initially, only one student seemed to fit the shaker profile. (The students involved were unaware of these appellations.)

In the following section, I discuss these categories of participation by using individual or pairs of students as representatives of the three above mentioned categories of participation.

Initially, the majority (10 members of the 17 student focal cohort) of the focal cohort fit most closely to the makers profile in that they expressed interest in STEM only as a vehicle that would ensure STEM jobs and commensurate salaries that would allow them to provide comfortably for themselves and their families. The next group, the takers, consisted of six students. As delineated above, these were students whose pre-identification survey responses regarding STEM aspirations suggested that they only saw STEM as a way to earn enough money in order to purchase the material accouterments that they desired. With these six students, there was no mention of familial considerations or responsibility.

The Shaker: Michael, was one of the majority of MAN UP's students that qualified for Free or Reduced Lunch (FRL); however, unlike the majority of MAN UP's students who were also classified as FRL students (80 percent), Michael came from a two-parent home. (Neither of his parents earned a college degree.) Michael was quite different in appearance, too: he is bi-racial (European-American and Afro-Caribbean) and as a result his skin tone fit closely with purportedly normative Eurocentric physiognomy. Nevertheless, Michael self-identified as African American. According to his mother, Michael was not being challenged in school. More precisely, his mother described a toxic classroom situation that in her estimation was functioning to stultify Michael, which was why she felt that he was experiencing difficulty realizing his full academic potential. Michael's grade point average, 2.56, was well below the average of the focal class (2.99); yet, his standardized test scores placed him in the Advanced Category in both Math and English Language Arts (ELA).

Because Michael's answers on the pre identification survey suggested that his association with learning STEM was more expansive than an individualistic desire to be positioned to earn a high salary, which is consistent with the taker profile or even to address his own immediate familial needs, like the makers, Michael wanted to pursue STEM in order to benefit "people of color" in general. For example, Michael answered the following pre-survey question "Why do you want to join a STEM Focused Saturday Program?" thusly:

> For me it's kinda important that people of color, or Black people, get to see people that look like them doing STEM careers and going to college for STEM, because a lot of times we hear that we can't do it—and we start to believe the lies. Plus, we can use STEM to kinda level the playing field some. So, I guess, I want to do STEM for those reasons.

It is clear from Michael's answer to this question that his desire to excel in STEM was predicated on his desire to respond to and even begin chipping away at the societal promulgation, on the one hand, and the internalization negative stereotypes by people of color regarding people of colors' (a term that was synonymous with Black people, for Michael) purported collective inability to excel in STEM, on the other. Michael is the only student from the focal cohort whose answer accounted for people beyond just familial/kinship relationships, i.e., "people of color/Black people."

The Makers: The second student profile that I identified as the "makers" seemed to reflect a collective interest in doing better in (i.e., taking all available knowledge) STEM so that they could work to ensure upward mobility, measured monetarily, in order improve the

socioeconomic realities for themselves and their families. Like the shakers, the makers also viewed STEM as a tool of sorts, albeit with different, more individualized applications.

Jeff was low income and came from a single-parent home; however, unlike the majority of MAN UP's students who hail from a single-parent home, Jeff's mother had a college education. Jeff felt as though he was doing well in school. He went to a parochial school on scholarship. His grade point average was higher than the average GPA for the focal class (3.35). His standardized test scores for both Mathematics and English Language Arts were categorized as Proficient. When asked why he felt it was important for him to learn STEM, Jeff answered thusly:

> I want to do well in school, specifically in math and science, so that I can get a good job when I get out of college. I heard something the other day that said that most of the new jobs by the time I get out of college will be in stem, so it makes sense for me to be prepared to do well in stem. Maybe, my dream is to be a professional basketball player, but I guess if I do realize my dream need to figure out how to keep my money. But anyway, the real reason I want to do well is so that I can get a good job and help out my mom and my sister. My mom works really hard to pay for my sister's college tuition, and if I don't get a scholarship she'll have to do the same for me when I get to college. So, I want to be able to pay her back. That's really important for me.

Jeff, was interested in doing well in STEM so that he could "go to a good college" and eventually earn a high salary in order to position himself to buy his mother her first home. He also wrote about wanting to position himself to afford a big screen television and a fast car, but he was resolute in first taking care of his mother. Jeff, like the other nine members of the focal cohort that fit this identity profile wanted to "do better" in math and science so that he could position himself to make money in order to provide for his family—more precisely, so he could repay his mother, monetarily, for the sacrifices she endured in raising him up until this point in his life. This was true of all of the students who fit within this profile. This was, by far, the largest group, which is not surprising in that most of these students came from single-parent, maternal households. All of the makers' responses to the pre-survey questioned that asked them why they wanted to join this STEM focused program included one or more of the following terms: job/money/earn money; mother/mom, grandmother, family; sacrifice/hard work/work less, repay, pay back; new car/new home. For this group, the concerns of their families, and especially their mothers were paramount and cited in over 90 percent of the focal cohorts' responses as the primary reason for their desired success in STEM.

The Takers: The third identity profile that I identified as the "takers," were similar to the makers in that they, too, were desirous of taking in all available STEM knowledge in their words, in order to "do better in school" so that they could secure "good jobs" in order to comfortably afford material items (e.g., Jordan sneakers, True Religion Jeans, etc.). However, unlike both the shakers and the makers, the takers responses to pre-survey questions did not seem to suggest that they envisioned themselves as young people capable of doing STEM. Instead, it was clear that for this group, learning STEM so that they could demonstrate their learning on standardized tests was a paramount concern. For the takers, it seemed that learning STEM material in MAN UP was quite simply a means to an individualistic monetary end, and at least early on, they had no stated desire to use STEM for familial or societal uplift.

Stevie was one of the few students in the program that was born outside of the United Sates (Africa). He was also from a single parent home and qualified for FRL. However, his

(divorced) parents shared custody: Stevie lived with his mother during the week and with his father on weekends. Stevie's mother did not have a college degree; and, she spoke very little English. Stevie's father earned a degree in Africa, but according to Stevie his father's degree "didn't count" here in America. Stevie was a stellar student according to his teacher at his school (all MAN UP applicants were required to submit letters of recommendation from their math teacher). Stevie, according to the pre-survey felt that he was doing well in school, yet, he indicated that he did not feel that his voice counted at his school (he "Disagreed" with the following question: At my home school it is clear that my teacher welcomes my input). Stevie's GPA (4.0) was well above the average GPA (2.99) for his MAN UP cohort; and, his Standardized test score in math was a perfect 600. He was the only student in his MAN UP cohort that earned a perfect score on the math section of the CST (more than once).

Stevie's answers on the pre-survey as an aggregate seemed to suggest that, for him, doing well in STEM was a way to extricate him from poverty. He did not want to live where he lived. And, he wanted to position himself to have the ability to buy whatever his heart desired. At this stage in his life, his heart desired video games. At just over 10 years old, Stevie was the youngest student enrolled in MAN UP. (I never confirmed this, but in all likelihood, he may have skipped a grade or two.) Stevie's response to the following question is demonstrative of the overall tenor of his responses to the pre survey: Is it important for you to learn STEM? Why or why not?

> Stevie's response: Yes, it's important, because engineers and doctors and people in tech…those are the people who make the best money. I mean, they get paid the most. So, I want to work and get paid a lot. I want to get paid so that I can buy a new PS4 (Sony PlayStation 4 video game console). Plus, I never really get new clothes; I just get stuff from my brother or my older cousins. I just want to buy my own stuff.

This answer is indicative of the students who were categorized, initially, as takers: that is to say, for them STEM learning was a means to a monetary end; however, unlike the makers, the takers only expressed interest in increasing their earning potential through STEM for individualized gain. The makers were concerned with taking in STEM as well; however, their impetus was to provide for their families in addition to themselves. Six students' pre-survey responses suggested that they fit firmly into this category. All of their responses to the question that asked why they wanted to join MAN UP featured one or more of the following terms: money/pay; job; shoes/Jordan's (shoes)/True Religion (jeans); myself/me; buy/purchase; and or Play Station 4/PS4/video games.

Based on this discursive analysis, while similar, the argument can be made that the makers—more than the takers—are beginning to see themselves as people who can learn and *do* STEM, albeit for micro-level, i.e., familial benefit.

Over the course of the MAN UP academic year, the focal cohort moved, fluidly, through these three student profiles. There was only one student whose post identification responses suggested that his own material needs took precedence over the perceived needs of his immediate family (makers) and or his larger local, national, or global community (shakers). (This particular student had more than 15 siblings.) On the pre-Identification Survey nearly all of the focal cohort fit within either the taker or maker profile (10 takers and 6 makers, respectively). However, sixteen of the seventeen focal cohort members' responses on the post-identification survey included one or more of the following words: family/global family/neighborhood/community/planet/environment; brothers and sisters. A response provided,

in response to the question: "Is it important for African American males have a STEM program?" by one member of the focal cohort best captures the sentiment of this group:

> It's important because, as African American males we face issues that a lot of people here in this country don't face. But, we're not the only people in the world that face negative stereotypes or discrimination or racism. So, we can understand what other people go through. And, it's important that we're in a STEM program, learning; so that they can see us and know that they can do whatever they set their mind to, too—and—and like us, they can also be applied STEM practitioners who use STEM to lift people up.

The above quote is representative of the general feeling of the focal cohort. They expressed, time and again, that they had begun envisioning themselves as applied STEM practitioners who: "can not only fix problems in our own communities, but can also be role models for other black boys and other stereotyped people. They can know that they have the power to change things they think are unfair—just like we do!"

Cases Studies: From a Taker to Shaker and from Makers to Shakers

Malachi, like the majority of MAN UP students was considered first in family, low-income, and hailed from a single parent home. Malachi's initial answer to the question of what he hoped to be when he grew up also demonstrated a shift in the way he identified with STEM. Initially, Malachi wrote: "I want to be a professional basketball player, so that I can buy whatever I want." This answers situated Michael within the takers profile as his focus is, entirely, on individual wish fulfillment. However, his response on the post-manhood concept inventory demonstrated an expanded purview and, simultaneously, a critical understanding of STEM as a potential tool for a socially just (future) applications of STEM: "I want to be any job in the black community that encourages young black boys to get an education, really. But, specifically, I want to be a math teacher so that I can share the math that I know with kids like me—my community and others like it."

Malachi's latter response pointed to his desire to positively affect not only himself but also his local and perhaps global community as well. Over the course of the academic year all 17 students from the focal cohort spent varied amounts of time in each of the three categories of participation. The profiles were fluid. However, by the end of the MAN UP academic year, students from the focal cohort irrespective of where they started within this continuum began to fit most closely with the shakers profile. In fact, the majority of students' (16 out of 17) responses to this particular question not only including STEM career aspirations, but also included mentions of their local, national, and global communities. More specifically, students made connections between their future STEM aspirations and the potential ameliorative power it holds. What is more, 16 of the 17 responses to this question featured one or more of the following words or phrases when students described why they wanted to take up STEM majors and, ultimately, STEM careers: help/aide/encourage/teach/model/make/smash. These words were used by students to describe what impelled them to pursue STEM; that is, they wanted to help/aide/teach the following people: marginalized/stereotyped/persecuted/racialized people. (The word "smash" seems somewhat out of place, but it was used in reference to "smashing" negative stereotyping.)

Further evidence of Malachi's identificatory shift can be gleaned from his responses to the pre and post manhood concept inventory. The question, Is race real?, initially stumped Malachi. He responded to this question by writing: "I don't really get this question. Of course

race is real!" His response on the post manhood concept inventory is especially poignant and, simultaneously, indicative of the ethos that describes the shakers profile: "No! Race isn't real. It is a system that was created to keep people apart. It has real consequences, but really the only thing that should matter is whether or not we help fill in the cracks we made in the world, not our "race". And, in MAN UP, we learned that we can fill these cracks using math and science and tech." So, then, Malachi's move from a self-interested taker to a young person who was interested in "filling the cracks he creates in the world" represented his move from a taker to a shaker. Malachi's answer on the post manhood concept inventory demonstrated care and concern for a cause larger than his own individual gain. This response suggests that Malachi recognized social inequity as "the cracks in the world", and that he recognized himself as someone capable of applying STEM to begin filling these fissures of social injustice.

Malachi's responses on the post-identification survey and RAM concept inventory indicated a shift in his critical understanding of who can be an applied STEM practitioner (ASP) and what an ASP can and should do. This critical perspective was also evident in his response to the question: Who defines black manhood? Malachi's powerful response demonstrated an understanding of societal ills, and injustices, which begs address. He wrote: "Those who defines black manhood are those that do not know what African-American males are capable of and can do to better their lives." His connected response to the following question, What is black manhood?, clearly demonstrated a clarity of thought regarding the positionality of African-American males in our society. He wrote: "Black manhood is the ability to know that you are better than those who hate your race, and that no matter what people say—we can change the world…we can be doctors, engineers, chemist, statisticians—whatever we want". His initial response to this question was telling in its simplicity: black manhood is being a black man".

From Makers to Shakers: Maxwell and Jeff's, both low-income, first in family students who hailed from single parent homes, respective responses to the question (on the pre-survey) of what manhood is, in addition to data collected from the pre identification survey, situated them squarely within the makers profile: makers seemed to reflect a collective interest in doing better in (i.e., taking all available knowledge) STEM so that they could work to ensure upward mobility, measured monetarily, in order improve the socioeconomic realities for themselves and their families.

Maxwell's GPA was slightly above the focal cohort average (3.05); he was considered Proficient in both math and ELA as determined by his prior year STAR test scores. In response on the pre-identification survey regarding his future aspirations, initially wrote that he wanted to be either a basketball or football player when he grew up so that he could "repay my [his] mom for all of the sacrifices she'd made for him and his four siblings." And, while never losing sight of the importance of providing for his family, Maxwell's answer to this same question on the post-identification survey demonstrates a substantial shift in his subjective identification with STEM. To the question, What you want to be when you grow up?, to Maxwell responded thusly:

> I want to be a scientist, because that way I can show other African-American males that we can do this. It's important to me to be a role model if I can be. And, I can work on things that are problems for black people, like heart disease, and diabetes and stuff like that. And, not just us, but other marginalized people, too.

Jeff, who like Maxwell was low-income, first in family and hailed from a single parent home, responses also demonstrated growth: "When I grow up I still want to be a math teacher, but I think I also want to get a PhD in math so I can be a math professor, too. That way I can teach teachers, like Mr. J and Mr. S, so that they won't continue to stereotype black boys, especially in

STEM." These two responses are indicative of what I have termed the critical contextualization of STEM: that is, when students began to recognize that they could be applied STEM practitioners capable of appropriating and using STEM for social justice, i.e., to positively affect their local, national and or global community.

Maxwell's response to question 1, What is manhood?, on the pre-manhood survey was: "Manhood is the maturity to get an education so that you can provide for your family." His response to the second question, "What do you want to be when you grow up, and why?" further illustrates his drive to be successful in STEM: "I just want to be successful and have kids look up to me and make a lot of money. My mom and dad and family have done a lot for me and I want to show them appreciation by doing well."

Jeff's response to question what was similar to Maxwell's: "Manhood is when you take care of your responsibilities like making sure that your kids have enough to eat and are taken care of and that they're happy." Like Maxwell, Jeff's response to the question regarding what it is that he wants to be when he grows up further illustrates his drive to be successful, monetarily: "Really, I just want to have a job where my mom doesn't have to work so much. I want her to be able to go on vacations like other people's mom's and have a new car and not always have to worry about bills. So, whatever job I can get maybe like a engineer, that's what I want to do."

Of all the focal students, it was these two that, perhaps, demonstrated the greatest shift. In responding to the same questions on the post survey, there was the clear presence of a critical perspective—that is, a perspective that was far more expansive than what they demonstrated on the pre-survey.

In answering the question, five months later, What is manhood?, arguably, Maxwell's critical context had been expanded. Maxwell wrote: "Manhood it is understanding that you can take care of yourself and your family, and that you have a responsibility to your community as well." Jeff also demonstrated a shift in the locus of his concern, moving from individual and familial concern to a broader concern for mankind. Jeff wrote: "Manhood is understanding that you have a responsibility to your family and your planet; for example, like when we figured out was how to use STEM knowledge to help our brothers and sisters in the Philippines. That's manhood to me." This connects, conceptually, the work done in the RAM course with the work done in the CS course, and is indicative of these young men's shifts from makers to shakers.

For Jeff, it was clear that his socio-political understanding of the place of a man in society had shifted and become more expansive. That is to say, his critical understanding of context, which was initially limited to only his immediate family, had grown to now encompass his global family as well. And, what is more, he included STEM as part and parcel of this newfound understanding. This is a prime example of the critical contextualization of STEM.

As evidenced by the focal cohort, shifts in profiles were largely predicated on varying levels of identification with STEM. The students who began to see themselves as young people capable of wielding their STEM knowledge to make the world a more socially just place, irrespective of where they began in this spectrum, eventually most closely aligned with the shakers profile. That said, a desire an ability to critically apply STEM for social justice was a concomitant virtue of all students that ended up in the shakers category. Nevertheless, this was true for all members of the focal cohort: once they began to believe that not only could they do well (or continue to do well) in STEM (as evidence by their increasing competence) but also that they could do STEM (in high school, college and as a career), or effectively apply STEM to equity issues that they felt were important, it became abundantly clear that they readily accepted the appellation of "applied STEM practitioners". Once they self-identified as applied STEM

practitioners, they were, necessarily, shakers. This process from makers or takers to shakers is the instantiation of the critical contextualization of STEM.

Of course, while it was important to analyze whether or not this process took place, it is equally important to attempt to understand what precipitated or catalyzed these shifts in the first place. Focal students' own words on the program yearend program satisfaction survey (YPSS) and yearend individual and focus group interviews provide valuable insight into this question. These two metrics where designed to get at identity generally, by soliciting student responses that spoke to their STEM attitudes and aspirations and their self-efficacy vis-à-vis STEM. While the criterion for the categories of participation were somewhat rigid, as expected, there was movement between and across profiles for the students in the focal cohort as evidenced by the case studies provided above. In fact, all but one of the 17 focal students, by the end of the academic year, were shakers.

Further Connecting STEM Identities in the Courses

In all three MAN UP courses, emphasis was placed on positioning students as "applied STEM practitioners." This was seen, in part, in the work on final projects that the students completed for each class. For math class the focal students used linear equations to create a symbolic mathematical representation in the form of a crest or insignia using linear equations to represent them as young scholars to the outside world. The symbol they created was a mallet breaking a large wall. At the year-end celebration, the class described the mathematical processes they mastered to create their insignia along with its symbolic implication. Speaking for the group, one student explained, "We created a mallet because in this program we are creating symbols using math…. If that doesn't smash stereotypes about us, I don't know what will…. We like the mallet because rubber is malleable…. We are, too!"

CS Final Project: In Computer Science the focal cohort contributed to the creation of a mobile application to raise environmental awareness that was led by the 8th graders. The focal cohort also contributed to its creation. Though the focal class did not lead this project, their understanding of their identities as STEM producers rather than consumers was reinforced through it. In focus group interviews, for example, one focal student reported that he now "feels connected to the producer role" because in developing this app he was "doing the producing instead of just talking about it." Another focal student commented that this process had "convinced" him that can and he will be a video game engineer that "creates [produces] good video games with positive African American male role models, unlike GTA [Grand Theft Auto]."

RAM Final Project: Proposed Project Presentation: Similarly, the final project in the RAM class was to curate a production of diverse digital narratives modeled after the museum installation called "Question Bridge Black Males." This project reinforced STEM identities in the focal students in a variety of ways. A member of the MAN UP instructional team served as one of the advisors for the development of Question Bridge Black Males <http://questionbridge.com/>. This member introduced the rest of the MAN UP instructional team to this exhibit, and the program eventually took all of the students on a field trip to see it at a local museum.

In RAM the goal of addressing issues of identity was explicit, and the students brought what they were learning about rhetorical analysis to the "re-production" of a Question Bridge as a final class project. The focal students videotaped themselves and students in the other two classes addressing questions of black male identity and life experiences as modeled in the

museum exhibit. When asked why they chose this project, students talked about how they wanted to smash stereotypes around African American males in STEM and how they felt that using technology to counter stereotypes of African American males was analogous to "performing their argument."

> *Mr. K*: "Please provide the panel with the synopsis of the project that you're proposing."
> Student 2: We want to create a project that's like the question Bridge project. What to ask us the same questions that they presented on the website and some that we saw at the exhibit. We're going to answer the questions and we want the seventh and eighth graders to answer the questions, too.
> *Mr. K:* What do you hope to accomplish with this presentation?
> *Mr. J:* What's your thesis?
> *Student 1:* "Okay, we know that there are a lot of stereotypes, negative stereotypes connected to African-American male youth. People say that we're lazy, violet, do drugs, stuff like that or that we can't work together. So, the thesis is that we want to smash the stereotypes by showing people who see this video that we know how to use technology, and STEM, just as well as they do.
> *Student 2*: "That's right, and the rhetorical piece, or what Mr. J calls performing our argument, is that not only are we talking about how we could do all these different things with STEM, we're actually doing it by producing are all the [technology-based presentation] like Question Bridge and, by doing this, other kids like us—that are unfairly stereotyped can be encouraged."
> Student 1: "And, this is how we can uplift not just ourselves, but also our community, too."
> Student 3: "It's like stereotypes force us to consume negative stuff about ourselves. Now we can use this video project to produce positive images of African American males.
> Mr. J: WOW! That's powerful, bro!
> Student 2: Mr. J, are you crying?
> Mr. J: "Maybe…this is powerful stuff. I've never heard 6th graders talking like this."
> Student 1: "That's right, you have to remember that we're the experts now…."
> Student 3: "Yep, and we're going to use our expertness [expertise] to breakdown these wack stereotypes so that other young brothas [brothers] will know that they can do this, too."
> Student 2: "And their teachers will know, too."

The above conversation took place towards the end of March 2014, which was the midway point of the second semester. The ethos demonstrated in the way that the focal cohort presented their project plan was in stark contrast to their initial conception of manhood as evidenced by the Manhood pre-survey administered January 2014. The following quote, below, demonstrates this conceptual movement. Initially a first year MAN UP student on the pre-survey defined manhood thusly:

> Manhood is the state of being a man rather than a child. Manhood in my opinion is taking care of your family, being responsible and being successful. Being a man takes a lot of responsibility, you have to take care of your wife and kids protect them and treat them with respect."

This quote captured the general feeling of the entire focal cohort as pertains to their definitions of manhood. In fact 16 of 17 focal students included the following words on their respective replies to this question: provide, protect/protection, family/kids, wife/women/lady. (The lone student

who did not use one of these words simply stated that manhood is—"just being a man".) On the post-survey, however, while still deeply invested in the protection of their future families, the focal cohorts' conception of manhood had been broadened, 16 of 17 students, in addition to the abovementioned words also included the following words: community/communities, neighborhood, culture/society, environment, and planet. This shift in contextual understanding was eloquently captured by the following focal student's response on the post-manhood survey: "Manhood is understanding that you have a responsibility to your family and your community, and your planet." This particular conceptual shift in this students understanding of manhood was indicative of the focal class by and large. Ultimately, I found that because MAN UP students were encouraged, empowered, and equipped to question seemingly axiomatic conceptions of manhood generally, and black manhood specifically, this criticality bled over into their association with STEM learning as well.

Commensurate with MAN UP's pedagogical approach, the MAN UP instructional team was interested in devising ways to contribute to the development of MAN UP students' agentive voices, by function as active listeners, while contributing to increases in their STEM related identification, competency, and socially just application of science, technology, engineering, and/or math. Based on this project as well as the projects that were birthed in students' STEM classes, I found that this was indeed taking place, and, I found that students were intent on using their agentive voices, their STEM knowhow, and their power to change the world—for the better.

Practically, by creating a digital media project using the five paragraph essay format and the rhetorical triangle, the focal cohorts' understanding of argumentation was strengthened (as demonstrated by their work on their RAM-specific final project). For example, the RAM Question Bridge Development Team, all members of the focal cohort, created a video project that interrogated the pernicious stereotypes that have been sutured to African American males in STEM and in other pertinent issues like familial and community relations. When presenting their work, this group of students identified and explained instances where their film demonstrated the themes covered in the RAM course:

> Mr. K: So, why did your group settle on the three or four questions that your video brought to the fore (Why should Black Men learn STEM?; What is the role of the Black man in his community; and, Whose responsibility is it to raise Black children; and, lastly, As a Black man in America, are you truly free?)?
> Student 1: Well, we wanted to make sure that our argument was rhetorical[ly] balanced.
> Student 2: Yeah, we didn't want our argument to be too pathetic—I mean too emotional, or offer just logical information [logos].
> Student 1: Right, we also want to make sure that it's clear that we know what we're talking about, so that our credibility—our ethos—is also covered.
> Student 3: Exactly, the question about freedom is, like, our emotional question. We knew that the conversation would get heated when we asked groups to argue each side. [The RAM group asked students, irrespective of their personal beliefs, to argue or discuss each question.] We also knew that the question about raising our children would appeal to the audiences' emotions and kind of open them up so that we could share positive facts about the power of the Black family.
> Student 4: That way, we could deconstruct the negative stereotypes that claim that there's something wrong with us and our families.

Mr. K: Okay, so, someone please sum up for me what it is that your project is hoping to achieve.

Student 1: I'll take this one [his group agrees with head nods]. We viewed this project as a message within a message, but I'll get back to that later. We constructed this like a five paragraph essay. The problem that we're addressing was that people see the Black male experience as one thing and that that thing is negative, because it's based on stereotypes like we're not smart, or we're violent, or we're lazy and we don't love our kids and families. So, our thesis was [this]: if we can show the ways that young people—us—are thing about all of these things, thinking critically that is, then, and people will understand that those stereotypes are untrue. So, we picked questions that asked the same question differently. I mean, at the end of the day, we wanted to answer the question: does the Black man have a role in society, with a "yes".

Mr. J: Say more, please.

Student 1: Okay, it's like this…

Student 2: I'll say more. All of the questions act as body paragraphs in the five-paragraph essay format. But like (Student 1) said, they all ask the same question so that they can help us demonstrate our argument: that the Black man has a huge role in family, community, STEM, and society. Because, when we all asked and you all debated these questions, it demonstrated how deeply we can think about all of these issues. It's not lost on us. That's how we concluded—by showing that we see the ways that we, a group of young Black men of the future, are paying attention to all of this and that we are smart enough and we care enough to plan to do something about it.

Student 3: Plus, like Mr. J always talked about with us: we preformed our argument by using tech to construct our argument.

Rhetorical argumentation for these students was no longer merely a rubric to follow; instead, this multimodal, digital project helped them arrive at a conceptual understanding of what it means to create and develop a cogent argument. And, by using the circle of critical praxis (Duncan Andrade & Morrell, 2008) to develop this project, students were introduced to the engineering and design process. What is more, this technological project was catalyzed by students' desire to infuse constituents of rhetoric and composition in the creation of a STEM focused project that they designed in order to create more equitable, more socially just reality.

The Medium is the Message: As evidenced by the exchange above, these students went on to construct a narrative that featured a strong logical appeal, a strong emotive, or pathetic appeal, and that was predicated on an ethical appeal based on their expertise as middle school African-American males in STEM. Throughout this particular project it became readily apparent that Mr. K's words were true: these students were taking ownership of their identities as applied STEM practitioners. They were desirous to demonstrate to their potential audience that they were a group of young men fully capable of applying STEM to a matter that was of utmost importance to them, individually, and to their community of other "negatively stereotyped people" more broadly. What is more, they had begun to connect their understanding of manhood, or, what it means to "MAN UP" to the pursuit of global equity, which is commensurate with the spirit of the program's name. And, they did so by "performing their argument". That is to say, by using technology, in this particular instance, to deconstruct and later correct and reconstruct negative, stereotypical depictions of African American males, they were instantiating their argument as well as the overall argument of MAN UP: urban, predominately low-income African American

middle school males are fully capable of learning and, subsequently, using STEM to address issues that are important to them and that inhere on social justice.

In this chapter I discussed the findings which pointed to the realization that the focal cohort had begun to see themselves as applied STEM practitioners fully capable of using STEM for social justice. This realization was the first step in these students in these students' shifts from self-centered, or family-centered consumer of STEM (takers and makers, respectively) to critically conscious producers of socially just applications of STEM (shakers).

In the following chapter, Chapter 5, I discuss the positive shifts in STEM competency demonstrated by the focal cohort.

Chapter 5: Developing Competencies in STEM and Beyond

In addition to developing the cohort's STEM identities, the MAN UP program also focused on developing specific STEM competencies required for college and careers. These two measures are not disparate. In fact this programmatic structure of MAN UP argued that the development of a positive STEM identity was essential to the development of STEM competency. To assess shifts in math learning, a core "concept inventory" based on California State Standards and the Common Core State Standards was used. Different concept inventories were developed for CS and RAM that reflected specific content addressed in those classes. Like the pre and post surveys, the concept inventories (except for the RAM class) were administered at the beginning and end of the 2013-14 academic-year. In addition to the above-mentioned metrics, I discuss data collected from the YPSS in order to underscore the focal cohorts' shifts in confidence, which positively informed their demonstrated gains in competency as well as their positive shifts in self-efficacy. However, prior to analyzing the data provided by the YPSS, it makes sense to first illuminate the gains that the focal cohort demonstrated based on their course-specific concept inventories.

Pre-post Concept Inventories

The math course aimed to prepare students to continue to be successful in grade-level math and also provide foundational skills and dispositions necessary to be successful as they advanced to higher levels of math. The math concept inventory captured the focal cohort's pre and post knowledge in three content areas: ratios and proportions, geometry, and statistics. All 17 students in the focal class completed the pre-MAN UP math assessment, which was administered September 2013. All 17 students in the focal class completed the post-MAN UP math assessment administered in June 2014. Pre- and post-MAN UP math assessment data were available for all 17 students in the focal cohort. The results of the pre-post math concept inventory were very encouraging: 94 percent (16/17) of the focal cohort demonstrated growth in mathematics performance from pre- to post- MAN UP. The focal class increased by an average of five items, or 14 percentage points (47 percent to 61 percent); in fact, bucking a seemingly ironclad trend, students eligible for Free/Reduced Price Lunch (FRPL), who had lower pre-MAN UP scores, had the highest post-math scores, demonstrating growth of 8 percentage points compared to non-FRPL eligible students (2 percentage points). This is vitally important because low-income African American males are, due to myriad reasons that have little or nothing to do with intrinsic ability, are seemingly permanent fixtures on the bottom rung of the latter of educational achievement.

What is more, the focal cohorts' responses in focus group interviews and on the YPSS indicated that they also saw increases in their confidence regarding math success. For example, all but one reported that they had learned a lot and that the program had improved their math skills. They spoke highly about ways that Mr. K's math course affected them. Many noted that they were ahead of the math they were learning in school as a result of participation in MAN UP. As one student said, "When I went to my math class, everyone was struggling except me because I had already learned it here." Another shared, "I always really liked math, but Mr. K helped me explore math and what it is and how to use it instead of just learning it." Students, when asked whether or not they felt that they could learn math more easily at MAN UP on the final focus group interview, pointed to MR. K's excellence as an educator as well as the overall atmosphere represented by MAN UP. For example, one student commented: "It was easier for me to learn

here [MAN UP] because I felt like what I said mattered and I also felt like Mr. K was willing to help me, even if it took me a while to get the concepts." This sentiment was echoed by another student who stated: "Being here with other black males who are good in math and with male teachers who always push us to be our best. At my school, I'm the only African American male in my math class. And, my teacher is smart, but he does all the talking. We don't get to say much. It's different here [at MAN UP]."

Similar developments in STEM competencies were achieved in the Computer Science/Mobile Apps class. Mr. S taught students how to design and build Mobile Apps using App Inventor programming language. However, beyond learning to program, the course focused on big ideas of computing including abstraction, design, recursion, simulations, and the limits of computation. The Mobile Apps concept inventory consisted of 8 items asked students to evaluate their skill level and ability to complete skills tasks, based on a 3-point Likert scale ranging from "not at all true" to "very much true." The students showed significant gains in their knowledge and skills with increases on every item including understanding how to create a storyboard and implementation plans for apps, knowing what a mock-up is, understanding how to create a design rationale, and understanding how to use app programming software. These increases were best captured by the focal cohorts' invaluable contributions to the eight grade cohorts' conceptualization, development and actualization of an environmentally conscious sustainability mobile application. The focal cohort helped storyboard and conceptualize the eighth grade project, relying heavily on their newfound understanding of the design process (which was the focus for the 1st Year Cohort). The focal cohort's interview and YPSS survey responses confirmed that they felt they were developing important STEM competencies.

Yearend Post-Satisfaction Survey (YPSS)

MAN UP was intended to be rigorous and a vehicle that resulted, ultimately, in measurable college-readiness for the students enrolled. There are a number of programs that do this type of work. The difference for this program, however, was a laser-focus and undying determination on creating an atmosphere that was built upon trusting, nutritive relationships within the MAN UP community. The strong feeling was that if middle school African American young men were in a STEM-focused educative program that celebrated who they are and developed a curricular foci and pedagogical approach that was based on their lived-experiences, concerns, interests, etc., they would not only improve in STEM scholastically, but that they would begin to do STEM. From a programmatic standpoint, this survey provided information for the MAN UP educational team to use for program improvement; for the sake of this study, this survey afforded a view into the ways in which the focal cohort recognized and identified with the atmosphere that MAN UP sought to engender and how it informed the development of a positive STEM identity for the focal cohort.

According to this survey, the focal class recognized that there was a difference in the way that MAN UP STEM instruction positioned them. For example, 15 out of 17 members of the focal cohort agreed that MAN UP challenged them to think about the way that they think in regards to their roles in society and how they can use STEM to be agents on positive social change. It is my belief that these shifts in STEM identity were precipitated on the critical pedagogical approach that MAN UP instantiated. This approach, predicated on a critical-reality pedagogical approach to STEM education, intentionally centered the lived-experiences, culture, concerns, issues and ways of being that these young men instantiated. Data suggests that students recognized that this approach was different than what they were used to in their respective

schools: 76 percent of the focal (13/17) cohort felt that race and culture were connected to STEM course content within MAN UP. Conversely, only 23 percent (4/17) of the focal cohort felt as though their schools connected race and culture to STEM course content. And, 88 percent of the focal class (15/17) felt that issues around equity and justice were connected to STEM course content within MAN UP. Conversely, only 23 percent (4/17) of the focal cohort felt as though their schools connected race and culture to STEM course content. Nasir's (2011) work demonstrated that there is reciprocal relationship between students' increases in (math) competency and increases in (math) confidence, and the obverse holds true as well. And, 94 percent of the focal class felt that MAN UP made them feel as though they could excel in STEM, versus only 23 percent feeling that their schools prompted this kind of confidence. The following data also speaks to the effect that that MAN UP pedagogical approach had on the focal cohort: 100 percent of the focal class reported that MAN UP improved their math skills; 88 percent of the focal class (15/17) reported that they learned "a lot" or "some" about mathematics in MAN UP; and, 88 percent of the focal cohort (15/17) reported that MAN UP increased their interest in Mobile Apps. In addition to these findings, the data also bears out that 76 percent of the focal cohort (13/17) reported that they learned how to create Mobile Apps in MAN UP; 76 percent of the focal class (13/17) learned "a lot" or "some" about Mobile Apps in MAN UP. And, 94 percent of the focal cohort agreed or strongly agreed that they felt that their confidence in their ability/ies to excel in STEM helped them do better in STEM.

These statistics provide valuable insight into what may have catalyzed the focal cohorts' shifts in STEM competency: as their confidence in not only learning but also doing STEM increased, they, in turn, began to see themselves as young people who could both learn and do STEM. This was the first, necessary, step in the development of their STEM identities as applied STEM practitioners that do STEM well.

Yearend Focus Group Interviews

Returning to a discussion of STEM competency, data pulled from the yearend focus group interview bears out that students experienced increases in their attitudes and aspirations relating to mathematics, Computer Science, college and career in STEM fields, and their own study patterns. As Michael remarked, "I think about my future more" and Jeff shared, "It made me think about being a creator, not just a user." Students found themselves striving to succeed as a result of the program, describing how it "makes me want to do better on my math so I can stay here next year and keep my grades up." Because the program also stressed the importance of college and careers, according to the yearend focus group, the focal cohort reported that they felt more committed to their futures with students sharing statements such as, "I knew math was important from the beginning, but coming here as an African-American, I know it is more important to show them that we are smart and we can do math," which is commensurate with the work that students were undertaking to dispel negative stereotypes. Another student added: "MAN UP made me more interested in building things, like mechanical things or wooden things or technology."

This sentiment was consistent throughout the focal cohort. In fact members of the focal cohort claimed that they were interested in wanting to "go to college earlier" and attend "a better college" than they had originally anticipated. Furthermore, students gained a new perspective on high school, sharing that the program "helped me because before when I thought about high school, I thought about work, work, and more work, but it [MAN UP] let me know that it isn't as hard I expected." Similarly, one young man stated that the program prepared him for high school,

and more specifically "what expectations are there, and how I can be mature, and give it my all to make the most of it." All of this is the direct result of students beginning to self-identify as young people who can both learn and do STEM.

This is evidenced by the focal students repeatedly describing the extent to which the program helped them think about STEM careers, or "new career options I didn't know about." For instance, Jeff discussed how the program showed him "there are more tech jobs, and how tech can be useful, to help you and help the community. There are more jobs I didn't know about that I might want to do, like Google jobs and Mobile Apps and creating cars that drive themselves." Michael explained that because of the speakers "talking about high school and college, it made me think about what I am going to do in the future, and made me think more about options for what I wanted to do in my life, like science, math, and technology." This data suggest that the focal cohorts' positive shifts in their STEM-specific attitudes and aspirations are concomitant with increased self-efficacy in STEM. Attitudes, aspirations and self-efficacy in STEM appear to be necessary steps in gaining competency in STEM.

Computer Science Course Concept Inventory

An example of connections between attitudes/aspirations and self-efficacy in STEM is in the fact that, 16 of the 17 students agreed that the program taught them a lot about Computer Science and that they now felt that Computer Science was interesting and fun. As one student noted, "I've never had a Computer Science class before. This was all new to me. Mr. S was so patient, and he really knows his stuff. I'm beginning to think that I really can be a video game designer." And, related to the focal students' increases in CS competency, they felt that this course encouraged, empowered, and equipped them to devise and, later, develop technology that would benefit not only their own immediate communities, but also similar communities worldwide. During the yearend focus group interview one student commented that "Mr. S helped me think differently about the roles that I can play in society. Like, now I think about ways to fill in the cracks that make life harder for certain people." This student's statement is indicative of the overall feeling of the focal cohort: 16 of 17 members of the focal cohort agreed, on the YPSS, that the CS course helped them think of new ways to use STEM for positive social change. In addition to helping to foster a critical (theoretical) understanding of the ways in which STEM can be applied for social amelioration, the CS course also taught students how to develop their "hard" computing (as evidenced by Table 1: CS, below) skills like storyboarding, developing mock ups, and employing the design process, for example. As evidence by Tables 1:1 and 1.2, the focal cohort increased from pre to post on their CS concept inventories. In analyzing this data, increase from pre to post is defined as: movement from students self-selecting the "Very Much" option on the pre CS concept inventory versus the number of students from the focal cohort that selected "Very Much", for a given question, on the post CS concept inventory. As evidenced by the tables below (Table 1: CS Concept Inventory Front-end Design and Table 2: CS Concept Inventory Back-end Design), the focal cohort experienced significant gains in their self-perceived familiarity and expertise with each of the questions represented on the two-part CS concept inventory. These gains are significant precisely because they demonstrated the focal cohorts' increasing confidence in doing CS (STEM), which is a both precursor for and indicative of the development of a positive STEM identity (Nasir, 2011).

Table 1: CS Concept Inventory Results, Front-end Design

CS Concept Inventory: Front End	PRE			POST			Pre-Post Increase: Very Much
	Not at all	Somewhat	Very Much	Not at all	Somewhat	Very Much	
I know how to create a storyboard and implementation plans for apps.	11	4	2	0	2	15	13
I know how to identify a community problem.	6	8	3	0	1	16	13
In user interface design, I understand the difference between visible and non-visible components.	14	2	1	2	4	13	12
I understand how to create and the purpose of a design rationale.	14	2	1	0	3	14	13
I know how to use app programming software such as Appery and/or App Inventor.	12	4	1	1	2	14	13
I know what a mock-up is.	13	3	1	0	3	14	13
I know how to work with others to create an app idea.	4	11	2	0	2	15	13
I know how to give a presentation about an app idea.	9	6	2	0	1	16	14

Table 2: CS Concept Inventory Results, Backend Design

CS Concept Inventory: Back-end Design	PRE			POST			Pre- Post Increase: Very Much
	Not at all	Somewhat	Very Much	Not at all	Somewhat	Very Much	
I understand how and when to launch the blocks-editor in app inventor	15	1	1	1	4	12	11
I understand when and how to use if/then conditional logic	16	0	1	1	5	11	10
I understand when and how to define a variable	14	2	1	1	5	11	10
I understand when and how to use an already defined variable	14	2	1	2	5	10	9
I understand when and how to write a procedure	14	2	1	1	7	9	8
I understand when and how to call a procedure already written	15	1	1	2	3	12	11

The Rhetorical Analysis of Manhood

The RAM class offered a unique space for seeing how the first year cohort was developing competencies in STEM as well as critical language skills. This course explored conceptions of manhood generally, and conceptions of African American manhood specifically in terms of definitions; individual, group, and societal perceptions; and the power relationships and media representations that influence all of these considerations. The students learned to use principles

of rhetorical analysis to understand and critique the various considerations of manhood surrounding African American males and honed their presentation and technical skills through the Question Bridge like video project.

The initial concept inventory for RAM was administered at the beginning of the second semester as opposed to the start of the first semester for the other two classes, and the post concept inventory was administered at the end of the program. The 19 questions on this inventory sought to ascertain students' conceptions of manhood. Data from these questions indicated that many students initially understood manhood as a static positionality that was predicated exclusively on the ability to provide both financial and physical security for women and children. This static conception of manhood shifted over the course of the second semester to a more malleable understanding of manhood as connected to being a caretaker, but also having responsibilities to improving the larger community. This shift was captured in an interview response of one of the 6th graders who noted, "Manhood is understanding that you have a responsibility to your family and your community, and your planet."

Across all three classes and across the various sources of data, there were clear indications that the MAN UP program had significant impacts on developing competencies as well as identities in connection with STEM subjects and careers. As one participant concluded in a focus group interview, "It's a great way to spend my Saturdays and stay off the streets because I bettered myself and my STEM skills."

In this chapter I chronicled the focal cohorts' shifts in STEM competency as well as their shifts in competency in their, non-STEM, RAM course in order to speak to the ways in which their increases in STEM identity contributed to their demonstrated increases in competency vis-à-vis the courses offered at MAN UP. That is to say, I worked to illuminate the potentially powerful connection between the intentional development of a positive STEM identity—as an applied STEM practitioner—to their confidence and demonstrated ability to excel in the STEM course content covered in MAN UP. In the following chapter, I discuss how the intentional atmosphere developed and curated at MAN UP facilitated and/or contributed to the focal cohorts' desire, willingness, and ability to apply their increased STEM knowledge for social justice—or to function as applied STEM practitioners.

Chapter 6: Creating Socio-academic Synergy for the Development of Socially Just Applications of STEM

The MAN UP instructional team worked collaboratively to design the courses and activities such that the students would not only be learning STEM, but also doing and applying STEM to equity and social development issues that the cohort identified as important. In order to position students to do this kind of STEM-mediated social justice work, by applying STEM to societal inequity, the MAN UP instructional team knew that we needed to focus not just on curriculum or pedagogy, but also on the atmosphere that our curricular and pedagogical approaches would be housed within.

Therefore, in this chapter I illuminate the connection between the focal cohorts' previously mentioned shifts in STEM identity and how it contributed to their increases in STEM competency and then connect these two linear yet conjoined strands to their newfound willingness and ability to apply their STEM knowledge for social justice. In order to discuss this process, I look at the effects of synergizing atmosphere, the socio-academic synergy, that the MAN UP instructional team tirelessly endeavored to create—an atmosphere that incorporated students' voices and their lived-realities into the curriculum as well as the overall ethos of this program—and how it informed the focal cohorts' willingness and confidence regarding their self-directed ability to apply STEM for social justice. Concomitantly, I analyze the effect that this move had on students' sense of belonging, self-efficacy in STEM, as well as their feelings of belongingness in STEM spaces and ultimately in STEM careers. Additionally, I speak to the importance of centering critical reality pedagogy in STEM and understanding the power of student agency via application, and why it is that a critical-reality based STEM pedagogical approach is a matter of social justice. And, to close out this chapter, I discuss the YPSS that students completed which speaks to their relationship and experiences with MAN UP vis-à-vis their own home schools.

Socio-academic Synergy: Cultivating and Curating an Educationally Nutritive Atmosphere

The MAN UP critical-reality pedagogical approach was predicated on a phenomenon I termed socio-academic synergy: Socio-academic synergy is a synergistic relationship between students' lives outside of educational settings and the curricular goals, course content offered at MAN UP, and the pedagogical approach employed by MAN UP instructors. The goal was to curate a positive, educationally-nutritive, and empowering atmosphere, which the YPSS data suggests represents a very different educational atmosphere than the atmospheres represented by the schools that the majority of the focal students attend. This approach is derived from and commensurate with culturally relevant pedagogy (CRP); however, there is a clear aim to not only make students comfortable in an accepted educational space, but also to encourage, empower, and equip them to use their agentive voices for positive societal change. CRP is an incredibly powerful educational paradigm, and I believe that it was further strengthened by working to shift MAN UP students' concerns beyond their own subjective levels of comfortability by positioning them as change agents able to extend their critical contextual understanding of their socio-political environment to issues that plague other hyper-marginalized people, too. So, this approach as an extension of CRP is not something implemented top down, from teachers to students'; instead it was co-constructed based on students lived experiences in and outside of the classroom. My presupposition was that in order for students to begin behaving as applied STEM practitioners, they had to be afforded a space where this identity was readily available and even

encouraged. By most of these students' (and their families') admission, they schools that they were enrolled in did not feature this kind of nutritive atmosphere—at least not for them.

A number of questions on the YPSS were geared to unearth students' experiences with this approach in differentiation from what they experienced at their respective schools. More specifically, students were asked to rate their experience with the purposefully cultivated MAN UP atmosphere vis-à-vis the atmospheres they encountered at their schools. The data collected was illuminating and provides valuable insight as to explanations regarding the focal cohorts' increases in STEM identity, STEM competency, and in their self-directed creation of socially just applications of STEM. To be clear, the goal if this survey was to devise new ways to improve MAN UP by working to address student-perceived holes in the educational atmosphere and concomitant experiences at their regular schools. My intention was not to sour them in any way to their home schools, which is why the YPSS was administered at the end of MAN UP, which was also the end of the focal cohorts' school year.

As evidenced by the YPSS, 16 out of the 17 focal students agreed that they were treated fairly by their MAN UP instructors versus only 6 of 17 of the focal cohort with regards to the instructors at their respective schools. This is particularly illuminating because it directly informs the next statistic: 16 of 17 members of the focal group agreed that the felt a sense of belonging at MAN UP as opposed to only 4 of the 17 members of the focal cohort agreeing that they felt a sense of belonging at their schools. Contiguously, 16 of 17 students agreed that they enjoyed attending MAN UP versus only 6 of 17 agreeing that they enjoyed attending their home schools. This is important because MAN UP meets on Saturdays, a time where these students could be involved in other (non-academic) activities; and, what is more 15 of the 17 members of the focal cohort agreed that MAN UP's curricular content was more challenging than what they were receiving in their schools. So, as evidenced by the data presented above, when taken together, what became clear is that these vibrant, busy young men would rather spend six hours, two Saturdays per month (for a total of 12 hours per month) in a program that, for the majority of them, featured academic work that was more challenging that the work that they encountered at their schools. And, while this is cause for celebration for the MAN UP instructional team, this is also, simultaneously, an indictment of the experiences that they, urban African American males, are forced to encounter traversing the contested terrain (Gramsci, 1971)—built atop a white supremacist agenda—that many of their schools represented. In spite of this oppressive reality, these students still thrived at MAN UP; in fact, 100 percent of the focal cohort agreed that MAN UP helped them develop confidence in learning and excelling in STEM as well as applying STEM to issues that are important to them. This newfound confidence helped the focal cohort become more self-efficacious and begin to see themselves as the powerful change agents, or in MAN UP vernacular, as the applied STEM practitioners that they truly are.

Shifts in Self-Efficacy

The focal cohort continually remarked that they felt the program had an impact on how they think of themselves. They described having "more confidence" and that the program helped them to "feel smarter, like I could do it." Malcolm stated that the program transformed how he sees his math abilities, saying, "I never thought I was good at math but I think I did well here...When I first came here, I kind of didn't know anything, and as the teachers worked with me, I found out that I was smarter than I actually thought I was." All of the focal cohort agreed that they felt that they found their voice as a result of participating in the program. For example, one student shared, "I learned not to be shy here, because it was an inclusive environment. The

instructors encouraged inclusiveness, and people that don't normally participate at school participated here." As a result, 16 of 17 students' self-efficacy was positively impacted, with one student explaining, "This program made me feel, instead of just having ideas about things and not building them, like I can actually build them and get the right materials instead of just thinking it. Like one time I had an idea of building a robotic arm and now I feel like I could build it." Similarly, Jeff shared, "It [MAN UP] made me feel that high school and college will be easier since I know what to expect and what to do."

Furthermore, students repeatedly mentioned the development of increased pride. Malachi, a member of the focal cohort, commented that "We are raising expectations…since there aren't a lot of African-American males in STEM, and opportunities can open up because of what we are doing here" and Jeff remarked that the program helped him to "have pride in young African-American men and seeing what we can do." Lastly, as cogently explained by Thomas, "I have never been in an environment that is even close to MAN UP, where we learn to help ourselves and our community by using STEM as tools."

The MAN UP atmosphere was built around and predicated on the lived-experiences of urban, predominately low-income, middle school African American males. Data from the YPSS suggests that students recognized this approach and that this intentional focus resonated with them. For example:

- 15/17 of the focal class and agreed that MAN UP challenged them to think about the way that they think about their roles in society.
- 16/17 of the focal class and agreed that the can use their STEM knowledge to make their neighborhoods better.
- 15/17 of the focal class and agreed that the can use their STEM knowledge to make the world a better place.
- 16/17 of the focal class and agreed that the instructors at MAN UP helped them see a connection between STEM and Social Justice.
- 16/17 of the focal class and agreed that the instructors at MAN UP helped them see a connection between STEM and Race.
- 15/17 of the focal class agreed that MAN UP helped them think about STEM differently.

Perhaps the most telling statistic was this: all but one (16/17) of the focal cohort agreed that MAN UP instructors connected STEM to their (the students) lives; conversely, none of the members of the focal cohort felt that instructors at their schools connected STEM to their (the students') real life concerns.

Overall, the focal cohort reported high levels of satisfaction with the MAN UP program on the YPSS. Actually, of all three cohorts, the first year MAN UP students reported being most satisfied with MAN UP: they repeatedly shared various experiences relating to what they enjoyed about the program. In addition to academic knowledge gained, they repeatedly described extensive satisfaction and growth as a result of being around same-race, same- gender peers and role models.

Additionally, students remarked that they felt they "benefited mentally seeing role models of my color skin" and that MAN UP is "a good thing for African-American boys." One student said he feels "less shy" as a result of the program, because he has "never been in an environment like this." Another young man stated, "It is a great way to spend my Saturdays and stay off the streets, because I bettered myself and my STEM skills." This was attributed to "getting together with kids my age and race to do work" and "getting help from teachers who inspired me and were my role models."

According to the YPSS students within the focal class looked up to the MAN UP instructors as mentors, with one young man stating, "I really didn't have a role model and now I have three [the MAN UP Instructional Team]." Another explained, "I never thought of African-American scientists and they [instructors] introduced me to some and I saw what we could do and it changed my perspective on my role models." This growth occurred throughout the school year, as described by another member of the focal cohort:

> Before I came here, I never thought of an African American male as a role model, because I am not super into sports so I wouldn't say Kobe Bryant or anything, but now it opened my eyes to all the good and important things African American males have done and it made me think about who my role models are. Maxwell, 1st Year MAN UP student.

What is more, MAN UP students even found themselves developing into role models for their peers; as one young man stated, "my friend now thinks of me as an inspiration." (Stevie, 1st year MAN UP student).

This data suggests that students recognized that there was something different about the curricular foci and pedagogical approach, both of which congealed to form an atmosphere that hinged on socio-academic synergy. And, more importantly, students realized that they had the latitude, and were even encouraged to be successful in STEM without being forced to change who they were. This sentiment was best captured by a students' responses to the final focus group interview question: Do you think MAN UP was successful? Why or why not?: "I know MAN UP was a success. A lot of us felt like we were okay or even good in math. But, I don't think many of us thought we could *do* math until we joined this program." Another student followed: "I always felt respected here, I mean, I feel like my voice mattered. So, I think that that gave me a lot of confidence that I could really be an applied STEM practitioner. I mean that I *am* and applied STEM practitioner". Contiguously, another student remarked, "This was so different from school: 40 plus African American males doing math together. No one was telling us to sit down and be quiet, or just listen. We got to teach, too. I know this helped me become someone who can *do* STEM, not just learn it."

All this suggests that socio-academic synergy (SAS) is integral to student success. SAS is predicated on multi-cultural education. It is inclusive; and, it is also prescriptive. Again, the goal of MAN UP was to create a safe space where urban, African-American males were not required to check their culture at the door in order to be considered successful students. We did this by focusing on three overarching components of the program: relationships, relevance, and rigor. In leading the charge for the design of this program, I was determined to create a program that was predicated on healthy, empowering, and educational relationships between the young men served and the MAN UP instructional team. Therefore, as I mentioned previously we were intentional about our curricular foci in that everything that we did needed to be in some way connected to the students' real life experiences. For example, when time for the assessments arose, we made sure that students were aware of the fact that doing well in these assessments was part of their civic duty. That is to say, we made sure that they were aware that the work that they did on these assessments were directly affecting their neighborhoods in a positive way, because if we could make the argument that this program helps them improve scholastically, then, not only with this program persists, but the eventuality of other programs being created to serve more students like them became becomes a strong reality as well. So, again, even in taking the assessments that the parent organization required as an auspice of the program's funder, the students were positioned as change agents who has the potential to use STEM to better their local national and global

communities. In this way, these assessments along with the MAN UP curriculum were made relevant while maintaining rigor. And, it was because of the relationships established with these young men that we could have a frank conversation regarding their role in contributing to the educational achievement of young men that will, potentially, follow in their footsteps. This conversation started on the first day of the program.

MAN UP was a rites of passage program in many respects; however, being fully aware of the critique of many rites of passage programs that exist for African-American males, we were guided by the desire to provide the students with not only a relational and relevant experience, but also a rigorous academic experience as well. As stated in the previous section, 94 percent of the focal cohort agreed or strongly agreed that the work that they do in the MAN UP program is more difficult than the work that they receive at their home schools. But, unlike the home schools that many of the students attend, we did not simply give them curricular material in a way that is consistent with the banking model of education. Instead we asked them to take the curricular material from the RAM course, and their math course, and their CS course, and not only learn it but also to apply it to situations that they felt were important—situations that were relevant to them based on their lived experiences. We wanted to model critically contextualized curricular and pedagogical practices so that they would begin to critically contextualize their STEM learning, in return. What this looked like, practically, was groups of students working collaboratively in Socratic seminars, questioning, reckoning, reasoning and, ultimately prototyping and designing solutions to the problems that they felt were most pressing. And for each session there were always student presentations in each group. Even the opening warm-up activity, which was always a complex math problem, was done collaboratively by the students; then, each group of students was afforded the opportunity to present along with their group on why it is they felt that they had arrived at the correct answer.

And, while there was an explicit emphasis on rigor, MAN UP, did not over-determine the importance of academic success. It was simply part and parcel of the holistic approach that MAN UP represented. Not only did we challenge the young men to "work together and work smart" using STEM for societal uplift, we also ate with these young men. We also brought our families to meet their families during MAN UP get-togethers. We built community with the young men served at MAN UP. This was the setting. This is why in the three years that I guided the MAN UP program, even though we know the saddening statistics regarding African American male suspensions and expulsions from school and how these disciplinary actions correlate with fighting in particular (Freeman, 2013: http://www.takepart.com/photos/8-disturbing-truths-school-suspensions-america/school-suspension-rate-dilemma), I was never forced to remove a student for behavioral issues. What is more, there was never anything close to an altercation at MAN UP. MAN UP was a brotherhood; more than anything this word, brotherhood, accurately described the MAN UP atmosphere. Even though this program was predicated on complex theoretical terms like critical pedagogy and reality pedagogy and featured rigorous course material, all of these aspects congealed into a socio-academic synergy because the brotherhood community of MAN UP was nurtured, cared for, insisted upon and as a result it was strong. This was a brotherhood where the concerns, the joys, the successes, the challenges, the lived experiences of urban, African-American middle school males was what animated and impelled this program. All of this resulted in the fact that these young men were beginning to see themselves as applied STEM practitioners, ready, willing, and able to use their STEM knowledge to better their local, national, and global communities. This meant that their culture was no longer deficient—at least not in this space. Instead, their culture, their lives, their ways of

being were re-positioned as valued assets. They began to realize that no one could speak to their unique perspectives like they could. This is captured by Jeff's pellucid response to the (YPSS) question: Why is it important for you to do STEM?:

> It's important because I have a unique perspective as a 6th grade African American male. I'm tired of always having other people speak for me, for us. We need to tell our own story. And, we can't expect someone who is totally different—who has a different life to understand us and fix our problems. We can do it ourselves. We just have to work together and support each other and not tear each other down.

In math this was realized through Mr. K connecting learning to larger societal inequities on one hand while centering it in the lived experiences of the students on the other. A key aspect of his pedagogical approach was to engage the students in critical dialogues about how math is crucial to engagements in personal and cultural group contexts beyond classwork in schools. Starting with simple examples like how frequent attempts have been made by unscrupulous merchants to short-change some African Americans based on assumptions that they might not be able to accurately count their change to the roles of math calculations for understanding the complexities of wealth accumulation as it is affected by things like credit scores, credit card debt, differential interest rates, taxes, stocks and bonds, and other kinds of math driven investment instruments.

Examples of Socially Just Applications of STEM

One of the many examples of Mr. K's focus on socially just applications of math was his unit on the role of fast food in health disparities suffered by African Americans. The guiding question for the unit was, "Is there a connection between poor health and poverty"? Students could choose any topic for which they felt they could use math to facilitate understanding and positive change. They decided to use statistical analysis to arrive at a list of healthy food alternatives for low-income people. They researched the amount of calories, fats, saturated fats, proteins, sugar, and sodium in the foods that they normally ate because according to one student "we all eat, pretty much, the same junk." These projects culminated in PowerPoint presentations to the class, but they also hoped to share their findings at their respective schools as well as at community events so that they could in the words of one focal student, "educate their brothers and sisters how important diet is." Ultimately, the focal students saw their experiences learning math in the MAN UP program as "better and more challenging" because it was "math in real-life situations" that was "more hands on and more interaction than regular class and more active." Because this work resonated with them, they were engaged and committed. Their engagement, then, lent itself to positive shifts in their math competency—in this example—because they were doing work that was critically contextualized in that it was predicated on issues that were important to them as African Americans.

Math Final Projects: During student work on their final projects, which was audio-video recorded or recorded, data on students' understanding of how to use STEM in order to address issues of social justice arose. Field notes by Sims were also used to collect data in the rare occurrences where A/V equipment was unavailable.

The final project in the math class required the focal class to create a crest or insignia using linear equations. This symbolic mathematical representation was intended to be emblematic of how the students saw themselves and how the wanted to present themselves to the outside world. During the presentation at the year-end event, the audience was wowed by students' ability to explain the process they undertook in creating the sophisticated insignias. Each grade-specific cohort completed a math specific final project. The focal class created a

symbol of a large hammer or more accurately, a mallet destroying a large wall. When students asked why they created this symbol, Michael spoke for the group:

> We created a mallet because in this program we are creating symbols using math, I mean, if that doesn't smash stereotypes about us, I don't know what will. And, we like the mallet because rubber is malleable, it's flexible, not a steel hammer. That's important because we are flexible. There's not just one way to be an African-American male. Sure, we can try to do sports or music or whatever. We can do anything we set our minds to. And, we can also do STEM. I think it's important that we know that all of us know that. That's we choose this symbol to represent us.

Though, perhaps, unaware of the proper nomenclature, this student is speaking to the ways in which the focal class sees themselves not only destroying stereotypes, but also smashing the essentializing narratives that these insidious stereotypes are predicated and reliant on. And, the impetus of this group's project, consistent with McLuhan's (1967) argument that the medium is the message, created their presentation based on a very astute observation. In this case the medium, the use of linear equations to create a symbolic representation of these predominately low-income, urban, middle school African American males strength, resiliency, and power—as the student above noted—was truly the message. This group understood the performative aspect of their work as evidenced by the first line of the above quote. So, then, the argument can be made that these students were alloying conceptual aspects of the RAM course, which dove deep into ideas of African American male representation, with both math and technology. Evidence of this kind of conceptual transference also came to the fore in the focal cohorts' conceptualization of the final project for their CS course.

In the Computer Science class, a critical pedagogy approach to engaging the cohort in mobile app development was taken throughout the school year. CS integrated technology and computer programming with political and societal issues to expand students' thinking on how technology can be leveraged to address the big problems of our day, and how contributions to community justice can be made through the design and creation of technology. Over the course of the school year, Mr. S noted that he saw a definite shift in students' perspectives about the roles and values of technology in contributing to social justice. Initially, his students felt that the extent of help they could provide to their communities was to devise ways for people to find resources or organizations that were able to help people in need. Over time, however, the focal students began to see themselves as the help. For Mr. S, this shift in the students—that is their becoming socially conscious, applied STEM practitioners—was one clear way that the critical pedagogy approach was working.

One of a number of examples of this was in the focal class' extensive participation in the 8th grade class' design and construction of a mobile app to raise environmental awareness for middle and high school students. The app was designed and played as a football game wherein the running back gained yardage with each right answer selected regarding sustainability, global warming, and environmental awareness. When asked, in the yearend focus group interview, what he enjoyed about working through this project, Jeff shared: "I liked working on video game production, because I play video games, a lot. But, this time I'm not just consuming—I'm actually producing, or helping to produce a game that helps our environment." The RAM course discussed the dueling roles of consumer versus producers in great detail. This is the same conceptual transference that became evident in the focal cohort's work on the math final project.

As noted earlier, Mr. J's implementation of critical pedagogy in the RAM class was key

to how the students were facilitated to cognitively wrestle with the applications and ethics of STEM knowledge and skills in conjunction with their emerging STEM identities. By continuously tackling different notions of manhood that are deeply entrenched in our national ethos, the students were positioned to also critically question other axiomatic conceptions. They did this by working through the rhetorical triangle in order to identify logical, emotional, and ethical arguments that were being put forth. Mr. J taught the students how everything can be considered as an argument, even the spatial positioning of their class rooms at their home schools.

This approach began with the very first assignment in the RAM course in which the students searched Google Images for the word manhood and black manhood. They, then, were told to select one of the first 15 images that popped up, with the lone proviso being these images could not have words, for each search and to deconstruct the implicit argument underlying the image using the rhetorical triangle as an analysis tool and paying close attention to the notions of European male vis-à-vis African American male that were being promulgated. Eventually, they began applying this critical framing to their STEM courses. So, where STEM had initially been neutral and axiomatic, the students began to ask more critical questions by applying the tools of rhetorical analysis to their STEM learning. They wanted to know: STEM for what, and, STEM for whom?

The impact of his approach on student learning is partially captured in the final class project to create a Question Bridge like video documentary (noted earlier in this chapter) that would reveal the diverse views on young African American men on the positive possibilities and intricate dimensions of manhood. Mr. J guided the focal cohort on storyboarding the project by using design principles learned in the Mobile Applications course**.** Before filming their classmates, the students developed a critical focus for the project utilizing elements of the rhetorical triangle and the circle of critical praxis that were central to the RAM curriculum. Once they concretized the arguments that would undergird the documentary, they then developed questions to ask the students who would be featured the video.

This project exemplified several core components of the MAN UP program simultaneously. It reflected the utilization of digital technology in the production of video documentary in conjunction with developing the students' understanding of how to use STEM to achieve social justice goals. Importantly, there was substantial cross-fertilization of development of the focal students across all three courses such that they were reinforced through work in Math, CS, and their RAM course to increasingly see themselves as capable producers of positive social change. Essentially, they learned to see themselves as young men that could use STEM to make the world a better place. Or in MAN UP vernacular, they became applied STEM practitioners (i.e., shakers).

It was the work on the final projects that, perhaps, provided the best vantage point in order to determine whether or not individual members of the focal cohort had made their way into the shakers profile, precisely because shakers were shakers because not only did they understand that STEM was a tool for social justice—they also devised ways to actually use STEM for social justice. MAN UP's critical-reality pedagogical approach, which challenged students to not only think outside of the proverbial box but also to consider the box itself and how its existence and positioning either negatively affected or privileged certain groups, was instrumental to catalyzing these shifts. Over the course of this academic year, I found that students in the focal cohorts increased ability to apply STEM for social justice was proof that students had successfully critically contextualized STEM, because the critical contextualization

of STEM is manifested when students who have appropriated STEM begin to use it for societal uplift, or, social justice. More precisely, students' ability to demonstrate socially just applications of STEM was predicated on their critical contextualization of STEM; and, what I found to be the case was this: the presence or absence of this ability was the best indicator as to where the focal students ended up on the takers, makers, and shakers continuum. Based on this criterion, when alloyed with the data that highlighted shifts in student identification and determined by both group and individualized work on course work and final projects as well as individual and groups interviews and surveys, at the end of the academic year all but one student from the focal cohort fit within the shaker profile. This particular student was unwavering in his belief that STEM was his way out of poverty, and at no point in the semester, on any of the measures above, did he move past an individualized relationship to and with STEM. For example, on the post identification survey, in differentiation from all of his cohort mates, when answering the question why is learning STEM is important, did not use words like: community/family/culture/brothers/sisters/world/neighborhood, which are collective terms and were used by the focal cohort to describe their goals in applying STEM for social justice. This particular student, however, only used individualized terms like: I/my/myself/mine, in speaking to the importance of his learning STEM. His answer was as follows: STEM is important because I can use it to get a good education and a good job so that I can buy whatever I want for myself and won't have to depend on anyone else. I'll be able to buy my own stuff, that'll be mine."

In this chapter I chronicled the steps that contributed to the atmosphere, predicated on socio-academic synergy, that MAN UP developed and curated and the effects that it had on the focal cohort based on their own accounts of its efficacy as well as what they demonstrated in their course specific yearend final projects. In this chapter I sought to illuminate the connection between the focal cohorts' previously mentioned shifts in STEM identity and how it contributed to their increases in STEM competency, and then connect these two linear yet conjoined strands to their newfound willingness and ability to apply their STEM knowledge for social justice.

In the subsequent chapter, I discuss the MAN UP curricular and pedagogical setting, making an argument for the importance of working to create an atmosphere that features socio-academic synergy; that is to say, an atmosphere that critically centers the lived-experiences of the students it serves.

Chapter 7: Discussion of the Pedagogical Setting Fostered at MAN UP

To discuss and further amplify these findings, this chapter will assess the pedagogical atmosphere that characterized this program and how it created a nutritive educational space that afforded the focal participants the opportunity to become applied STEM practitioners by, to varying degrees, critically contextualizing STEM. In researching programs that were STEM focused that also served middle school African American males, the first noteworthy finding was that in area that MAN UP was housed, which has one of the highest absolute numbers of African American males on the West Coast in the feeder school district, there were no other programs exclusively for this group that were in anyway STEM based even though the hub for technological advancement, Silicon Valley, is not all that far away. There were, however, a number of programs for African American males that work to connect them to their history through the arts. So, from the onset this program was different. What made it even more innovative and, perhaps, even more rigorous was its focus on issues that inhere around social justice. There were programs in the general vicinity of MAN UP that focused on social or restorative justice; however, not one of these programs sought to develop an intersection between STEM and social justice.

Another aspect of MAN UP that made it innovative was the pedagogical approach, which centered critical-reality pedagogy. This approach was necessary in order to facilitate the focal cohort's (demonstrated) growth in their social political understanding of their lived contexts, or critical contextualization, so that they could, eventually, extend their understanding of social justice and equity such that they began to envisage ways to use their STEM knowledge to address and redress issues that affected them as well as other marginalized groups—which is demonstrative of the critical contextualization of STEM. Critical contextualization of STEM is not just attitudinal or aspirational, however: it should result in measurable shifts in STEM competency as well. And in this study, the data suggests that it did.

Paradigm Shifting Approach to STEM Education

To be clear, deciding to take a critical-reality pedagogical approach to learning, identity, and skill development of African American middle school students was considered to be radical by the host organization of the MAN UP project. However, the MAN UP instructional team was convinced that connecting STEM learning to social justice would be crucial to the effectiveness and success of the program, and I believe this is reflected in the findings reported. I, along with the MAN UP instructional team, was also clear on the possibilities of our approach to STEM learning from the work of scholars like Moses and Cobb (2001) with the Algebra Project, Gutstein's (2006) work on mathematical literacy as a critical literacy for increasing equity in society, and Blikstein's (2008) work on the use of science and digital technology as necessary tools for fulfilling Freire's vision of humanization and societal transformation. This work argues, and I think the MAN UP program demonstrates, that mere access to STEM subjects and careers is not enough. Instead, critiques of the roles of STEM in the processes of oppression must accompany considerations of the potential for STEM to be used to mitigate oppression as part of the process for opening wider access to STEM as a civil and human right.

Throughout the program the MAN UP instructional team was careful not to push students into thinking that they needed to be future STEM professionals in order to be successful. Instead, students were encouraged to ask questions as to why STEM education is important in the first place and what is it about STEM education that has prompted all of the attention about

racial and demographic differences in outcomes? Rather than encouraging them to simply identify with STEM majors and careers, students were invited them to ask critical, epistemological questions about the roles of STEM in larger societal processes and problems. Instead of passively receiving or absorbing STEM knowledge, they were empowered, encouraged, and equipped to relate whatever knowledge they received to their daily lives and the lives of other marginalized people. In so doing, our hope was that they would be able to flip the script and co-construct along with their instructors new possibilities for STEM and for themselves.

Data from the preceding two chapters, when taken together, seem to point to a synergistic relationship between the atmosphere and pedagogical approach featured at MAN UP and the real life concerns of the young men in this program. As I mentioned earlier on: this is not happenstance. The impetus of this program was to create a STEM enrichment program that was, simultaneously, a safe space for urban, African American males to not only maintain their identities as such, but also to further develop their identities as applied STEM practitioners—fully capable of learning and doing STEM for their individual benefit as well as the overall benefit of their local, national and global community. However, this philosophical positioning was not enough for the funders. And, quite frankly, this goal was not enough for the MAN UP educational team either. Urban African American males, even at the middle school level, face deeply entrenched, structural bulwarks of white supremacy that delimit their access to the type of quality education that leads to material upward mobility. However, often times this reality is obfuscated with rhetoric that is based on deficit model thinking, and/or oppositional culture (Fordham & Ogbu, 1986), whereupon these young men, these children are, essentially, blamed for increasing the achievement gap—even to their own educational detriment. Or their parents, who have had to endure the same inequity are made to be completely culpable for raising their children within a so-called culture of poverty. Thus, we were committed to creating a program that at least in some small measure began to chip away at this inequity. This, of course was a tall task. However, I am encouraged by the focal cohorts' near unanimous positive shifts in STEM identity, which led to their personal and collective instantiations as applied STEM practitioners as evidenced by 16 of 17 students fitting within the shaker criterion by the end of the academic year. These young men have the potential to not only do well scholastically, they also have the potential to advocate for themselves and other hyper-marginalized students like them because their critical consciousness around STEM was raised as evidence by their emerging critical contextualization of STEM. So, then, not only did 16 of 17 members of the focal cohort experience gains in STEM competency, they also grew in their demonstrated ability to apply their STEM knowledge in the amelioration of social inequity and injustice; or, more specifically—to envision themselves as and behave as applied STEM practitioners (or shakers in MAN UP parlance).

Why the of Critical Contextualization of STEM Mattered

At the end of the academic year, as evidenced by the data collected and analyzed throughout this study, 16 of the 17 members of the focal cohort aligned most closely to the shakers student profile (which is analogous to the role of an applied STEM practitioner), precisely because they demonstrated not only the ability but also the willingness and ability to use STEM for societal uplift in the interest of social justice. These 16 students' ability and willingness to use STEM for social justice was contingent upon both an increase in their STEM identities, as applied STEM practitioners and in their ability to actually devise socially just applications of STEM, which spoke to their increases in STEM competency, respectively. And, what is more, all 16 of the

students who ended the year as shakers also improved in that math-specific and CS concept inventories, respectively, which further strengthens the proposed corollary between the critical contextualization of STEM and increases in STEM competency. This is important because it suggests that there is a positive relationship between these students' feelings of belongingness, in that, in contradistinction to ubiquitous, negative stereotypes of Black male failure in school and in STEM specifically, they succeeded in STEM when working with a group of peers who were also excelling in STEM and who were deeply invested in devising ways to critically apply STEM for social justice. According to the YPSS, 16 out of 17 members of the focal cohort agreed or strongly agreed that they felt more comfortable at MAN UP than they did at their schools. And, the same number of students agreed or strongly agreed that they felt "smarter" after their first year attending MAN UP, versus only 3 of the 17 agreeing that they felt "smarter" as a result of their previous year spent in their regular schools.

To be clear, it was never my goal to sour MAN UP students to their regular schools; instead, my goal in designing questions that juxtaposed MAN UP with students' regular schools was so that I could design future iterations of MAN UP so that they would continue to fill in some of the atmospheric gaps that students experienced at their schools. Thus, it was important to know whether or not students felt empowered, equipped, and encouraged at MAN UP vis-à-vis their regular schools.

Focus on Relationship Building

The MAN UP instructional team was intentional in our goal to create and curate a positive academically rich atmosphere for MAN UP students, because as a team, we were convinced that relationships were king, so to speak. We adhered to the old educational adage: "kids don't care about what you know until they know that you care." More precisely: we did not want the African American males that we served to feel as though they had to check their identities as urban, African American males at the proverbial door of the classroom. We needed them to know that they could be exactly who they were and still be successful academically without sacrificing their ways of being or language or cultural affinities by donning a "white mask" (Fanon, 1968).

Thus, we encouraged students to think about what it meant to be an applied STEM practitioners, because inherent in this term was the thought that applied STEM practitioners are, in fact, change agents. We referred to them as applied STEM practitioners because this recursive linguistic shift over more common terms like student/s, for example or even simply STEM practitioners, fully captured the essence of the work they were being asked to do. These young men were being asked to learn STEM, but not learn STEM in the way that there were most accustomed—via the banking or absorption model. Rather we were asking these young men to learn STEM while doing STEM, that is, while wielding STEM as a tool for social justice. There is a direct analog between the appellations applied STEM practitioner and shaker; however, the focal cohort was never made aware of this terminology (i.e., shaker, maker, taker)—they were, nevertheless, routinely referred to as applied mathematicians and/or applied STEM practitioners.

Focusing on Students' Real Lives

Also, this pedagogical approach, unabashedly, sought to situate STEM learning vis-à-vis the subjective experiences, concerns, affinities, interest, etc., of urban, middle school African-American males. This is what Emdin (2010) referred as cosmopolitanism (Hull, 2003), that is, the purposeful integration of students' environments into a given educational space. This

philosophical and spatial (re)positioning is derived from multicultural educational approaches. The MAN UP pedagogical approach built on this framework. However, instead of simply integrating the students' lives into educational spaces while still covering decontextualized course content, we made every effort to use student experiences as the starting point for the curricular material; and, we invited students to do the same. For example, the first question we posed to MAN UP students was why a program like this needed to exist; and in doing so, we invited students to begin making connections between race and STEM opportunity, access, and achievement. The year-end MAN UP survey asked students to juxtapose the atmosphere at MAN UP with the atmosphere at their respective schools. This was an attempt to determine whether or not the atmosphere at MAN UP, which encouraged students to maintain their identities, even though their identities are considered non-normative or even worse, are systemically pathologized, was markedly different from what they experienced at their respective schools. The importance of this atmosphere is best captured by an emotive conversations I had with Michael, a first year, sixth grade MAN UP student.

Mr. J: Michael, you are a little loud, bro—take it down a few notches, please.

Michael: Okay, Mr. J. My bad.

(Moments later I noticed Michael yelling in excitement.)

Mr. J: Michael, come here [Michael walks to Mr. J]. Did you notice what happened with that group when you walked over here?

Michael: No.

Mr. J: You notice they're much quitter now, right?

Michael: Yes, Mr. J. Sorry.

(Michael beginning to walk away, but now he looks dejected. So, I call him back.)

Mr. J: Mike, are you okay? You look down. (Michael is looking down, at the floor.) Bro, I'm not trying to single you out to make you feel bad. I know that lunchtime is your time to catch up with your friends. I'm just asking that you do it a little quieter.

Michael: I get it, Mr. J. It's just that everywhere I am, especially at school, people are always telling me to sit down and be quiet. I never felt that here; here I feel like I can be me. I mean, I feel like my voice counts.

Mr. J: You're right, Mike. I apologize for not really hearing you. So, what should we do now? Your voice counts. How can we move forward?

Mike: I guess I can be quieter, if it makes you feel better.

Mr. J: You're fine, bro. Just enjoy your lunch.

This conversation was quite revealing, and I must admit quite convicting. Here I, along with the MAN UP instructional team, had worked to curate an atmosphere where students felt as though their voices counted, and as perspicaciously noted by Michael, I was trying to regulate his personhood by diminishing his voice. Of course classroom decorum is important, but this conversation happened at lunchtime, where all cohorts along with the instructional staff eat together. We often held lunchtime whole group conversations, but this was not such an occasion (lunches were always provided by MAN UP). This conversation spoke to the importance of MAN UP as a safe space for the students served. At MAN UP, Michael felt welcomed, respected and appreciated—he felt as though his true voice was being heard, perhaps for the first time in an educational setting. In fact, these four words: respected, appreciated, welcomed, and heard, occurred most frequently when students described their impression of MAN UP during the yearend focus group interview.

This particular pedagogical approach was innovative and it was vitally important because it led to the realization of socio-academic synergy, which was manifested in an educational atmosphere that valued these students for who they were, while also challenging them to excel academically in STEM so that they could benefit, individually, while making the world more socially just (i.e., becoming a shaker), which, again, is the goal and realization of the critical contextualization of STEM.

In this chapter, I underscored the importance of the realization of an educational setting, built upon a critical-reality based, nutritive pedagogical approach that worked towards socio-academic synergy between students' real lives and the course content. And, simultaneously, I argued that a critical-reality pedagogical approach to STEM education was integral to the creation of just such an atmosphere because it carved out a space for the realization of a socio-academic synergy, which, then, encouraged students to envision themselves as applied STEM practitioners based on their demonstrated critical contextualization of STEM. Contiguously, I spoke to the rhetorical and discursive choices made by the MAN UP instructional team, in the purposeful conversations we had with students and in the ways in which we referred to them and to other members of the MAN UP community. I also underscored the importance of the realization of an educational setting, built upon a critical-reality based, nutritive pedagogical approach that worked towards socio-academic synergy between students' real lives and the course content. And, simultaneously, I argued that a critical-reality pedagogical approach to STEM education was integral to the creation of just such an atmosphere because it carved out a space for the realization of a socio-academic synergy, which, then, encouraged students to envision themselves as applied STEM practitioners based on their demonstrated critical contextualization of STEM.

In the final chapter, I conclude by discussing the implications for urban STEM education derived from this study.

Chapter 8: Now What? Implications for Educators

This chapter draws implications for educators from the discussions raised in this study with regard to curriculum development as well as future research and educational policies that need to be conducted to better understand the importance of creating an educational climate, classroom by classroom if necessary, where hyper-marginalized students can begin critically contextualizing STEM so that they will experience increases in their STEM identity, competency, and demonstrated ability to apply STEM for social justice.

Clearly, the focal cohorts' competency with regard to the STEM subjects covered in MAN UP grew both individually and collectively as evidenced by their improvement on the course concept inventories conjoined with the focal cohorts' feedback on the YPSS and the yearend final focus group. In fact all but one student improved from pre to post on his math assessment and Computer Science assessment. (This particular student was only able to attend two-thirds of the MAN UP academic sessions.) Along with their growth in competency it was also evident from their own personal accounts that their confidence grew in not only learning STEM but also doing (or applying) STEM for social justice.

Nevertheless, it is no secret that African American males are grossly underrepresented in STEM. This inequity is neither happenstance, nor the result of any intrinsic cognitive deficiency endemic to African American males as Murray (1994) erroneously argued. The truth is much more pernicious: African American males have been systemically excluded from realizing their full potential in STEM due to a lack of opportunity to do so. This opportunity gap has precluded far too many African American males from developing a positive STEM identity. Therefore, the shifts in identification with STEM, discussed in this study, are incredibly important if there is ever to be a measurable shift in STEM access, opportunity, and success for African American males throughout K-12, college, and in their future careers. And, while I am indeed heartened by what the data of this study suggests, my goal in developing this program was not merely to aid in the growth of African American male technocrats; rather, the shared goal of the MAN UP instructional team was to contribute to the growth of African American males who are equipped to succeed academically in STEM while, simultaneously, developing a critical, social consciousness so that they use their STEM knowledge to better their local, national and global communities. The data suggest that we were able to achieve this goal in 16 of 17 of the focal students.

That said, MAN UP represented in many ways an ideal atmosphere for these young men to thrive. The MAN UP instructional team was, firstly, composed exclusively of men of color, (two of which were low-income, urban African American males like the majority of MAN UP students). And, the MAN UP instructional team because of the university connection of two of the instructors received (free) professional development and advising from Professor Jabari Mahiri, whose research focuses on urban education, on pedagogy as well as the overall structure of the program. And, what is more, the entire instructional team had an understanding of critical race theory, critical-reality pedagogy, and were attuned to and vitally interested in the plight of African American males. This educative situation is rare in K-12 education because, in reality 80 percent of teachers in the United States are European American (65 percent of teachers in the US are European American women). So, the question becomes: how can these experiences translate into academic success in STEM for urban, African American males who are for whatever reason unable to attend programs like MAN UP—where they meet, exclusively, with other African

American male peers who share their excitement regarding STEM, and/or their commitment to using STEM to first improve their own communities before working to improve the entire world?

Implications for Educators

I do not have a definitive, sweeping solution for this conundrum. Clearly, there needs to be more work done to understand how to develop urban African American males as well as other hyper-marginalized students' positive academic identities so that they begin to see themselves as young people fully capable of excelling in STEM, and using their STEM knowledge to improve their communities as well as similar communities throughout the world in the interest of shrinking both the achievement and opportunity gaps. Traditional approaches to STEM education, which are plenteous in low-income, urban school systems throughout this country, have systemically delimited African American males as well as other low-income underrepresented minorities from receiving critical and empowering STEM education that encourages, empowers, and equips them to develop not only their STEM competence but also their (requisite) STEM identities. With this in mind we worked diligently to create opportunities for social-academic synergy: we concentrated on involving MAN UP students in planning what it is that they would be doing in their courses as well as on the final projects that emanated from each course. We also endeavored to move students away from simply creating a catalogue of inert facts by empowering, equipping, and encouraging them to apply their newfound STEM knowledge in the amelioration of issues that were germane to their lived-experiences. Eventually, they began to devise ways to ameliorate social injustice that was outside of their immediate context. That is, they began to shift their critical contextualization understanding of socio-economic, socio-political, racial, educational, cultural, and environmental differences, which then afforded them space to begin applying their STEM knowledge as a tool for social justice (which is the actualization of the critical contextualization of STEM).

This process, revealed two important, even indispensable educational implications: firstly, that a critical-reality based pedagogical approach was instrumental in contributing to students' increases in competency, identity development, and demonstrated ability to apply STEM for social justice. And, secondly, in much the same way that even the most state of the art powerboat is powerless and incapable of realizing its potential outside a body of water, a critical-reality based pedagogical approach must be placed within an educational atmosphere working to develop socio-academic synergy in order for its potential transformational power to be realized. In order to alloy MAN UP's critical-reality based pedagogical approach to STEM education with an educational atmosphere predicated on socio-academic synergy, we focused on building relationships that were nutritive and supportive while involving students in the meaning making and curricular processes so that course material was relevant to them. And, we made sure to push them, while providing all necessary support, to critically contextualize STEM in a thoughtful and rigorous way.

Cultivating Student Voice through Critical-Reality Pedagogy

In our work at MAN UP, the pedagogical work was sutured to and even the byproduct of the socio-academic synergy that we worked diligently to ensure. So, while these elements of good teaching are immensely helpful, they must be predicated on empathetic, nutritive relationships that feature work that is intentionally connected to students' real-life subjectivities. By creating just such an atmosphere, predicated on socio-academic synergy, where hyper-

marginalized African American males did not have to check their variegated cultures at the door of the classroom, we were able to build relationships that gave us insight into their interests, concerns, and aspirations so that we could co-develop rigorous STEM course material with them and for them. This is a crucial point and may be the most pivotal part of the success that this program enjoyed: we co-constructed not only meaning within the courses offered to MAN UP students—we also co-constructed our curricular scope and considerations based on the interest of the students being served. I cannot stress this enough: as a result of our "frontend" work to cultivate an educative atmosphere that invited students to co-develop both the curricular considerations and course material, student buy-in was not hard to obtain, which meant that engagement was high and behavioral issues were almost non-existent. This socio-academic synergy worked because we saw the work of connecting what we termed the Three R's: relationships, relevance, and rigor as indispensable to these students' scholastic success and to the strengthening of their agentive voices.

However, often times educators are lead to believe that they are some type of messianic figure whose commission is to rescue hyper-marginalized students from their immediate environments, which are admittedly, far too often, sites that are potentially deleterious. However, we must bear in mind that for these students, there is also beauty—even if our eyes are not attuned to see the radiance that they see. Emdin (2010) talked about giving youth cameras in the projects in New York: his expectation was that they would come back with pictures and video of old, dilapidated buildings and weathered, oxidized windows. This would have suited his needs nicely, as he hoped to talk to them about weather processes and pollution and the like. Instead, Emdin (2010) noted that these students came back with pictures of rainbows in the projects that they lived in and pictures of familial tenderness, e.g., big brothers walking their younger sisters to school. My point is this: we educators cannot unproblematically foist our sensibilities and/or our worldviews on the students we serve. We need to make our sensibilities jive with theirs' if we truly hope to reach them; this positionality will allow us to hear our students' voices. It is important to note that that these students do not need us to help them find their voices, which is a romanticized narrative that pervades rhetoric around teaching and learning in urban communities: they have incredibly powerful, transformative voices. They merely need someone who is willing to listen to and value what it is that they have to say. This study suggests that focusing on cultivating an educational atmosphere predicated on socio-academic synergy, by working diligently to realize synergy between relationships, relevance, and rigor is integral to providing a space for hyper-marginalized students to not only increase their competence in STEM, but also to both recognize and apply the power that they have to use STEM for the amelioration of inequitable societal realities (i.e., for social justice).

Conclusion

So, the goal must be to create educational spaces for hyper-marginalized students to be who they are—to not have to check their culture at the doors of their classrooms—and still be treated as students full of promise and potential, not students who are in need of remediation simply because they come from a purported culture of poverty. An educational approach that uses African American male students' as well as other hyper-marginalized students' lived experiences as the starting point of instruction is not only important, it is exigent.

Finally, in returning to this specific study, the findings from this study provided evidence that there was indeed a shift in identity taking place for the focal cohort. This is important because we know from the work of Nasir (2011) and others that there is a positive correlation

between the development of an academic identity and increased levels of math competency, for example. The findings illustrate connections between socio-academic synergy and positive STEM identity development and increased competency in math and Computer Science and the creation of Mobile Apps also. Additionally, the findings suggest that our critical-reality based pedagogical approach was important in helping the students critically contextualize STEM, i.e., to devise ways apply STEM for social justice purposes. This frame, complete with a purposeful emphasis on conjoining relationships, relevance, and rigor, was central in helping students feel empowered, encouraged, and equipped to develop their positive STEM identities while gaining competency and using their knowledge to improve their local, national and global communities. The three R's when instituted critically, equitably, intentionally, and in-line with students' lived-experiences have the potential to produce an educational atmosphere where socio-academic synergy can hone their agentive voices. If this study is any indication, this kind of atmosphere, when working in concert with a critical-reality based pedagogical approach, has the potential to empower, equip, and encourage students—perhaps especially hyper-marginalized students—to become world shakers by critically contextualizing STEM. After all, creating positive, nurturing educational spaces for urban, African American male students to succeed in STEM is not just the order of the day: it is a matter of social justice.

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Appendix A: Pre/Post Identification Survey

- Please draw an engineer, present your drawing.
- Please draw a scientist, present your drawing.
- Is it important for you to learn STEM? Why?
- Does a STEM program just for African American males need to exist? Why?
- What do you want to be when you grow up? Why?
- What is social justice?
- How do you know if something is unjust?
- Why are there so few African American males in STEM professions?
- Is there a connection between STEM opportunities and race?
- Can you see yourself being a scientist, engineer, technologist or mathematician?
- Can YOU use STEM to improve your community? How?
- Whose job is it to improve your neighborhood?
- Is there a connection between STEM and social justice?
- Why did you sign up for this program?
- What do you hope to gain from this program?
- What do you think will be the biggest difference from now to the end of the academic year?
- Who can do STEM?
- Why is STEM for African American males important?

Appendix B: Manhood Survey & Rhetorical Analysis Concept Inventory

- Please answer the following questions to the best of your ability: please make your thoughts/argument clear. Please provide a thorough/complete answer. Thanks.
- What is manhood?
- How do you define manhood?
- What is black manhood?
- What makes a man a man? Please explain.
- Who defines black manhood?
- How do you define race?
- How do you define racism?
- Is race real?
- Please explain your answer.
- What is a stereotype?
- What is stereotype threat?
- Is there a connection between race and STEM achievement? Please explain.
- Does race factor into STEM achievement and/or STEM excellence? Please explain.
- Is there a connection between race and STEM opportunity? Explain.
- Do certain races get more exposure to STEM based on their race?
- Is there such thing as acting white? Explain. If so, provide examples.
- What does acting black mean? Please provide examples.
- Why do you think that there are so few AfAm males in STEM majors and in STEM careers?
- Does doing well in school mean that you are acting white? Please explain.

What do you want to be when you grow up? Why?

Rhetorical Analysis

What is the rhetorical triangle, define each part.

What is a syllogism?

What is an enthymeme?

What is a thesis statement?

What are the parts of the five-paragraph essay?

What is evidence?

Define critical thinking?

What does cogent mean?

Appendix C: MAN UP Yearend Program Satisfaction Survey (YPSS)

This survey is to get a gauge of what we are doing right and which areas need improvement for MAN UP (MAN UP)

Key:

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

STEM= Science, Technology, Engineering and Math

* Required

Top of Form

I have a good relationship with my STEM teachers at school.

1 2 3 4 5

Strongly Disagree Strongly agree

At my school my teachers talk openly about race.

1 2 3 4 5

Strongly Disagree Strongly agree

I feel comfortable at my school.

1 2 3 4 5

Strongly Disagree Strongly agree

I feel like my "race" and culture are talked about and connected to course content in most of my classes at my school

1 2 3 4 5

Strongly Agree Strongly Disagree

The work I do at my school is exciting.

1 2 3 4 5

Strongly Disagree Strongly agree

The work I do at my school is challenging.

1 2 3 4 5

Strongly Disagree Strongly agree

At my school, most of my teachers are "good" teachers

1 2 3 4 5

Strongly Disagree Strongly agree

Learning STEM is important.

1 2 3 4 5

Strongly Disagree Strongly agree

I can see myself pursuing a STEM career

1 2 3 4 5

Strongly Disagree Strongly agree

I feel comfortable at MAN UP (MAN UP).

1 2 3 4 5

Strongly Disagree Strongly agree

At MAN UP, most of the instructors are "good" at bringing out my best.

1 2 3 4 5

Strongly Disagree Strongly agree

MAN UP Instructors help me see myself as someone who does STEM, not just someone who learns STEM.

1 2 3 4 5

Strongly Disagree Strongly agree

MAN UP instructors are patient.

1 2 3 4 5

Strongly Disagree Strongly agree

My STEM teachers help me individually when I request help.

1 2 3 4 5

Strongly Disagree Strongly agree

MAN UP is helping me improve my grades.

1 2 3 4 5

Strongly Disagree Strongly agree

Racism is partially responsible for the lack of AfAm/Latino males in STEM.

1 2 3 4 5

Strongly Disagree Strongly agree

Laziness contributes to the lack of underrepresented minorities in STEM.

1 2 3 4 5

Strongly Disagree Strongly agree

Environment contributes to the lack of minorities in STEM.

1 2 3 4 5

Strongly Disagree Strongly agree

It is important for more underrepresented minorities and women to pursue STEM majors and STEM careers.

1 2 3 4 5

Strongly Disagree Strongly agree

At my home school, my individual voice is recognized and encouraged.

1 2 3 4 5

Strongly Agree Strongly Disagree

At MAN UP, my individual voice is recognized and encouraged.

That is to say, you know that you count as an individual.

1 2 3 4 5

Strongly Disagree Strongly agree

My school challenges me to think about the way that I think.

1 2 3 4 5

Strongly Disagree Strongly agree

I usually learn new things at my home school.

1 2 3 4 5

Strongly Disagree Strongly agree

I usually learn new things at MAN UP.

1 2 3 4 5

Strongly Disagree Strongly agree

STEM can be used as a tool to help people better their lives.

1 2 3 4 5

Strongly Disagree Strongly agree

I will be able to use STEM to help people live better lives.

Appendix D: Teacher Interview Questions

• What does student empowerment look like?

• Did you design your course to facilitate the development of student agency? How so?

• Is agency important?

• Is it important to attempt to make STEM curriculum critical? Please Explain?

• What would you say to someone who claims that talking about inequity, racism, ageism, and or sexism creates victims?

• What did you do, regularly, to make sure that this wasn't the case?

• Do you think that your curriculum in concert with your pedagogical approach achieved the goals that you were after, personally, and that the program claims to be after, generally? Please explain.

• Do you think that the MAN UP educational approach is working? How do you know?

• Please provide a story where your ideological predispositions were challenged directly or indirectly from one or more students. How did this change your views? Or, if it did not change your views, why not?

• Please provide a narrative around one or more students experiencing an "aha" moment when either learning new material, or connecting material to existing issues of problems.

• Please provide a narrative of a time where one or more students connected their struggles or the struggles of middle school African American males to the struggles of someone or a group that is different from their own.

• Provide an example of one or more students using STEM to address a local, national, or global issue.

Appendix E: Yearend Focus Group & Individual Interview Prompts

Please use this scale to respond to the following survey prompts:

1	2	3	4	5
Strongly Disagree				Strongly agree

- At MAN UP I feel like my voice mattered
- At my school I feel like my voice matters
- At my school we discuss social justice matters
- At MAN UP we discussed social justice matters
- MAN UP made me feel like I can succeed in STEM
- My school made me feel like I can succeed in STEM
- MAN UP made me feel like I was a successful STEM student
- My School made me feel like I was a successful STEM student
- MAN UP made me feel like I can be a role model
- My school made me feel like I can be a role model
- MAN UP talked about what it means to be a change agent
- My school talked about what it means to be a change agent
- MAN UP made me feel like I can be an applied STEM practitioner that can positively affect my community
- My School made me feel like I can be an applied STEM practitioner that can positively affect my community
- MAN UP challenged them to think about the way that they think about their roles in society.
- My school challenged them to think about the way that they think about their roles in society.
- MAN UP helped me believe that I can use my STEM knowledge and skills to make their neighborhoods better.
- My school helped me believe that I can use my STEM knowledge and skills to make their neighborhoods better.
- MAN UP helped me believe that I can use my STEM knowledge and skills to make the world a better place.
- My school helped me believe that I can use my STEM knowledge and skills to make the world a better place.
- My teacher/s at my school helped me see a connection between STEM and Social Justice.
- My teacher/s at my school helped me see a connection between STEM and Social Justice.
- My teacher/s at my school helped me see a connection between STEM and Race.
- The instructors at MAN UP helped me see a connection between STEM and Social Justice.
- The instructors at MAN UP helped me see a connection between STEM and Race.
- I felt more comfortable at MAN UP than I did at my school.
- I felt “smarter” after attending MAN UP.
- I felt “smarter” after attending my school.
- My ability to identify with STEM subjects and careers was highly impacted by having instructors who were themselves role models of STEM practitioners.

- Race and culture were connected to STEM course content at MAN UP.
- Race and culture were connected to STEM course content at my school.
- Issues around equity and justice were connected to STEM course content at MAN UP.
- Issues around equity and justice were connected to STEM course content at my school.
- MAN UP made confident that I can excel in STEM.
- My school made confident that I can excel in STEM.
- MAN UP improved my math skills
- My school improved my math skills
- I learned a lot about mathematics in MAN UP
- I learned a lot about mathematics at my school.
- MAN UP increased my interest in Mobile Apps.
- My school increased my interest in Mobile Apps.
- I learned how to create Mobile Apps in MAN UP
- I learned how to create Mobile Apps at my school.
- I learned “a lot” or “some” about Mobile Apps in MAN UP.
- I learned “a lot” or “some” about Mobile Apps at my school.
- I learned how to improve my community using STEM at MAN UP.
- I learned how to improve my community using STEM at my school.
- I was encouraged to think about my role in society at my school.
- I was encouraged to think about my role in society at MAN UP.