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Pursuing Greatness at Math Corps: Changing the Way Students View Math in Detroit through Esprit de Corps

By

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Abstract

The achievement gap has been plaguing educators and researchers for decades. While some find possible answers in psychology, others believe a culturally specific approach to education would provide a resolution, and some believe it to be both. The only way of finding a viable solution is to examine student assessment data, study programs designed to tackle the achievement gap, and decide what can be extrapolated and applied on a larger scale to narrow the gap even further. While there are numerous programs in the United States designed to tackle the achievement gap, Detroit is home to one that advantageously utilizes its university location to prepare African-American children in the city for the adjustments that higher education and life will require from them. By using Math Corps as a case study, this thesis analyzes the success of a program whose leaders focus narrowly on aspects of a child's education that the leaders do have control over such as course pace, safety, and respect. Discussions surrounding these experiences are relayed through interview transcripts and articles written by Math Corps leadership. These interviews reveal specific ways in which children feel supported and inspired by academic staff through group work and identity-affirming interactions.

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Preface

Math Corps is a six-week summer enrichment program that combines an intensive mathematics curriculum with mentorship (Edwards, Kahn, and Brenton, 2009). It was established in 1991 by Steven Kahn and other faculty in the Department of Mathematics at Wayne State University and began as an after-school tutoring program for middle and high-school students enrolled at Detroit Public Schools (Edwards, Kahn, and Brenton, 2009). By the following year, Kahn and his colleagues quickly realized that they could not operate out of Detroit Public Schools due to the conditions of the buildings and the unchanging negative attitudes of the teachers.[1] Although Math Corps originally started in Detroit with Wayne State University, it has since formed partnerships with other universities such as the University of Michigan - Ann Arbor campus and has extended to metro-Detroit as well as other parts of the country. Regardless of its expansion, over ninety-percent of the students recruited from Detroit self-identify as African-American (Edwards, Kahn, and Brenton, 2009). At Math Corps, students are divided into groups based on their grade-level in school and then taught by a combination of college faculty and high-school students who have gone through the middle-school phase of the program (Edwards, Kahn, and Brenton, 2009).

The founders of Math Corps hope that by inviting students to interact with mathematicians in a university setting they will grow to excel in the subject due to a newfound appreciation. Ideally, this appreciation will motivate students and "create a self-perpetuating corps of students…who will pass their knowledge and appreciation of the subject on to younger students" who in turn, will do the same (Edwards, Kahn, and Brenton, 2009). What Math Corps is describing could be defined as esprit de corps. According to Merriam-Webster, esprit de corps

[1] This was revealed to me on a Skype call by Dr. Stephen Chrisomalis in summer of 2021.

is a French term dating back to 1780. Although it is often used nowadays in military contexts, it is defined as "the common spirit existing in the members of a group and inspiring enthusiasm, devotion, and strong regard for the honor of the group" ("Esprit De Corps"). In short, it refers to a close group of people who respect and motivate each other and is a specific culture that is difficult to establish in earnest. Math Corps establishes a rotating body of faculty by ensuring each student admitted to the program knows that they are being cared for and brought into a tight-knit familial-type of bond.

An Introduction to Math Corps

Math Corps serves students in grades seventh through twelve and draws instructors from its alumni (Chrisomalis, 2015). Started by the dejected leader of the Wayne State mathematics department, after being ignored in Detroit Public schools, Math Corps emerged as a partnership between Detroit schools and Wayne State University that employs approaches inspired by psychological and anthropological research. Math Corps utilizes heterogeneous grouping, collecting student grades specifically for record-keeping purposes only and accepts students based on their application essays to ensure that those who are invited to attend will stay for the duration of the program. Through both classroom instruction and its application process, Math Corps intentionally seeks to differentiate itself from the student's school and home-life in order to serve as an academic escape for those who would not otherwise be exposed to intensive mathematic education.

Students are selected for admission based on a written essay describing why they are applying to the program. Only those who seem genuinely interested in excelling in mathematics and willing to put in effort are chosen (Edwards, Kahn, and Brenton, 2009). At its main location in Detroit, there are four hundred middle and high school students in attendance at Math Corps.

Students typically enter the program in seventh grade and continue through middle school, some staying through high school to serve as teaching assistants (TAs) and later as college instructors (CIs). Because the only formal requirement is the application essay, both honor roll students and remedial education students are placed into the same program resulting in heterogeneous grouping (Edwards, Kahn, and Brenton, 2009). The goal is for each student to learn concepts well beyond their grade level which will make them then better equipped to handle mathematics at school and on standardized tests. The program boasts an eighty-percent postsecondary enrollment rate for its alumni who participated in the program for three or more years while another ten percent enroll in the military ("Math Corps", 2021). While the latest data for Detroit Public Schools showcase a high-school graduation rate of seventy-two percent with an average ACT score of seventeen, Math Corps alumni with a twenty average in math still surpass other Detroit Public School students in both categories (Chambers, 2021). The students at Math Corps are not representative of the student body in Detroit, Michigan. Because students are selected for admittance into the program based on application essays, all of the students who attend Math Corps are already the types of students who are willing to put extra time into succeeding at school and have access to a reliable mode of transportation to take them to and from Wayne State University.

Other than Math Corps, few programs accept full responsibility for a student's educational achievement, particularly mathematic achievement. It neither seeks nor expects parental engagement and instead challenges the assumption that there are adults in a child's life. This is a beneficial approach since explanations for the achievement gap that emphasize out-of-school activities have the potential to induce resignation from teachers (Anyon, 1997). Instead, it focuses on aspects of a child's education that the leaders do have control over such as course

pace, safety, and a reprieve from the judgement that its students experience during the school year, both from invasive and dehumanizing systems such as facing metal detectors and being constantly watched by school resource officers. Math Corps offers an educational experience to its predominantly African-American student population that instills a greatness mindset, such as the type described by Carol Dweck, while teaching advanced mathematics (Chrisomalis, 2013). Dweck describes the growth mindset as one that allows a person to focus on factors within their control when striving for improvement.

This thesis examines the role of educators and their unique view of mathematics instruction in perpetuating Math Corps program success and seeks to examine what insight from cultural and psychological theories are implemented when doing so. Ethnographic interviews provide insight into how individuals become empowered to join a cause for change and, on some occasions, to return to support programs that have benefitted them in the past. I will argue that narrowing the achievement gap depends on placing student attitudes at the forefront of educational pedagogy and curriculum structure. Before turning to ethnographic work with Math Corps constituents, I first examine the ideological and scholarly history that informs this project, comparing the psychological and cultural approaches to understanding the achievement gap in education. This study contributes to literature on multicultural education and improving learning outcomes for minority groups by expanding on discussions of inequity in schools and utilizing concepts from developmental and cultural fields of study to better understand the successes of Math Corps. It is through analyzing the interviews of past Math Corps instructors, the vast majority of which were students themselves, that one observes the most crucial aspect of educational reform in action. Math Corps excels at providing an environment in which students and staff feel part of the same team.

Math Corps is a twenty-nine-year running six-week summer mathematics intervention based out of Wayne State University in Detroit, Michigan with the goal of improving mathematic success for students enrolled at Detroit public or charter schools (Chrisomalis, 2015). Professor Kahn originally wanted to improve mathematics performance within Detroit Public Schools, however, he abandoned that idea after receiving no support from the school board. Started by the ejected? leader of the mathematics department, Math Corps emerged as a partnership between Detroit schools and Wayne State University that employs approaches inspired by psychological and anthropological research. Math Corps utilizes heterogeneous grouping, collecting student grades specifically for record-keeping purposes only and accepts students based on their application essays to ensure that those who are invited to attend will stay for the duration of the program. Uniquely, the program seeks to separate itself from the student's school and home-life in order to serve as an academic escape for students who would not otherwise be exposed to intensive mathematic education. Because Math Corps provides students with the tools to excel in their school while offering a better learning atmosphere than their schools can provide, the mathematics being taught is viewed as both "locally and universally valuable" by the program's student body.

Literature Review

I. The Achievement Gap

The achievement gap, differences in average standardized test scores and grades between White students and their minority peers, reflects a myriad of sociohistorical factors. Beginning with the absence of formal education, and later access to only segregated education, African-Americans have not been provided the same scholastic support as their White peers and these decades of unequal treatment led to a sizable achievement gap. Although Brown v. Board of

Education established that separate, but equal was not in fact equal, that ruling only put an end to outright, de jure, segregation while allowing de facto segregation to be widely accepted (Rothstein, 2014). De facto segregation is not encouraged by racist public policy or redlining as its de jure counterpart was; instead it persists due to policymakers attributing "the residential isolation of low-income black children" to "economic circumstance, demographic trends, personal preference, and private discrimination" while ignoring the past policies of exclusion, disinvestment, and unequal treatment that placed African-Americans in this position (Rothstein, 2014). Unfortunately, the prolonged period of unequal access has led to a lack in familial resources. This combined with the general nonchalant attitude expressed by individuals at educational institutions has led to the historical failure of African-American students in schools (Rong and Brown, 2007).

Richard Rothstein offers objective data detailing how social and economic disadvantages, including not only de facto racial segregation but also the intergenerational poverty that often accompanies it drastically change how a student performs in school. Impoverished children are more likely to miss school than their peers because they are unable to access annual preventative health care before a sickness progresses to the point that absenteeism is necessary (ibid). Students with lower socioeconomic status than their peers also have less adequate housing leading to fewer quiet places to study (ibid).

Stanford's Center for Education Policy Analysis has compiled data on the achievement gap over the past forty years using test scores from the National Assessment of Educational Progress (NAEP). Stanford states that it uses the NAEP to determine trends because it allows them to measure reading and math skills generationally. Their data sets reveal that the achievement gap decreased drastically from the 1970s into the mid-1980s, where the trend of

improving minority scores suffered from stalled progress and in some regions worsened, until in the 1990s and onward, where achievement gaps in every grade and subject have been consistently decreasing (Stanford CEPA, 2021). Stanford's empirical data shows that the average 13-year-old Black or Hispanic student today scores almost as well in mathematics – the central concern of this study - as the average 17-year-old did in 1978 (Stanford CEPA, 2021). Midwestern states are among those with the largest remaining gaps between White and Black student achievement, all while those same states are simultaneously closing their achievement gaps at the quickest rates relative to the rest of the country. Midwestern states are on the right track to closing achievement gaps but would benefit from successful interventions that could allow the narrowing of those gaps to occur at a quicker rate.

As I will examine in detail, proposed solutions to the achievement gap can be divided into two categories: cultural explanations and psychological explanations. Psychological explanations focus on the individual and how schools could better shape identities of students. Cultural explanations point to the difficulties that arise when a student attends a school that has no connection to their culture and life away from school. While cultural approaches seek to rectify the discrepancy between school and home life, psychological approaches work to improve the way schools address students' individual concerns and assess their student body's needs. Neither approach alone will provide a solution for the achievement gap, yet both together allow for promising discourse. Individuals and educational institutions have employed either or both of these approaches in various ways. As discussed earlier, effort that has been placed into closing the mathematics achievement has shown progress proven by the ways in which students of color outperform their parents' generation on standardized tests. With this in mind, it is crucial to focus on how cultural and psychological factors can be brought together by an intervention

such as Math Corps, designed to close the mathematic achievement gap between African-American youth and their White peers.

II. Psychological Explanations of the Achievement Gap

Each student is an individual with a life outside of school that influences how they experience school. Margaret Beale Spencer's Phenomenological Variant of Ecological Systems Theory (PVEST) aims to explain the "universality of human vulnerability" (Spencer and Swanson, 2016). PVEST shows how the individual and their environment are mutually shaping. Her theory asserts that each individual has protective factors and risk factors that shift from person-to-person, based on the individual's race, sex, socioeconomic status, familial support, friendships and a myriad of other components. Spencer's work introduces a psychological explanation for the achievement gap.

Spencer references developmental theorist Erik Erikson's belief that psychological development is characterized by crises that become turning points in one's life, each one being an identity crisis (Spencer and Swanson, 2016). She also adopts his terminology and belief in four distinct reactions adolescents have to an identity crisis. They progress through states of identity diffusion, foreclosure, moratorium, and identity-achievement; however, both Erikson and Spencer agree that an identity-achieved individual could re-enter the exploratory state of moratorium at any time (Spencer and Swanson, 2016). Identity diffusion occurs when an individual does not have an established identity because they are not actively searching for one. An individual is in a state of foreclosure when they express commitment without yet experiencing a crisis and exploring ideologies (Marcia, 1966). Moratorium is an individual's status when their commitments to life goals and ideologies are vague due to actively

experiencing a crisis. Lastly, identity achievement "implies that the individual assesses strengths and weaknesses and determines how he or she wants to deal with them" (Erikson, 1950).

PVEST asserts that individuals are immersed in environments that provide for more or less exploration based on protective and risk factors and allows for an "analysis of particular levels of supports and protection" (Spencer and Swanson, 2016). Protective factors are defined as biological, psychological, community, and cultural levels of support such as religious beliefs or cultural socialization practices. Protective factors are associated with an increased chance of positive outcomes regarding identity. Alternatively, risk factors result from a lack of support systems and often lead to an increased likelihood of identity diffusion, foreclosure, or moratorium. Spencer and Swanson suggest that research has often narrowly defined protective and risk factors within the scope of Whiteness using blanket assumptions of privilege and hindrance (Spencer and Swanson, 2016).

Spencer and Swanson argue that African-American youth are at a great disadvantage compared to their peers because their unequal access to opportunities results in fewer chances for African-Americans to explore and experiment with their identities. This then leads to fewer African-American adolescents with identity-achieved identity statuses, and more time spent in the other states. Identity status could be improved by schools, but there has been a lack of identity-building school environments for African-American youth. Spencer and Swanson argue that students of color who do not show a high level of association with school-linked competencies are actively working to protect their identity from being altered or dismissed by school experiences that do not acknowledge their current adaptive coping mechanisms or other similar protective factors. Educational programs that encourage students to openly share their thoughts and place an emphasis on collaborative work allow for students to explore different

roles within a group, widening their view on where they belong and what tasks they are capable of. They also facilitate a feeling of respect. Spencer and Swanson maintain that students need to know that they are respected rather than denigrated when attending school; otherwise, they will be encouraged to disengage academically.

The growth mindset offers an alternative to colorblind psychological investigation of the causes behind the achievement gap. Instead of centering around the external struggles children face, Dweck places importance on strengthening children internally so that they have confidence in overcoming hardship later. Dweck explores the growth mindset throughout Mindset: The New Psychology of Success and argues for its advantages over a fixed mindset. She defines a growth mindset as a theory of intelligence that links hard work and effort to positive success, and a fixed mindset as characterizing those who believe that intelligence and other personal traits are innate and stagnant (Dweck, 2006). Students with fixed mindsets are more likely to blame their lack of success on external factors preventing them from putting in the necessary work to excel. Dweck also enlightened readers on the difference between praising effort and praising talent. When students are praised for generally performing well, they internalize the successful outcome without connecting it to anything else. This means that children only exposed to general praise will not be prepared to handle daunting tasks that may not come naturally to them due to the fear of failure. When a student is instead praised for the effort they placed into achieving the positive outcome, they are then aware of what actions to repeat in the future and how to alter their approach when met with a more difficult challenge. This removes the idea that any one task is insurmountable for the student and encourages adaptability and mental flexibility.

Psychological approaches offer a way of viewing the achievement gap though the lens of each individual student. Spencer's PVES T shows the ways in which an individual and its

environment are constantly influencing each other. As one progresses through life, they encounter various moments of conflict and it is the results of these conflicts, how the individual responds, that will then impact their later responses. Dweck builds off the work of Spencer, Swanson, and Erikson by not only explaining that children need adequate support though crises in order to better prepare for difficulty in the future, but also elaborating on how to encourage this shift in mindset. However, psychological perspectives do not show how to overcome the achievement gap for students struggling to navigate a school-life that is potentially incompatible with their home-life.

III. Cultural Explanations of the Achievement Gap

Although similar to psychological, cultural perspectives provide a slightly different explanation for the achievement gap. Cultural anthropologists such as Eisenhart asserts that school culture in America is reflective of a singular home culture, White, middle-class culture, leading to a large divide between home culture and school culture for students who possess neither of those characteristics (Eisenhart, 2001). White middle-class students can see a multitude of careers as attainable because they have friends, family, and other community members involved in them. For example, if a Black student does not know anyone who has gone to graduate school, then they know that doctors, lawyers, and professors exist, but they have no idea how to bring aspirations toward such jobs into fruition. They do not know institutional agents, individuals who work in public and private institutions, that could guide them on what to study during their undergraduate years in order to become a competitive candidate for intellectual property law, as an example. Cultural perspectives posit that by creating ways in which cultural knowledge that is typically held by White middle-class individuals could be passed along to African-American youth, the achievement gap will continue to close.

Margaret Eisenhart also carefully outlines the different issues that plague African-Americans specifically in education. For example, immigrants who have had a positive assessment of schooling are more likely to feel empowered to overcome discrepancies between home-life and school-life while this becomes increasingly harder for marginalized groups that do not have a positive history with schooling in the United States. She claims that in western schools, teachers exchange knowledge for compliance with students and reward the most compliant students with the highest grades (Eisenhart, 2001). This is dangerous because higher grades lead to better college prospects and eventually more prosperous careers for only the most compliant students. As PVEST explains, the individual and their environment are mutually shaping. An unwelcoming school environment caused by teachers seemingly disconnected from the daily lives of students becomes a risk factor for African-American youth. This is one of the reasons that students who do not find fulfillment in attending school often leave, are noncompliant, or perform poorly; they are seeking validation aligned with who they are elsewhere from peers, popular culture, and their parents. Different cultures recognize and value different ways of learning; some prioritize engagement and others observation (Rogoff, 2016). Unfortunately, as mentioned earlier, schools in America cater to a single culture.

Nasir, similarly, asserts that all knowledge is cultural (Hand, Nasir, and Taylor, 2008). Knowledge is deeply connected to identity, meaning that if one does not have a firmly established school identity, created by bridging the gap between their home-life identity and their school-life identity, then they will not perform well at school because students feel cornered into choosing one identity or the other. The home-life identity takes precedence in a student's life since it develops prior to the start of school. Students who cannot reconcile these two identities will continue to find the ways in which schools present information to be ineffective (Hand, Nasir, and Taylor, 2008). Linking in-school experiences to out-of-school experiences provides

students with a more efficient way of retaining the concepts that they are being taught because it builds on a student's current understanding of a concept. This is far better than forcing students to start with neither a shared cultural nor educational commonalities with their teacher or the topics being discussed. This also helps diminish the perceived "higher-status" school possesses, welcoming students who otherwise might have felt comparatively inferior due to their marginalized socioeconomic, racial, or gender status (Hand, Nasir, and Taylor, 2008).

Eisenhart is not alone in believing schools ignore students outside of that very specific demographic. Rogoff emphasizes the importance of examining community routines based in culture and to never take for granted cultural norms and their differences (Rogoff, 2007). Western schools largely remove autonomy from its students, a potentially unfamiliar cultural practice to non-White individuals. She suggests that schools should provide students with an ample variety of approaches to learning so that people who benefit from different methods due to their levels of exposure are not inherently disadvantaged (Rogoff, 2007).

Ladson-Billings writes about the ways in which culture is often used as a proxy for race and race has become a catchall to describe "forces, events, classes, and expressions of social decay and economic division" (Ladson-Billings, 2006). She goes on to discuss how culture is often incorrectly used synonymously with difference and negatively associated with defiant behavior. Because teachers often emerge from White, middle-class, monolingual areas, they struggle with viewing themselves as members of a specific culture because their traits reflect what is observed and upheld within society. Ladson-Billings challenges teachers to address the cultural motivations behind their own thoughts and beliefs while paying closer attention to how students behave in social contexts outside of the classroom (Ladson-Billings, 2006).

The achievement gap does not have a quick and easy solution and although the various approaches can be classified as separate categories, there is a significant amount of overlap between the cultural and psychological explanations for the achievement gap. Psychological explanations of the achievement gap provide insight on how each individual goes through multiple stages of development until reaching a stable personality/understanding of self. Cultural explanations for the achievement gap offer a few options on how to ease the process of identity achievement for minority students specifically through the dissemination of cultural knowledge often reserved for White middle-class individuals.

IV. Mathematical Applications Using Psychology and Culture

Jo Boaler introduced a detracked mathematics approach at Railside School utilizing "complex instruction", a classroom instructional practice that is designed to address inequities between students by encouraging them to hold each other accountable and value each person's unique perspective (Boaler, 2006a). Detracking is designed to diminish distinctions between students by combining students with weak mathematics understanding with students who have an advanced understanding, eliminating the need for honors and remedial distinctions to be made. For the purposes of Boaler's study, Railside School was considered urban due to its high minority population, number of English-language learners, and location within an undisclosed Californian city. Over the course of four years, Boaler and her team compared the mathematics achievement of students at Railside high-school to two other high schools in the country with less diverse student populations in higher-SES neighborhoods (Boaler, 2006). The other two high schools utilized tracking and traditional teaching methodologies and served as controls for the experimental methodology being used at Railside.

Due to the consistent group work required as part of Boaler's detracking approach, students at Railside School prioritized respecting each other before all, even before learning, as this becomes a necessity in heterogeneous grouping. Because mathematics under Boaler's approach entailed more than memorizing formulas and solving equations quickly, the parameters most often used to define mathematic achievement in school, students readily performed the additional task of helping their peers follow along with concepts (Boaler, 2006). This provided a sense of community among students and allowed a multidimensional view of what a good math student could look like. Boaler attributes the improved mathematic performance at Railside school to its ability to change the ways students looked at their peers. Students cared more about how a fellow classmate did because rigorous group work and student responsibility were now part of the mathematics classroom competencies. When there are more pathways to success, diversity in the classwork expectations, then more students will be successful.

Bob Moses' work, similarly, emphasizes the importance of empowering African-American youth, and bolstering their identity, while engaging in day-to-day classroom activities (Moses and Cobb, 2001). He compares past African-American struggles with technological advancement with their present-day struggle with mathematic achievement. He consistently likens the struggle for voting rights among African-Americans to the current struggle for mathematical proficiency (Moses and Cobb, 2001). He further explains that the children themselves, the ones being impacted by teachers and society as a whole, have low standards placed on them and explains this served as the impetus behind establishing The Algebra Project, an organization designed to improve mathematic competency for African-Americans (Moses and Cobb, 2001). Throughout his writings on The Algebra Project, Moses makes it clear that his program was not created to merely help children perform better in mathematics; rather, it seeks

to alter children's perception of the subject altogether, in the hope that this will motivate and improve children's math learning and provide children with tangible career choices when they reach adulthood. The emphasis on collaboration and shared responsibility mentioned by both Moses and Boaler are observed in a typical Math Corps classroom as will be shown in subsequent analysis.

V. Conclusions and Future Implications

Both the cultural and psychological explanations for the achievement gap provides ways in which education could be altered to better account for the variation in childhood experiences among students. The biggest distinction between the two is that psychological approaches begin with the individual student and cultural approaches address how to bridge the gap in knowledge between school expectations and student preparedness. As evidenced by both Moses' and Boaler's respective studies, cultural and psychological methods can be combined for use in a single educational program or intervention. The Algebra Project began as a call to action and instilled that same urgency within its staff and students, a similar origin to that of Math Corps. Although through Moses' writings, one can learn the perspective of leaders and educators, the interviews of Math Corps staff, largely alumni, provides a unique opportunity to see the exact positive influences that inspired their students to either enter education themselves or continue to volunteer at the program years after completion. African-American students need what all students need, a comfortable and flexible course pace, exposure to real-world application, individualized attention, and care. The last part, care, is where individualization becomes most necessary.

Nel Noddings, known for her extensive research regarding care in education, provides necessary insight to understanding Math Corps' classroom instruction and its expectations for

educators. Noddings characterizes caring relationships in education by the ways in which educators consider the impact their actions have on themselves as well as their students (Noddings, 1988). Teachers who excel at providing an ethic of care for their students do so by recognizing the goals of their students and taking responsibility for helping them achieve said goals. Noddings suggests that teachers should remain with the same group of students for multiple years allowing adequate time to create a community of care within a classroom (ibid). While her suggestion has not led to widespread implementation of multiyear classrooms, interviews from instructors at Math Corps provide ample support for her claim.

Methodology

I attended Wayne State University for my bachelor's degree and took several classes taught by Professor Stephen Chrisomalis while I was there. Since he is a linguistic anthropologist and I was pursuing a degree in anthropology at the time, our paths crossed often. During one of his classes, he mentioned his involvement with collecting data for Math Corps on behalf of Wayne State University. When I began taking classes at the University of Chicago and learned about how negative educational outcomes disproportionately impact students of color, I quickly realized that I wanted my thesis to revolve around teaching practices in my own backyard. I soon realized after reaching out to several of the staff at Math Corps, including Dr. Chrisomalis, that monitoring live classroom discussion would not be possible this summer while the coronavirus pandemic was still occurring. The staff at Math Corps were unable to take time away from ensuring students had success in their current virtual model.

Fortunately, Dr. Chrisomalis kindly shared his entire data set with me from the years 2009-2014. The interview data provided was based on a script written to analyze instructors and participants' interest in the program and assess mathematical competency of instructors. For the

purposes of this study, I chose to only look at college instructors and I excluded all data that was about the field of mathematics rather than its application within Math Corps. This does mean that I did not play a role in interviewing or creating the interview questions; I am therefore limited to what Dr. Chrisomalis asked staff and students. Because this thesis is designed to use Math Corps as a case study for educational programs designed to address the achievement gap, it is crucial to understand what the program's founders, staff, and students find valuable. Analysis of the interviews will be categorized by Math Corps' six guiding principles, as outlined in their teacher's guidebook (Chrisomalis, 2021). Math Corps prides itself on the following six guiding principles of practice:

1. Providing students with a sense of family
2. High standards and expectations for students
3. Mathematics education
4. Providing challenging content instead of remedial content
5. Encouraging students to teach each other
6. Learning occurs in groups

After reading through staff interviews, I created a coding schema based on the six guiding principles of Math Corps in hopes of extrapolating how they come together to result in improved mathematic educational outcomes for its Detroit attendants. In addition to coding for principles, my schema coded each time a staff member mentioned collegiate aspirations they gained from attending for Math Corps, the different reasons staff attended and later taught at Math Corps, and the positive life experiences they were benefitted by attending Math Corps. I sought to understand how staff at Math Corps implemented each of these principles into their teaching practices and what additional instruments are used to do so. Reading through staff

interviews revealed the varying motivations behind working at Math Corps, and the positive effects it has had on the lives of their alumni. Although not every instructor in the interviews was an alumnus, every single person interviewed became involved due to the outstanding recommendation from an alum. Math Corps has a specific organizational structure that allows for students to actively learn and teach. Middle school students at Math Corps are taught by high-school teaching assistants, the vast majority of whom are graduates from the program themselves. The high-school students are supervised by college instructors who are also often alumni of the program. The behavior and knowledge of the college instructors is determined by the volunteer faculty from Wayne State University's Department of Mathematics (Edwards, Kahn, and Brenton, 2009).

Dr. Chrisomalis provided data that was partially coded to begin with; he separated interview participants into different groups based on their status as a camp attendant, a TA, or a CI. For the purposes of this research endeavor, only the staff interviews were reviewed. Additionally, the names of all who were interviewed have been changed for use in this analysis.

Analysis

A Closer Look at Math Corps' Guiding Principles

I. Providing students with a sense of family

To an outsider, the mentioning of family may imply the concept of fictive kinship. Fictive kinship is most often used in the United States to describe the phenomenon of extensive kin relationships within African-American communities that provide social support for their members (Chatters, Taylor, and Jayakody, 1994). Those who bear a fictive kin title are not blood related to other members; however, their role to others within the group is comparable to that of a blood family member. Fictive kinship is more than a title given to favored members within the

community, instead it is an obligation to "participate in the duties of the extended family" (Chatters, Taylor, and Jayakody, 1994).

John Ogbu and Signithia Fordham expand on this definition of fictive kinship to explain the ways in which African-Americans establish identity. They believe that it emerged to symbolize shared unity and establish a sense of peoplehood amongst African-Americans as a result of years of slavery and later mistreatment of African-Americans (Fordham and Ogbu, 1985). Fordham and Ogbu later share that the terms "brother", "sister", "soul sister", and "blood" are used along with others to describe fictive kin relationships. The authors agree that fictive kinship uses group-defined criteria to give others membership and this criterion serves as the ideal by which all other African-Americans are judged by (Fordham and Ogbu, 1985). Both agree that African-Americans who subscribe to this notion are engaging in sociological interdependence leading to groupthink. Using Nat Turner's slave rebellion as an example, Ogbu and Fordham describe the worst outcome that can result from assuming fictive kinship. After Turner's rebellion, hundreds of Black men, women, and children, were killed due to assumed involvement and blind racism by Whites at the time. Those who participated in killing innocent slaves were not viewing the slaves who rebelled as different from those who did not, they were all lumped together regardless of involvement (Fordham and Ogbu, 1985). While this is an example of collective identity that differs from fictive kinship specifically, it shows the error in assuming all who share an identity share the same values and practices. It goes against the PVEST theory discussed by Spencer and disregards the variability of human experience.

Math Corps avoids this discourse entirely by utilizing a family title without attaching racialized notions of fictive kinship at all. Instead, it is through action rather than solely words that this relationship is established. Big-brother and big-sister relationships are initiated by

ensuring each student feels valued as an individual and knows that they are special to others within the organization. Math Corps does not artificially inject fictive kinship into its program to ensure this bond occurs; and indeed, only approximately sixty-percent of college student instructors and thirty-percent of professional staff identify as African-American (Edwards, Kahn, and Brenton, 2009). Dr. Kahn utilizes the morning assemblies at Math Corps to encourage children and emphasize the social support that is being offered to them through the program, making clear the morals and principles he hopes to impart on the students. Dr. Kahn stated to the children in one assembly, "One of the things that you guys will come to learn is that, more than anything, this is family. And we will watch out for each other and protect each other and care about each other in this place. Way beyond math, way beyond math".

The family aspect develops based on kindness and compassion, but it flourishes with active interaction, partially encouraged by the morning assemblies and partially by the emphasis on students-teaching-students. Math Corps instructors are urged to develop rapport with their students, monitor individual student progress, and serve as a positive and reliable adult mentor. Dr. Kahn and the other founding staff hope that students who enter Math Corps will continue to return year after year for as long as they want, first as students and then as volunteers and teachers. For them, that is the true determination of whether or not a familial atmosphere has been achieved (Edwards, Kahn, and Brenton, 2009).

As mentioned before, Math Corps aims to create an environment that encourages mathematic success from its students while simultaneously inspiring them to join along in doing the same, not dissimilar from Bob Moses' Algebra Project. The best way to know whether or not this has proven true is by analyzing the interview data. Out of over thirty interviews with college instructors and high-school teaching assistants, only two had not been members of Math Corps in

middle-school. A family dynamic is helpful to the academic growth of students for a multitude of reasons. Stanton-Salazar has commented on the importance of institutional agents in the past, emphasizing the ways in which they allow individuals from lower social status to gain funds of knowledge. Funds of knowledge is defined as the access to social networks and information that develops historically and culturally over time and increases one's ability to function and succeed in a society (Rios-Aguilar, Kiyama, Gravitt, and Moll). Institutional agents are those who work in public and private institutions (e.g., schools, religious institutions, government agencies) and have the potential to use their position to offer opportunities for individuals who lack access to the same resources their peers do. This provides a more equitable school environment for all instead of only those who are afforded the opportunity of having educated parents or a tight-knit family with a plethora of academic familiarity (Stanton-Salazar, 2011). An institutional agent is any individual who occupies a high position within a society or organization. Math Corps introduces students to a support-network filled with educators and teachers who are aware of the specific socioeconomic reality of Detroit, Michigan. Math Corps encourages its students to think of each other as part of an extended family by requesting students use the term "family" to describe their relationships to others at the program; data extrapolated from the interviews show that this approach is effective at ingraining the family belief system, and establishing esprit de corps.

Detroit, Michigan has a single-parent household percentage rate of seventy-two (Witsil, 2018). Additionally, the average household in Detroit is less than three people (Williams, 2017). Both of these factors combined with the ways in which disenfranchised groups are less likely to have institutional agents to rely on for support means that the majority of students at Math Corps' Detroit location face specific struggles. When asked by Dr. Chrisomalis whether or not he

has told any friends or family members about the program, a TA who will be referred to as Timothy awkwardly responded that they "don't really talk to [their] family like that nor do they seem interested". At this moment, it becomes clear that Dr. Chrisomalis regrets asking that question, as he quickly changes the topic afterward. In other interviews, Dr. Chrisomalis is especially attentive to the different struggles Math Corps students face even while attending the program. When talking with one of the college instructors in the program, he shares a story regarding food insecurity: "And like, I had a kid once stop me in the middle of an interview and say, it was a breakfast interview and say, would it be okay if I ate breakfast? And I'm just like oh my God, I'm doing this interview and the kid's not eating breakfast. And it just tears you apart. And so now when I do breakfast interviews, the first thing I say is have you eaten yet? And if the answer is no, I say well why don't you get something to eat?"

The instructor he was interviewing at the time of relaying this story, David, opens up about how one of the professors in the program has helped him look at his problems in a more positive light which then allows him to be a better support for the children:

> Yeah, I know Mr. Boehm the other day…he was saying how you know he had a problem with that his parents there, they weren't always there for him. You know here is one of my stories. Um he acts like you know what is my motivation? And I just expressed to him…we have good people around us, really good people around us. And so our experience that you know we've had, we work our own, so now we're able to relate to the kids that's here. And that's probably why you see six of us here and it would have been seven if my brother didn't have summer school just so you know.

This statement speaks to the personal growth and development David has experienced with the help of his extended Math Corps family while simultaneously revealing that he is one of several siblings who has been part of the program for years. David states in other interviews that there were two factors that led him to Math Corps; his older brother's recommendation and attending a pre-calculus class taught by Professor Boehm at Wayne State University. David

enjoys the program exactly as it is. He stays because he believes mathematics proficiency allows for an increase in opportunities available in the future, as evident in this next quote:

Interviewer: What do you say to somebody who says, you know, "I don't need math. Math, I'm never going to use math in my life. What's math good for, whatever?"

David: I say, "I agree." I tell them I agree. You don't see it on an everyday basis or anything like that, however, what math does is it allows you to think, and it gives you an opportunity to have higher ordered thinking skills. And those people who are sitting around making these iPads and things like that, those are the math guys, these people with high ordered thinking skills.

David shares here that mathematics education prepares students for future challenges they may encounter. He makes it abundantly clear that this is what he emphasizes to the young men and women that he teaches and mentors through the Math Corps program. His commitment is evident in the ways he speaks as well as his actions. David became a college instructor for Math Crops after hearing about the program through a professor at Wayne State University. After attending a few Saturday sessions with that professor, David began volunteering yearly, convinced all of his siblings to attend or teach at Math Corps as well, declared his major in education, and now has the goal of improving Detroit schools through teaching.

A few of the other TAs who grew up in the suburbs of Detroit rather than the city itself spoke to the struggles they observed from other students. During an end-of-year interview, CI Devin asserted that their biggest takeaway was realizing that many things in their life were worse than in those of their students, calling it a revelation they spoke about in counseling. "I realized that it could be a lot worse. Like some of these things that some of the students go through, oh like, man. Compared to my problems. Like they're so young so um, they have more problems, I had a revelation". Mentorship provided a healthier mental outlook and the opportunity for identity confirmation for Devin because he was better able to understand and recognize his purpose through immersion in Math Corps, supporting Erik Erikson's argument about when an

individual has settled on an identity. He wants to continue being a teacher to uplift the lives and futures for Detroit students.

Charlotte stated in multiple interviews that she believed the family aspect of Math Corps to be more central to the program than mathematics itself. She sees Math Corps as a "second family" and describes her first day at the program when she was in middle school in the following quote:

When I first got to Math Corps into Math Corps…you're-well, I don't know. You're like, marrying into the family. We know you're part of the family, but you're not part quite yet. Like in the beginning, that's kind of how I felt, like the relative that was like, coming in to the family. Like, this is like nothing I was used to. So, then after that, like every summer after that, I was like, oh, wait. Now I know what it means to be part of the Math Corps family.

Reflecting on her own feelings of warmth and welcomeness caused Charlotte to recall a conversation she had with one of the students. In the following passage, the interviewer notices how Charlotte continues to move away from mathematical concepts during the interview and probes further to uncover why Charlotte places such high value on the non-mathematical benefits of Math Corps:

Interviewer: Like, are those your favorite type of experiences here, or?

Charlotte: I really like those kinds of experiences just for me, like, personally because I've had a little struggle overcoming some of my family's issues or what have you. So, you know, I, when I think about the students and having it hard…All these [kids] who are positive and smiley every day and then at the end of camp, they kind of let you into sort of like, what they may have had going on at home. And then, you know, they say, like, one girl said, "Oh, when I come here, there's so much love and everybody's happy. And then when I go home, it's just like there's nothing. You know, like, it's just empty" and this and that. And I thought, you know, I never would have guessed for her that she would have that kind of thing going on. And you I think it's important for kids, too, because if they're like, not getting certain needs met at home or this or that. Like Dr. Kahn and them say, if you don't get those, you might not be pushing yourself, mathematically or achievement-wise. You might not even feel like you can go in that direction.

After being exposed to more students as described in her last quote at Math Corps, Charlotte claims she began to shift perspectives in what her role as a teacher inside and outside of the

program entailed. As of her interview, Charlotte has been working as a high-school teacher for two years. The biggest difference she's noticed between the two work environments is the time allocated for supporting children. Due to Math Corps' small classroom sizes and daily staff debriefings, "if you hear about a problem that they've [a student] got going on at home, there's just so much support. I mean. Somebody will mention it in the debriefing and then it's like [a staff member] will be like, "Okay, I'll talk to them." While teaching in a high-school, Charlotte is disappointed in the larger classroom sizes leading to the responsibility over one-hundred fifty students and less time to develop personal connections like the ones she formed with her students through Math Corps. The aspect of family along with unwavering support of the program comes up repeatedly when reading interviews relating to the program's core principles and it has proven effective since nearly seventy percent of students who attend Math Corps their seventh grade year return the following summer and over sixty-percent return as high-schoolers as well (Edwards, Kahn, and Brenton, 2009).

II. High Standards and Expectations for Students

Due to the quality of education at the vast majority of schools in Detroit, most students entering Math Corps do not have a firm mathematics foundation (Chrisomalis, 2013). This is why the program begins its six weeks by starting at an elementary level and walking students through remembering the number line, fractions, and basic algebra. After the brief introduction, students who were once considered below-grade-level are then introduced to college-level mathematics concepts such as imaginary and complex numbers along with graph theory (Chrisomalis, 2013). This is done intentionally as Math Corps expects all of its students, regardless of the grades they have previously received, to meet their high academic standards (Edwards, Kahn, and Brenton, 2009). Staff regularly encourages students to complete their daily

homework assignments, attend class every single day, and to always arrive on time. Unexcused absences and tardiness are strictly prohibited and excuses are evaluated by faculty on an individual basis. The policy is not inflexible, but it is highly regulated much like discipline. Because the students are taught in a university-setting, it is expected that they behave no worse than the college students around them and this has proven successful thus far. Math Corps proudly asserts that the "importance of hard work, academic success, and student achievement are stressed and publicly acknowledged" by leaders in the program to students on a daily basis (Edwards, Kahn, and Brenton, 2009). The self-esteem and confidence of students is promoted through strengthening their mathematics identities or in the cases of some students, working to establish one entirely because the opportunity to do so has not presented itself before since basic needs such as love and support were not first being met.

The high expectations that are placed on students is directly associated with their assumed home-lives. In the following quotation, the interviewer asks one student, Frederick, if he has ever witnessed a student getting into trouble due to violence at Math Corps and the instructor reminisces on a memorable incident:

Interviewer: Alright. Can you think – I think I know the answer to this – but can you think of a time when there's been a student who's gotten in trouble for some violence?

Frederick: Yeah. I mean, there have been several. I know one was my student. He was involved in – I think someone just playfully slapped him on the – no, he playfully slapped some other kid on the back of the head very lightly because they said something silly. I think this was the incident. I don't know if it was, but my student was involved in one and this might have been a different one, but I remember that. And it was clearly just horseplay. Neither one was mad, and they didn't think it was serious until they were taken into the supply room and talked to and sent home. And I had to sit on, in on the meeting with my student because his parent wasn't there. She had to work or something. And so just, there was Pops, Ms. Weeks, and Ms. Martel were there. And they were talking to him about, like, how he could have responded instead of being, acting in violence…they really impressed upon him the importance of not using violence. And I just thought that was, I don't know. I've never really seen anyone be this strict about violence before, so that was – but I think the meeting went really well and he understood it, so.

Interviewer: Do you think the punishment was too strict?

Frederick: His punishment was a one-day suspension, I think, and I used to think it was too strict, but I'm kind of beginning to think that it was good and in line of what Math Corps is trying to do. There's part of me that's just like, they are boys, and they like to wrestle and play and I think that's okay. But there's definitely a line when horseplay becomes violent, and you don't want the kids to get anywhere near that line. And so, I can understand Math Corps, for. The good of all kids, wanting to stay away from touching each other in any way, even horseplay.

The takeaway from this anecdote is that Frederick listened in on his student's disciplinary meeting and filled a slot comparable to that of a parent during the disciplinary meeting, they helped ensure that the student understood why his behavior was considered inappropriate. Despite acknowledging the student's playful intentions, Frederick continues to support the high expectations Math Corps places on its students.

III. Mathematics Education

This principle is where Dr. Chirsomalis' involvement is most apparent. The team at Math Corps views mathematics immersion to be as crucial to subject mastery as language immersion is for language-learners. Every aspect of Math Corps works to centralize mathematics including games such as "Mathematics Jeopardy" that is played with students (Edwards, Kahn, and Brenton, 2009). While other subject matters are introduced in relation to mathematics such as art, finance, and science, the focus is never taken away from mathematics itself. This is to emphasize the ways in which mathematics can be fun and interesting on its own and shift students' perception of mathematics towards something positive regardless of their current thoughts regarding the topic.

The TAs and CIs involved in Math Corps were tested periodically throughout the summer to ensure their mathematics skills never faltered. During this time, the instructors were questioned on how they introduced different concepts to their students, how much success they

have found with the development of their children, and the ways in which they encourage participation from everyone. While reading through the interviews of middle-schoolers reveal that not all children are thrilled about just doing math over the course of six-weeks in the summer, this was not the intention of Math Corps. Math Corps employs various methods to prepare its students to achieve in mathematics while also learning to enjoy it, but this is not accomplished by masquerading math in everyday contexts. There are no art nor language classes as part of Math Corps. Middle and high-school participants are expected to write a journal entry at the end of each day, middle schoolers respond to prompts while high-schoolers write freely. High-schoolers read through the middle-schoolers' entries while the college instructors read through theirs (Edwards, Kahn, and Brenton, 2009). This is done to ensure that the students are reflecting on their time at Math Corps. Journals are not the only written documents that are frequently checked by staff. Teachers at Math Corps begin each day by going through the notes of their students and praising those who took meticulous notes the day before. This is a way of linking hard work with success, showing other students a classroom role model, and providing recognition to students for a task that goes unnoticed in traditional school settings.

David was one of the few college instructors interviewed who did not attend Math Corps as a child. When asked if he learned anything new from Math Corps that year, he commented on the program's curriculum:

Interviewer: Right. So, I'm wondering if you could think of anything new that you've learned this year at camp. It could be mathematical; it could be otherwise.

David: Mathematically, well in Discovery the kids found out what the square root of *i* was. I didn't know it before they came up with it. I saw it, so I don't know if I learned that or confirmed or

As mentioned earlier, all the interview transcripts used in this analysis were conducted with college instructors. David, a current college student, was caught off-guard by the curriculum

being taught to his middle and high school students, supporting the idea that Math Corps is effective in introducing African-American students to college-level mathematics. Even if he is expected to teach concepts unfamiliar to him, as evidenced by this discovery class anecdote, he continues to grow along with his students and strengthen his own mathematics to better help them. David is able to relate to his students in ways that differ from alumni who return as instructors. Here it is quite evident that David was not exposed to higher-level mathematics prior to entering college. He learned of Math Corps only after taking his first mathematics course at Wayne State University, yet he still pushes himself to learn alongside his students as they all strengthen their mathematics competency.

IV. Providing Challenging Content instead of Remedial Content

This principle overlaps with the second one mentioned since both specifically pertain to the expectations of students. Students are encouraged to explore an interest beyond their comfort while attending the program so that they may leave with higher mathematics skills than when they entered and come to view mathematics as a process of sense-making rather than solely problems on paper (Edwards, Kahn, and Brenton, 2009). By asking students to describe complex concepts such as why $\sqrt{2}$ is not a rational number aloud to the class, students are gaining confidence in their mathematics comprehension, gaining experience in addressing groups, and gaining a better understand of how mathematical ideas develop and continually progress.

Math Corps does not consider any aspect of its program to be remedial despite the elementary-level that students are initially taught at. Each lesson that is taught is designed to start from a basic level and then expand to a collegiate understanding. Common fractions, for example, are taught to middle school students through the use of fractals or infinite series,

eliminating the need for separate remedial and advanced curriculum. Math Corps places no value on the mathematics grades earned by students prior to entering their program because they assume the students were never effectively introduced to mathematics from the beginning of their educational journeys. Dr. Chrisomalis has stated before that this balance between introductory and high-level mathematics is what makes Math Corps difficult to market to schools, the program is not designed for only one type of learner.

Math Corps manages to provide each student with appropriate challenges through the various structures of their classes. As mentioned before, students begin each day with a morning assembly. Afterward, students attend a class called "The Real Number System" for half an hour. Following this class, the middle school students attend "Team Time", led solely by the college and high-school students. At this time, the middle-schoolers play mathematics-based games and last night's homework assignment is discussed so that no one has any questions before it is turned in. Math Corps hopes that Team Time allows the middle-school students to bond with their older mentors and view them in a big-brother or big-sister sort of light (Edwards, Kahn, and Brenton, 2009). Following Team Time is lunch and then discovery class. Discovery class uses a Socratic approach that covers varying topics. It is labeled as a college-level instructional class, however, there are two groups divided by school grade. The older students study introductory calculus while the younger students study logic (Edwards, Kahn, and Brenton, 2009). In this class, students are expected to answer questions posed by their instructors and fellow classmates. Math Corps believes that this allows students to relate their own knowledge and experience the concepts that they are learning.

Every instructor at Math Corps understands the difficulty of navigating a detracked mathematics program. In the following excerpt, the interviewer and instructor Sophia discuss how they ensure all students are learning new concepts during Team Time at Math Corps:

Interviewer: Half the time, sometimes there's been some kids sitting around. I'm like, okay, I'll give you a problem. It's just like, give them a problem and in particular there's been a couple of kids who are way, way, way ahead.

Sophia: Really? Yeah.

Interviewer: And you know, they, I don't know. They get, some of them are doing ninth grade homework in eighth grade, but I don't know. That's like, even that's not necessarily – they might be ahead of that, too. So I sort of end up, I don't know. Just, just, not teaching, but just like, doing a problem and working it through with them. And I've found that to be very enjoyable. But I don't know because it does seem like sometimes those kids who are really, really bright get a little bit bored and I was, you know, what they should be doing, I guess, is helping other people who are not there yet, but.

Sophia: That, yeah, that's a magical thing, if it happens. Sometimes it happens, sometimes it doesn't.

Both Sophia and the interviewer agree that there are some students that perform at a higher competency level than their surrounding peers in the program. The interview briefly discusses the prioritization conflict that emerges over two of Math Corps' guiding principles, encouraging students to learn from each other and believing that learning is most effective when conducted in groups. Although program staff openly encourage students to work with and help each other, they understand that this is an expectation rather than a reality. Additionally, every student deserves work that challenges them. Team time is fairly unstructured compared to the rest of the Math Corps day, allowing the time and flexibility for individual attention and assignments to be given to students that may not otherwise experience that at other times of the day.

V. Encouraging Students to Teach Each Other

High-school students who have been through years of the program already, serve as tutors to middle-school students who are enrolled (Edwards, Kahn, and Brenton, 2009). This is designed so that middle-school students are exposed to children only slightly older than them with a high-level of mathematics understanding that they could use as role-models and encouragement. Alternatively, the high-school students are forced to evaluate their own understanding when they tutor the younger program attendants. Students who find success in tutoring receive a hefty boost in confidence and self-esteem through mentorship and are better-equipped for college success since they must master concepts adequately-enough to provide educational insight for other students (Edwards, Kahn, and Brenton, 2009).

Throughout a typical day at Math Corps, middle and high-school students are not separated until the afternoon. Middle-schoolers participate in "a variety of hands-on mathematical activities, such as art projects, a stock-market game" and computer-based assignments (Edwards, Kahn, and Brenton, 2009). The high-school students attend a class taught by college-level mathematicians and a professor while working together to solve group problems. The high-school students are also introduced to Texas Instrument graphing calculators that have been purchased on their behalf, unlike their middle-school counterparts who are not taught using a calculator. After classes are done for the day, the high-school and college students along with staff have a debriefing meeting where each person addresses challenges that they encountered throughout the day. Continuing from their conversation regarding how to challenge mathematically advanced students, Sophia informs the interviewer of the responsibility some students exhibit during the daily team time:

Sophia: Sometimes you get a student who's, you know, really smart and they get it and sometimes they'll be just as polite and just wait for the TA to come over there. And not, like, really interact with somebody else. But others…they wander off and just kind of…look and see what somebody else is doing. And then they'll be done and maybe the TA is kind of overloaded

with one student and they'll say, "Well, you made a mistake here, you know. You're supposed to, this is how you would do it". Kind of like, showing them, helping them out, trying to get them to understand what's going on. And that's a beautiful thing when it happens.

Interviewer: But it's hard to make happen. I think –

Sophia: It has to kind of happen naturally. It's not something you can force on kids. I think Mr. Boehm does that very eloquently when he says, "What matters is what you do with your talent. If you're great, if you're great at math, what are you doing with that? And he's not necessarily saying helping out with students, but I think some students say, "Okay, I'm good at math. Maybe I can help others with math," you know.

By having professors, teachers, graduate students, undergraduate students, and high-school students all serve as varying types of instructors, Math Corps is ensuring that every staff and student involved understands that learning looks different for everyone. The graduate student instructors who are currently studying how to teach mathematics may have a solid understanding of what concepts need to be incorporated into curriculum, but a teacher who has worked in education for decades could provide insight on classroom conduct and student behavior.

VI. Learning Occurs in Groups

The final principle of Math Corps claims that students most-effectively learn when collaborating with each other. Open discussion and teamwork is featured in every class every day during the six-week program. Teachers collaborate as well when leading different classes throughout the day, indirectly showing students that collaboration will be a valuable skill in their future careers. The classroom is not the only way group relations are emphasized; students begin each day by convening together for a morning assembly that lasts the first hour or so (Edwards, Kahn, and Brenton, 2009).

Math Corps offers its students a different experience than they are accustomed to by taking them to learn on a university campus, however, Math Corps does not confine students to one location. Each summer features multiple field trips for students, one annual trip is visiting a

nationally-ranked chess master (Edwards, Kahn, and Brenton, 2009). The chess master plays simultaneous rounds with all of the students during multiple sessions that day and the Math Corps staff feel that this experience is especially well-received since the chess master is an African-American man and can serve as another role model for its students. The students also enjoy the end-of-program "Math Olympics" that is hosted. This is where fifteen mathematical contests are set for the students to compete in individually or in groups together. As discussed previously, all knowledge is cultural. Nasir and Hand wrote that social interaction is crucial to learning and believe human cognition to be a "socially distributed phenomenon" (Nasir and Hand, 2006). Both authors explain that tasks such as air traffic control and ship navigation are accomplished only through relying on teamwork and the knowledge that emerges as a result of the collaboration involved (ibid). By placing a high value on role modeling and students teaching students, Math Corps is effectively leaning into a supported cultural model that prepares students later in life for similar responsibilities that would require adapting quickly and learning alongside others.

Math Corps emphasizes group teaching procedures in its guidebook for its instructors. The guidebook explains that encouraging students to respond in unison to questions "highlights that the group is a well-regulated team with a common purpose" (Chrisomalis, 2022). Additionally, it allows all students to be involved while answering a question without exposing those who do not know the answer. An example of how beneficial this practice is for students can be observed through the dialogue between instructor Sophia and the interviewer, a fellow Math Corps instructor who will be referred to as Robert:

Robert: Well. You know, there's one, there's one kid who's a seven who's, he's got, like, a real, I mean I don't know whether he's got a diagnosed, like, a learning disability or developmental disability, but it's just, it was very clear from the beginning that it was just going to be, it was going to be a real struggle for him no matter what.

Sophia: Right, yeah.

Robert: And, and so you can really see, I mean, he really works hard. I mean, I don't understand how he does it, to be honest, because his class is just -

Sophia: Oh, Mr. Boehm works with him?

Robert: Yeah, just like, he will like – and he'll pick, you know, he, whenever he asks any question, he always makes sure to like, ask some easier questions. Like, you know, just like, a multiplications problem or he'll ask one of those students who's not strong to just, like, pick another student or just do something that he knows they'll be able to get.

Sophia: So they keep them involved, yeah.

Robert: To just keep them involved so every single…everybody answered a question. And the fact that one person answered a question that's, like, way above grade level and the other person just basically answered a question which was, like, multiplying two single digit numbers, I don't think everybody always notices that. Well, I mean…I don't think the kids always noticed. And so everyone comes out feeling really good, like everyone contributed to that process of getting to that answer.

Robert addresses one of the largest potential struggles faced by recruiters for Math Corps. It is a difficult program to advertise since it is not designed for remedial students nor honors students while offering advantages for both. It is because heterogenous group instruction is employed that instructors must be equipped to cater to students of varying difficulty-levels and conceptual understanding. This daunting task is accomplished by prioritizing inclusivity of everyone in the classroom.

How Math Corps Measures its Success

At the start of each summer, Math Corps provides each middle school student with an intake exam created by the professors at Wayne State University based on both conceptual and computational metrics for both the seventh and eighth grade students. (Edwards, Kahn, and Brenton, 2009). The average score for the pre-test is only around thirty-percent while the average score for the post-test raises to ninety-percent ("Math Corps - Our Results"). The

assessments are directly related to the material they are taught (Edwards, Kahn, and Brenton, 2009).

Aside from test scores, Math Corps gauges its own success largely based on the feedback they receive from participants. Students are required to journal their experiences daily during the summer program; middle schoolers are given specific prompts while their high-school counterparts are not. These journal entries reveal that students have fun while learning mathematics and developing friendships alongside caring staff.

At Math Corps, middle, high-school, and college students each keep a journal where they log daily entries during their time in the summer program. While the middle and high-school students follow prompts, the college students' entries are open-ended. The high-school students read through the middle schoolers' entries while the college student instructors read through theirs. Following a similar theme to her initial interview, in a subsequent conversation she revealed the changes that occur quickly in the journal entries of new Math Corps attendants.

Interviewer: I know that you've been here a couple of years with Math Corps but what's been your favorite part of Math Corps up until now?

Charlotte: Oh my goodness. Okay, well I'll just say this because I mentioned it last time but I would say like the family feel. I probably talked a lot about that so it's kind of hard for me to remember specifically what I might have said about the family feeling. When I was reading some of the TAs journals this summer, I could tell who had not been in the program and who had been in the program. 'Cause the ones who are like brand new to the program like their first journal entries were about like, "Oh, I'm coming here to like improve my math skills and to help kids, you know, and teach them math and by teaching them math I'm going to get better at math." I would say I had two who had never been in the program. Like three or four journals later it was like I couldn't even tell that they were brand new to the program because they were talking about like the heart of the Math Corps that all the other kids had been writing about from the beginning. Like stuff like, you know, how important their kids are, how important it is that they, you know, have a wonderful summer, different things about their students and then it was just a complete change.

Interviewer: What do you think made that change?

Charlotte: The Math Corps, like everybody around and everybody together and just really noticing what the culture is all about. Like I think in the beginning they had a very specific idea of what their job was, like it was more like, "My job is to teach the kids, be on time, do this, do this," and then, sort of after they got exposed to the culture and really got involved in it, they realized like, "Oh my gosh, that's not my job. My job is so much more than just, you know, teaching math and giving math problems. It's, you know, caring and, you know, loving the kids and all this and that."

A few emergent themes within the journal entries include students commenting on the welcoming familial atmosphere as described by Charlotte. Furthermore, these entries reveal the ways in which Math Corps students are aware of and thankful for the differences between the ways concepts are introduced in non-conventional ways that hold their attention and stretch their application of mathematical concepts. Additionally, students respond well to working on their self-esteem. Numerous students wrote that their confidence improved not only in math, but in everything they do after attending the program. The middle-school participants return at such a high rate, now as high-schoolers, that Dr. Kahn states the program no longer needs to go out and recruit high-school students (Edwards, Kahn, and Brenton, 2009).

Conclusion

It is not enough to acknowledge the success of Math Corps as a summer intervention. With locations in multiple cities and states now under a National Science Foundation grant, it is crucial to understand how the program's success has been distributed to new and distinct areas. Locations in Cleveland, Ohio; Utica, New York; and Philadelphia, Pennsylvania are demographically different from Detroit, however, results thus far have shown comparable rates of success. The first year in that aforementioned list of cities is only four-weeks long. The second year is also four-weeks long for every city except for Cleveland, Ohio. Regardless of the duration differing from Detroit's location, the results on the pre-test are all around the thirty-percent mark that Detroit middle school students enter at as well. The post-test administered at

the end of the program reveal scores between seventy and ninety-five percent on average ("National Science Foundation - Math Corps").

As part of their deliverables for the National Science Foundation's grant, the program must create a handbook outlining its philosophies, instruction, and practices so that places where a Math Corps campus will emerge have resources on how to create a community of practice based on the "Math Corps way". Dr. Chrisomalis shared that handbook with me during our Zoom meeting. Reading through it, most of the content is centered around ways to make children feel more comfortable and welcomed by this school-like environment that Math Corps recreates. It instructs teachers on always emphasizing the usage of names, ensuring their students know who their classmates are. Math Corps does not encourage calling on people who do not have raised hands because it may intimidate them until they will not be as eager to participate in class; as an alternative, the guidebook recommends praising that student in other ways and calling on them first as soon as they are comfortable and confident enough to raise their hand. This relates to a different recommendation made by the guidebook where it says encourage the class to answer as a group as this helps construct community and build identity. The underlying philosophies throughout the handbook are often constructing community and building identity, goals that Math Corps makes paramount. A successful educational intervention begins by ensuring every student always feels included in activities. This could be accomplished through posing questions to the class that are across a range of competencies so that every student is able to answer something proving an increased understanding of the concepts being taught, as referenced in the exchange between Sophia and Robert.

A sense of community is what has allowed Math Corps to continue for decades with multiple campuses around the country. As the interviews reveal, particularly Timothy's, some of

the students at Math Corps do not have academic supports at home. Rothstein suggests that poorer children have fewer quiet places to study and Math Corps provides that, but the organization provides something more as well. Math Corps built itself around the specific demographic of African-American youth in Detroit and this means accepting that parents will not always be involved and planning around them. Although Math Corps does expect parents to engage enough to provide transportation for their students to and from the camp, that is where the expectations end. The program places high expectations on students while ensuring their basic needs of being cared for a loved are met first. Math Corps encourages feedback from their participants on the program through journal entries that are read by staff daily. By actively monitoring the progress of students, Math Corps ensures that no students fall behind in the curriculum or misunderstands concepts. The advanced mathematics curriculum directly relates to Math Corps' high expectations of students. There is grace for the instructors who are being introduced to concepts at the same time of their students. Meanwhile, instructors feel a sense of pride in their students' retention of mathematical concepts. Group work is a chance for students to showcase their mathematical expertise while improving the learning outcomes of the other students around them.

In this thesis, I have argued that Math Corps' dedicated effort at establishing esprit de corps shapes that ways in which every aspect of the program is constructed and explains why it is well-received by former participants. The learning community established by Math Corps has allowed for a familial bond to form between staff and students. This bond is a large part of what makes Math Corps successful at closing the achievement gap. Rather than focus on bringing aspects of a student's homelife into the classroom, Math Corps seeks to help students envision themselves within a classroom. The program wants to encourage a confident mathematical

identity for all of their students in hope that this confidence impacts all areas of their lives. Although they are not the multiyear school Nel Noddings imagined, Math Corps is a multiyear summer enrichment program that places an emphasis on care in the classroom. Spending years with the same group of children allows for closer monitoring of their educational progress along with monitoring a student's progress to their own goals after school. Math Corps is effective due to its ability to understand the local landscape that their students come from and not allowing that to restrict the way in which they teach. Math Corps provides a learning opportunity for other summer enrichment programs as well as schools. If basic needs of an individual are met first, they feel loved and listened to, then they will engage more inside of the classroom and return for years.

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