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Organizing a Grassroots Math Literacy Campaign: The Launching of the Young People's Project in Los Angeles

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LOYOLA MARYMOUNT UNIVERSITY

Organizing a Grassroots Math Literacy Campaign: The Launching of the
Young People's Project in Los Angeles

by

Michael Jacob Farber

A dissertation presented to the Faculty of the School of Education,
Loyola Marymount University,
in partial satisfaction of the requirements for the degree
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This project is dedicated to my mother, who introduced me to the world of education when I was a young teenager. I had my first experience as a teacher in her after-school program with special needs pre-school students.

This project is dedicated to all the students I have ever worked with and will ever work with.

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ABSTRACT

Organizing a Grassroots Math Literacy Campaign: The Launching of the Young People's
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By

Michael Jacob Farber

The purpose of this study was to delve into the emerging awareness of the social factors that contribute to the teaching and learning of mathematics by documenting the experiences of Math Literacy Workers in the Young People's Project, as it formed its Los Angeles Chapter. Twelve high school students, three college students and one program coordinator participated in this research study.

This research study focused on a series of math literacy workshops conducted as part of an after-school program at Roosevelt Elementary School. Built upon the legacy of the Mississippi *Freedom Riders*, the Young People's Project has developed an engaging program that allows participants to take direct action in transforming their communities. The design of a pedagogy rooted in the tenants of civil rights, youth leadership, civic engagement, *criticalmathliteracy*, situated learning theory, cultural relevance, peer-to-peer education, social empowerment, grassroots leadership, and community organizing, enabled participants to develop their identity as agents of social change. This research examined the capacity of critical literacy and the methodologies

used to promote math literacy and youth leadership as aspects of the Math Literacy Workers training program.

The Math Literacy Workers training program positively impacted youth participants' math literacy, problem solving, academic achievement, communication, organizing skills, leadership capacity, self-confidence, civic engagement, critical literacy, and self-identity. Participants described how the program allowed them to achieve praxis, through continuously reflecting on their identities and the social significance of their experiences as they took direct action as facilitators of the math literacy workshops at Roosevelt Elementary School.

CHAPTER 1: INTRODUCTION

Math and Social Justice

Mathematical knowledge and its applications are critical elements in the development and sustainability of human civilization. A central component of technological achievement, economic power, medical advancement, mathematics, specifically algebra, has become the symbolic language and gatekeeper of participation in the digital age. The presence of algebra as the symbolic language of the digital age elevates mathematics as an indisputably crucial element of a general education. As reading enabled educational, social, and political power in the mid 20th century, with the voter registration campaign of the *Freedom Riders* movement, today, mathematics has emerged as a civil right and a necessary component for educational access, political power, community empowerment, and full social participation (Moses & Cobb, 2001).

With concerns for low student enrollment in higher mathematics, low US test scores, ineffective teacher preparation programs, educational inequalities, college entrance statistics, and remedial course offerings, a focus on standardization has emerged to dominate educational discourse. This problem is compounded by the growing disconnect between formal school mathematics and the mathematics students encounter in their everyday lives. The focus for the past twenty years on math research has drawn attention to distinctions and debates between procedural fluency versus conceptual understanding, teacher-centered practice versus student-centered practice, and reformed education versus traditional education.

These debates, commonly referred to as the math wars (Schoenfeld, 2004), resulted in often causing the theory, research, and practice of critical math literacy and the teaching of mathematics for social justice to become silenced by the focused public debates between reform and traditional educators. The alternative educational practices of critical math educators and theorists are rooted in the holistic and liberating pedagogy of the modern school movement of 19th century Europe (Averich, 1980). It was not until after the impact of World War II that a group of European educators began to explore the role of mathematics as a means to ensure social transformation, equality, and equity (Skovsmose, 1994). The main concern of these educators was to design a mathematics education to prevent another Auschwitz (Adorno, 2003a, 2003b). The work of these educators from the mid 20th century inspired a new generation of mathematics educators from South America to Europe and from North America to Asia to develop philosophies, theories, practices, and research that emphasized the role of mathematics as a means for social justice and critical thinking.

One such result of this lineage is the work of Robert Moses, co-founder of the Algebra Project and sponsor of the Young People's Project. Established in the mid 1980's, the Algebra Project is a national literacy campaign designed to use mathematics as a tool for community organizing and social transformation. Co-developed in the mid 1990's by the children of Robert Moses and several middle school Algebra Project participants, the Young People's Project facilitates the emergence of youth leadership as part of the national literacy campaign of the Algebra Project. The Young People's

Project is an after-school math literacy program whose mission is to “Use Math Literacy as a tool to develop young leaders and organizers who may radically change the quality of education and life in their communities so that all children have the opportunity to reach their full human potential” (Moses, 1995, Para, 1).

This research study focused on the launching of the Young People’s Project in Los Angeles, and sought to document its effort to build a youth-centered, grassroots, and community organizing math literacy-training program at Horton Charter School (pseudonym). Using qualitative methodology this research study focused on (a) the experiences of participation with the Young People’s Project, (b) the practices used to promote peer leadership, student engagement, and mathematical literacy, and (c) the impact participation has on self-identity, family involvement, leadership, and community organizing with the 16 Young People’s Project participants at Horton Charter School.

Background

U.S. Reports.

The legacy of concern for mathematics education in America goes as far back as the creation of the public school system. Using the research of Donoghue (2006) and Schoenfeld (2004), consistent patterns of concern have arisen with American public schools regarding issues of college readiness, social participation, and global competitiveness. These issues have all been correlated, with some skepticism, to mathematical literacy and academic achievement (Roschelle, Singleton, Sabelli, Pea, & Bransford, 2008).

In 1893 the National Educational Association (NEA), a non-governmental professional group, commissioned a study of secondary education in the USA. The Committee of Ten issued its *Report of the Committee on Secondary School Studies*, recommending changes to the high school curriculum in order to better prepare students for college and social/economic participation. The report noted that only 66% of students were enrolled in algebra or geometry, then the only math courses required, with passage rates below the 50th percentile (Schoenfeld, 2004). The American commissioners of the 1912 report to the International Commission on the Teaching of Mathematics (ICTM) further identified the need for better-prepared mathematics teachers as the main issue facing secondary schools.

After the launch of Sputnik in 1957, fearing global competition, the National Science Foundation and other government agencies pumped millions of dollars into science and mathematics education. Algebra II became a third year expectation for high school mathematics education and ultimately a college admissions requirement (Schoenfeld, 2004). Not long after this, the SAT emerged as a key indicator for college readiness and mathematics became locked into the scope and sequence of today's standards movement.

In 1983, the National Commission on Excellence, appointed by Ronald Reagan completed its *Nation at Risk* report, criticizing American public education as mediocre, citing the same concerns as earlier reports for college readiness, teacher preparation, civic participation and global competitiveness. This report stimulated a further study by the

National Research Council (NRC), whose 1989 *Everybody Counts* report continued to cite concerns about college readiness, social participation, and global competitiveness as issues of social importance with direct correlations between mathematical literacy and academic achievement. The report expressed the concern that “innumeracy threatens democracy because people who understand mathematics will join a technologically powerful elite” (NRC, 1989, p. 26).

After more than eighty years of expressed critique and concern about the quality of American mathematics education, the rise of the math wars, and the millions of dollars invested in math education, the *American’s Choice: High Skills or Low wages* (1990) commission on the skills of the American workforce described a bleak situation regarding a skilled labor force that can participate in the transition from an industrial to a technological age. The Commission cited mathematical literacy and achievement as an integral component of our nation’s successful transition from the industrial to the digital age.

In 2001 and in the wake of *A Nation at Risk* (U.S. Department of Education, 1983), former President George W. Bush signed the No Child Left Behind Act (NCLB) into law. This new federal policy focused American educational efforts on standardized reform, assessments, and scripted curricula in an attempt to address continuing anxiety regarding mathematical achievement and American public education.

Following NCLB the 2008 National Mathematics Advisory Panel (NMAP) recommended a complete overhaul of the delivery system of mathematics education in

American schools. As cited earlier in this paper, the NMAP found American students lagging behind those from other countries in mathematics achievement.

Statement of the Problem

The Concerns for United States Mathematical Underperformance.

Reviewing data from the 2003 Trends in International Mathematics and Science Study (TIMSS); The National Mathematics Advisory Panel (NMAP, 2008), cites United States eighth graders ranking 15th out of the 46 participating nations regarding Number Sense Computations, Algebra, Geometry, and Data and Chance Calculations. These international assessments have raised questions and concerns regarding the instructional practices of American mathematics classrooms and their relevance to the needs of the 21st century. Based on poor performance on standardized tests and preparation for college mathematics, many groups recognize the need for radically revamping the methods of teaching mathematics in the U.S.

The National Mathematics Advisory Panel (NMAP) committee has stated, “Without substantial and sustained changes to its mathematics educational system, the United States will relinquish its leadership in the 21st century” (p. 1). The National Mathematics Advisory Panel cites the results of the 2003 Trends in International Mathematics and Science Study (TIMSS), the results from the 2007 Nation’s Report Card, and the increasing demand for ‘remedial’ mathematics courses in both four-year universities and community colleges as symptoms and consequences of a broken educational system (NMAP, 2008).

In 2007, 36 countries participated in the Trends in International Mathematics and Science Study with U.S. fourth graders ranking 11th, an improvement from the 2003 12th place ranking. Of 48 participating countries, U.S. eighth grader scores in mathematical achievement improved from 15th to 9th place from 2003 to 2007.

Even though there is some improvement relative to other countries on TIMSS, Moses and Cobb (2001), reference data from University of Arkansas in Monticello showing that 80% of their freshman must take remedial math courses. This data parallels results from the University of Kentucky in Louisville showing that close to 90 % of their entering minority students must take remedial algebra, for which they receive no college credit (Horn & Nuñez, 2000; Horowitz, 2005). The need for a growing number of college students to take additional remedial courses plus an increase in tuition, places a greater burden on individual college expenses and financial aid resources. When looking at the demographics of the students needing to take remedial college courses a noticeable correlation is evident between enrollment and socio-economic status, implying an injustice in the way the system functions and who benefits from it (Gatto, 2001, 2003; Horn & Nuñez, 2000; Horowitz, 2005; McLaren, 1989, 1999; Moses & Cobb, 2001).

Roschelle et al., (2008) highlight concerns about the use of standardized international assessments, such as the Trends in International Mathematics and Science Study (TIMSS), when drawing comparative analysis. The first point raised by Roschelle et al., indicates that even though Singapore leads the world in standardized math scores, their “educational ministry and researchers are deeply concerned” (p. 612) about their

country's "intensely assessment-driven culture" (p. 612) producing high test scores, "but squelching the creativity and innovation needed by future scientists" (Luke, Freebody, Shun, & Gopinathan, 2005, as cited in Roschelle et al., 2008, p. 612).

Citing Lewis (2004), Rochelle et al. draw attention to a second concern related to the interpretation of international standardized assessments, "Despite long-lived fears of declining mathematical competence among [America's] school aged students... the United States is more consistent in innovating and increasing productivity across many sectors of its economy than any other country" (p. 612). They suggest "The definition [of Algebra] should bring to life how students learn to use Algebra with strategic competence, develop capabilities for adaptive reasoning, and perhaps most important, develop the proclivity to use mathematics appropriately and powerfully in everyday situations" (Roschelle et al., 2008, p. 612).

Why Mathematics?

The National Mathematics Advisory Panel in their 2008 report *Foundations for Success* confirms the emphasis on math literacy. "The National Science Board indicates that the growth of jobs in the mathematics-intensive science and engineering workforce is outpacing overall job growth by 3:1" (NMAP, 2008, p. xii). Based on findings from the American Electronic Association (AEA), Moses and Cobb explained, "high-tech workers earned 82% more than people in other industries earned" (p. 8). They further stated 60% of the new jobs of the 21st century will "require skills possessed by only 22% of the young people entering the job market" (p. 8). This poses an underlying question: Who

are the individuals prepared for these ‘math-intensive’ careers? The 2007 Nation’s Report Card suggests more students from middle to upper class families who study in private or parochial schools are so prepared (Rose, 2001).

A key aspect of the 1980’s mathematics reform movement concentrated on closing the “achievement gap” between white and non-white, and wealthy and poor students in American public schools. Even though mathematical achievement for eighth graders’ showed improvement across all income levels since 2005, the 2007 Nations Report Card illustrated that an achievement gap still persists.

Using a sample of more than 350,000 fourth and eighth grade students from public, private and parochial schools, the 2007 Nations Report Card illustrated that based on a scaled score of 500, students not eligible for free or reduced lunches had an average score of 291, while students eligible for reduced price lunches scored an average of 274, and those who are eligible for free school lunches had an average score of 263.

Jacobson (2000) further highlights the social inequities of our modern educational system as she explains the impact of Proposition 209, known as the anti-affirmative-action legislation, which requires the Universities of California to emphasize SAT quantitative reasoning scores as an admission requirement. This newly emphasized math literacy requirement resulted in, “...Berkeley reporting a 65% drop in ‘minority’ admissions in 1999,” statistics reflective of preaffirmative action days (Jacobson, 2000, p. 3) Why is it that a new emphasis on quantitative reasoning as a requirement for entrance into higher education had such an impact on one specific community within American

society? The National Mathematics Advisory Panel (2008) stated, “This panel, diverse in experience, expertise, and philosophy, agrees broadly that the delivery system in mathematics education—the system that translates mathematical knowledge into value and ability for the next generation—is broken and must be fixed” (p. xiii).

American educational research has emphasized the isolation of single variables as a means to identify cause and effect relationships within classroom learning. With this overemphasis on isolating single variables, a perception exists that if we, as educators, isolate the problem, we can fix it. This thinking has led many researchers, educators, and policy makers to search for the magic bullet, whereas other researchers emphasize the need to explore more qualitative data that examine the context and culture of mathematics education as well as the content and teacher knowledge.

The National Mathematics Advisory Panel’s Final Report (2008) emphasized data collected from research isolating single factors, “such as teacher’s content knowledge,” to determine measurable impacts on learning (Roschelle et al., 2008, p. 610). In the single variable paradigm, the teacher is usually identified as the party solely responsible for transmitting the necessary knowledge to the student (Boaler, 2002; Freire, 2004; Lave & Wenger, 1991; McLaren, 1989, 1999; Wenger, 1998). However, others stress the need for deeper research. “The complexity of mathematics teaching and learning requires approaches that integrate many individual resources and capabilities, systematically, to produce profound mathematical experiences” (Ball & Farzani, 2007, p. 610).

Critiques of the National Mathematics Advisory Panel's Final Report (Pierson, 2008) illustrate that emphasis on single-factor interventions resulted in omitting important qualitative data from the Trends in International Mathematics and Science Study (TIMSS) classroom observation video comparisons. The most recent video observation study was conducted in 1999 as part of the TIMSS to conduct an in-depth investigation, comparing eighth grade mathematics classroom teaching practices in the United States with six of the top scoring countries, including: Hong Kong SAR, Japan, Czech Republic, Netherlands, Australia, and Switzerland.

The video study provided comparative data that supports an analysis of the way in which educational leadership policies and practices that are related to instruction and curriculum are being implemented in the classroom. Stigler and Hiebert (1997) articulated how the classroom observations “Show that American teachers tend to minimize the cognitive complexity of the tasks students work on...” (p. 614). Beyond omitting the results from the video comparison research the Scaling up SimCalc (as cited in Roschelle et al., 2008), “found trends linking teachers’ mathematical knowledge to student achievement but [found] much stronger correlations between specific teaching practices and student achievement” (p. 613). They described an observable “instructional contrast [exemplifying] the overall finding that American teachers typically focus on procedures, and their knowledge is generally rule-bound and fragmented” (Stigler & Hiebert, 1997, p. 614).

Acknowledging the controversial and historical debate of the math wars between a student-centered versus a teacher-centered pedagogy, The National Mathematics Advisory Panel's task group on Instructional Practices addressed this dispute (Boaler, 2008a; Lobato, 2008; Schoenfeld, 2004). "Limited to studies that directly compared these two extreme positions" (NMAP, 2008, p. 45) the task group found eight studies that met their research standards of quality, allowing them to compare these practices with consistent definitions. "We defined teacher-directed instruction as instruction in which it is primarily the teacher who is communicating the mathematics to the students directly, and student-centered instruction as instruction in which primarily the students are doing the teaching" (NMAP, 2008, p. 45). The task group reported that no empirical evidence was found to show that one method was preferential to the other, and suggested that the most effective classroom practice includes both of these types of focused learning experiences. The task group drew attention to the cooperative learning strategy of Team Assisted Individualization (TAI) and its consistently positive impact on student computational skills, and saw no clear impact on student conceptual understanding. The use of explicit or direct instruction was noted by the task group as being a strategy that shows consistent "results... for students with learning disabilities, as well as other students who perform in the lowest third of a typical class" (NMAP, 2008, p. xxiii).

As she critiqued the *Final Report of the National Mathematics Advisory Panel* task group on Learning Processes stringent research methods, Lobato described the "report's dismissal of a Vygotskian approach, which becomes more serious when one

realizes that other major theoretical perspectives important to mathematics education research were also overlooked” (2008, p. 598). She included perspectives of situated cognition as part of a developing field of experimental research that offers alternative perspectives regarding the three major issues raised in the NMAP (2008) report on “The nature of what is learned, how learning occurs, and the transfer of learning” (Lobato, 2008, p. 595).

The broader view of learning that is emerging, which includes more attention to social, cultural, and out-of-school factors, deserves more attention in planning curriculum, specifying requirements for teachers’ mathematical knowledge, and designing innovations that increase the opportunities for all students to progress towards advanced mathematics. (Roschelle et al., 2008, p. 615)

The notion that the teacher’s responsibility and identity is one that transmits knowledge whereas the student’s responsibility and identity is one that simply receives knowledge needs to be reconceptualized. In the current model, the focus is for students to memorize facts and procedures rather than using the knowledge in real world situations. This historical reliance on memorization is a key element in mathematical learning, and the research practice of identifying a single variable contrasts with an emerging view of education as offering a “broader view of learning... which includes more attention to social... factors” (Roschelle et al., 2008, p. 611).

Historically, the traditional approach to mathematics education was based on a curriculum of abstract principles and algorithmic procedures, stripped of human context.

One assumption of this type of curriculum is that only some students possess the ability to understand these concepts. Jacobson (2000) referred to the result as the “Cultural discontinuity [of] school math versus real math” (p. 46). In present form, the ability model for learning modern mathematics is elitist (Skovsmose, 2005). In a classroom the ability model for learning polarizes students into two groups: those who have the innate ability to do the work, and the other students who do not have the ability and cannot develop it. Even though all students use mathematics throughout their day, school math has become separated from their personal and familial experiences.

The current curriculum focus makes it increasingly difficult for students to recognize any similarities between the math they do and understand outside the classroom and the math they see and learn in school. Iseke-Barnes (2000) described how the “assumption that mathematics was independent of culture,” (p. 5) played a significant role in the formation of modern mathematics education. It was this assumption of independence of culture that led modern students to feel a sense of alienation and disharmony (Resnick, 1988; Schoenfeld, 1989). Likewise, Erlwanger (1975), and Secada, Fennema, and Adajian (1995) illustrated students’ perceptions of mathematics as being disconnected from their real worlds.

The initial findings of the 2008 National Mathematics Advisory Panel included reference to the disparities of mathematical access, ability, and achievement as they relate to the race and class struggles of poor, disenfranchised American citizens. The report cited a series of studies that identified collaboration, peer-assisted learning, praise, and

environments that stressed communal values as fundamental to the development of math literacy. Roschelle et al., (2008), further explained these strategies as key practices that are “particularly useful for students on the wrong side of the achievement gap” (p. 615). However, the National Mathematics Advisory Panel provided little to no direction for educators to actually reconceptualize how school mathematics relates to social inequalities and injustices and ways in which we can use mathematics as a means to alleviate present educational and social inequality (Anyon, 2005; Bowles & Gintis, 1976; D’Ambrosio, 1979, 1981, 1992, 1993; Frankenstein, 1983, 2008; Gutstein, 2003, 2007; Kozol, 1991, 2005; Lobato, 2008; Moses & Cobb, 2001; Roschelle et al., 2008). It is this gap between theory and practice in the recommendations of the National Mathematics Advisory Panel’s report that led this researcher to study the launching of the Young People’s Project, a peer-to-peer learning model that targets the most needy and underserved students in the educational community.

The Modern Context of Los Angeles

That algebra is perceived to be a key ingredient for a general education is evidenced by California education code section 51224.5, which has three specific requirements related to the education of mathematics and the responsibilities of schools to cultivate mathematical literacy related to algebraic thinking. Section 51220 requires any “adopted course of study for grades 7 to 12, inclusive, shall include algebra.” Section 51225.3 of the California education code set in motion a policy to ensure that commencing with the 1998-1999 school year all California high school students would be

required to study at least two years of mathematics. Students who were able to successfully study Algebra I prior to entering ninth grade are required to study a minimum of two years of mathematics beyond Algebra I.

In response to the recommendations of the NMAP and in accordance with No Child Left Behind (NCLB) federal mandates for all students to achieve proficiency on state standardized assessments by 2014, and supported by Governor Schwarzenegger, in July 2008 the California State Board of Education (SBE) proposed a bill mandating all California eighth grade students study Algebra regardless of prior mathematical achievement. The Governor has enthusiastically expressed his desire for California to have high academic standards and refers to this requirement as one that will allow California schools to better serve their students (Williams, 2008). The act does not provide a strategy nor the means to prepare students to take algebra in eighth grade, but simply requires that they must take it, which raised a public response and ultimate legal action due to the lack of clarity regarding the implementation of the way this plan will actually be enacted (Williams, 2008).

Students in the Los Angeles Unified School district lag behind their peers in Los Angeles County and the rest of the state in mathematics preparedness to take algebra. The 2007 State Testing Accountability Report (STAR) shows us that in the Los Angeles Unified School District (LAUSD) only 10% of 25,309 eighth graders taking a general math or prealgebra assessment scored at proficient or above on the California Standardized Test (CST), compared to 24% in Los Angeles county and 26% across the

entire state. Of the 23,887 LAUSD eighth graders taking Algebra I, only 21% of these students scored proficient or above, compared to 24% in the county and 34% in the state (STAR, 2007). In the context of the findings of the National Mathematics Advisory Panel the question arises concerning whether Los Angeles' historical pattern of low levels of mathematical literacy and achievement in the middle grades are a cause for concern for the future welfare, educational achievement, technological advancement, and global participation of the city of Los Angeles.

A recent longitudinal study by Kriegler and Lee (2008) from the UCLA Department of Mathematics, cited that even though California schools were able to almost double the number of eighth grade students taking Algebra from 2003 to 2006, the actual outcome has been that only 2% more students are scoring at or above proficiency levels in Algebra I, a growth from 41% to 43% (Kriegler & Lee, 2008). Kriegler and Lee (2008) also conducted a comparative study between LAUSD middle schools that enacted a conservative placement strategy for eighth grade mathematics and schools that simply placed all eighth grade students into an algebra class. The study showed, that 90% of the schools that used a conservative placement strategy saw academic growth with their students while only 20% of schools that placed all their students into an Algebra class saw academic growth. The Algebra Project is focusing our attention on the question of what are we doing to prepare students in the early grades so all students are ready to take Algebra in the eighth grade, preventing student anxiety, dis-engagement and, ultimately, academic failure.

Call to Action

Formed in 2002 as a collective among the U.S. Department of Education, the National Education Association, and numerous businesses such as AOL Time Warner, Apple, and Microsoft, the *Partnership for the 21st Century* (2009) mission is to “Serve as a catalyst to position 21st century skills at the center of K-12 education...” (Kay, 2002). Recognizing the profound gap between the knowledge and skills students learn in school and the knowledge and skills needed to participate in the typical 21st century community and workplace, the *Partnership for the 21st Century* works with education centers to ensure all children are provided with opportunities to develop the knowledge domains of communication, problem-solving, self-determination, global awareness, financial literacy, and civic literacy.

For the *Partnership for the 21st century* the math achievement gap is reflective of the larger social issue and economic crisis of American inequality and wealth disparity (Apple, 2000; Anyon, 1980, 2005; Bowles & Gintis, 1976; Domhoff, 2006; Kozol, 2005; McLaren, 1989). The persisting achievement gap between wealthy and poor students, Caucasian or Asian, and African American or Latino students is at the core of the concern for the national literacy campaign of the Algebra Project in their effort to not simply close the gap, but more importantly to raise the floor for all students to achieve high levels of academic success (Moses & Cobb, 2001).

In an attempt to integrate the messages of inspiration as well as the call to action during Barack Obama’s inauguration as the 44th president of the United States of

American to transform American schools so that we may “Meet the demands of a new age” (2009), this study is humbly documenting the grassroots efforts of the youth empowerment program known as the Young People’s Project in its efforts to support the national math literacy campaign of the Algebra Project:

We will restore science to its rightful place, and wield technology's wonders to raise health care's quality and lower its cost. We will harness the sun and the winds and the soil to fuel our cars and run our factories. And we will transform our schools and colleges and universities to meet the demands of a new age. All this we can do. And all this we will do. (Obama, 2009)

For President Barack Obama the world of the future will be crafted by the work of scientific and technological imaginations, inventiveness and creative achievement. A world described by D’Ambrosio (2000), Moses and Cobb (2001) and Skovsmose (1994, 2007) as having mathematics as its symbolic language and the key tool for social expression and material formation. This presence of mathematics as a driving force and binding element of the vision of the new administration codifies the social and moral responsibility of mathematics educators (Apple, 2000; D’Ambrosio, 2000; Frankenstein, 1983, 2008; Friedman, 2005; Gutstein, 2003, 2007; Gutstein & Peterson, 2005; Lubin, 2006; Moses & Cobb 2001; NMAP. 2008; Obama, 2009; Skovsmose, 1994, 2005, 2007):

Truly understanding [...] new technology requires a new literacy. Computers are run by symbolic systems. To understand the language of computers, we must

have an understanding of the mathematics that encodes quantitative data and creates symbolic representations. The place in the curriculum where students are introduced to this language is algebra. (Checkley, 2001, p. 6)

Purpose of the Study

In their critique of the 2008 National Mathematics Advisory Panel's Final Report, Hegedus & Penuel (2008) and Stroup, Ares, & Hurford (2005) pose this questions to the research community, "How can challenging aspects of algebra learning be addressed using classroom network technologies to overlay social and contextual meanings with mathematical meanings" as educators "...look seriously at the mathematics that matters in the 21st century"? (p. 615)

This research study seeks to delve into the emerging awareness of the social factors that contribute to the teaching and learning of mathematics by documenting the experiences of youth participants working as Math Literacy Workers in the Young People's Project.

This dissertation research will provide particular attention to the pedagogical models and specific strategies used to incorporate peer-assisted, student-centered learning experiences into mathematics education.

The research on the launching of the Young People's Project, a youth-facilitated math literacy campaign in Los Angeles, will illustrate how math education can be reconceptualized to become engaging, community-based, and conceptually challenging.

This inquiry will document the experiences of the Math Literacy Workers and the ways they transform mathematical literacy into a community task.

Cultural Formatting Power of Mathematics

The existence of mathematics as a fundamental principle in the formation of civilizations is a well-documented occurrence. Historically, mathematics has been and continues to be interwoven with the political, economic, religious, social, intellectual, artistic, and natural elements of human culture and society (Bishop, 1988; Gates, 2000; Ghyka 1977; Greer & Mukhopadhyay, 2003; Moses & Cobb, 2001; NMAP, 2008; Obama, 2009; Reyna & Brainer, 2007; Skovsmose, 1994, 2005, 2007). D’Ambrosio (2000) portrayed math as having global perspectives of time and space leaving its trace as part of the imprint of the human species on the universe. Bishop (1988) and D’Ambrosio (2000) saw math as fundamental to the means by which humanity copes with our search for understanding and knowing of our existence. Moses and Cobb (2001) stated “economic access and full citizenship depend crucially on math and science literacy” (p. 5). They further elaborated that they “believe that the absence of math literacy in urban and rural communities throughout this country is an issue as urgent as the lack of registered Black voters in Mississippi was in 1961” (Moses & Cobb, 2001, p. 5).

The Algebra Project: Math as a Civil Right

Incorporated as a national nonprofit organization “that uses mathematics as an organizing tool to ensure quality public school education for every child in America” (Moses, 1982) the Algebra Project is designed to promote the integration of classroom

and real-world experiences supporting students as they “exercise full citizenship” (Moses, 1982). By building coalitions and developing a curriculum that “addresses directly the conceptual leap students must make from arithmetic to algebra” (Moses, Kamii, Swap, & Howard, 1989), the Algebra Project aims to prepare students to “succeed in this technology-based society” (Moses, 1982). With a focus on the acquisition of the formal language of mathematics, Moses developed a five stage experiential learning model known as the *Transition Curriculum*, and a teacher training program. The teacher-training model was developed in collaboration with the *Efficacy Institute* in an effort to transform educational opportunities and achievement so that *all* students may be successful in mathematics (Moses & Cobb, 2001; Moses, et al., 1989; Nelson, 1997; Silva, Moses, Rivers, & Johnson, 1990). Built on the work of Harvard trained social psychologist Dr. Jeff Howard, the *Efficacy Institute* has “developed a model of learning based on the idea that intelligence can be built through effective effort” (Howard, 1989).

The Young People’s Project

Formed by the children of Robert Moses, several of their friends and nine eighth grade Algebra Project students from Brinkley Middle School in Mississippi, the Young People’s Project incorporated as a national nonprofit organization in 1996. Omo Moses, the son of Robert Moses described it as “the same way that Ella Baker helped fashion a space for the students who sat-in [during the civil rights movement] to think and organize for themselves, the Algebra Project provided a space for [the Young People’s Project] to grow and develop” (Moses, 1995). The Young People’s Project, is a collaborative

between high school and college age students who “develop [as] young leaders and organizers who [work to] radically change the quality of education and life in their communities” (Moses, 1995).

With just over ten years in existence the Young People’s Project has grown from its humble roots of several Algebra Project graduates in Jackson Mississippi working with nine eighth graders to a national community organizing effort that includes training sites in Atlanta, Virginia, Miami, Mansfield, Springfield, the Mississippi Delta, New Orleans, and Los Angeles (Management Consulting Services, 2008). More than a thousand young children across the nation have participated in math literacy workshops facilitated by Math Literacy Workers with over 250 high school and college students trained as literacy workers.

“The Young People’s Project model is built on the belief that young people can and must demonstrate to *each other*, the value of mathematics and the centrality of their own direct participation in creating a responsive educational system” (Management Consulting Services, 2008, p. 1).

The pedagogical model of the Young People’s Project is designed around the four pillars of (a) peer-to-peer transfer of knowledge, (b) building a sense of long term purpose, (c) cultivating a robust sense of freedom, and (d) and in the tradition of Gandhi, who asked us to “Be the change we want to see in the world,” individual transformation stimulates social transformation (Management Consulting Services, 2008). The Young People’s Project’s main objectives are to nurture holistic positive growth amongst youth

related to both their attitudes and behaviors towards mathematics and to stimulate social transformation as a result of young people's choosing and being committed to be agents of social change. "By focusing on math, the Young People's Project uses a subject matter that acts as a critical lever in setting the stage for successful transition into adulthood" (Management Consulting Services, 2008, p. 2).

With the youth facilitated community based literacy workshops emphasizing collective learning, critical reflection, and collaborative experiences the Young People's Project has developed a sustainable organizational model in which "participants do not 'age out' of programming – [but rather] they 'age in' to another level of participation" (Management Consulting Services, 2008, p. 3). The organization structure is designed to support the younger school-aged students who participate in the workshops by having the high school literacy workers that facilitate the workshops receive their training from college literacy workers who are trained by a veteran instructor who is trained by the national Young People's Project training team.

The Young People's Project model of excellence revolves around the four instructional themes of the way one sees one's self and others, the creation of we, being of service and communication in and with mathematics. These four themes are further compartmentalized into twelve sub-categories.

The LA Cohort of the Algebra Project and the Young People's Project

In the spring of 2006, Robert Moses, and Ernesto Cortes, a community organizer affiliated with the Industrial Areas Foundation (IAF), who are long-time friends and

MacArthur Fellows, participated on a panel at the Mathematical Sciences Research Institute (MSRI) conference in Berkeley. During this conference Cortes asked Moses and the Algebra Project to become involved in a Sacramento initiative called the Sacramento Valley Organizing Community (SVOC) that was being sponsored by Industrial Areas Foundation (IAF) with support of the California Teachers Association (CTA).

With a successful collaboration in Sacramento between the Algebra Project and the Sacramento Valley Organizing Community and a recent grant awarded to the Algebra Project by the National Science Foundation (NSF) for its expansion, plans for the LA Cohort began to develop in 2007. One-LA, the Industrial Areas Foundation (IAF) affiliate in Southern California, was invited to participate in the National Science Foundation (NSF) grant to expand the work of the Algebra Project across the nation. Los Angeles was to be one of four new sites for the Algebra Project, and One-LA is the main sponsor of the LA initiative. The prime responsibility of One-LA is to create and sustain the political space that will allow the Algebra Project to organize a math literacy campaign in Los Angeles. As an Industrial Areas Foundation (IAF) broad-based organization, One-LA is comprised of some 90 institutions across Los Angeles county, including churches, unions, schools, and community based organizations. In collaboration with the extensive member base of these organizations, One-LA has been able to successfully negotiate the economic, political, and social terrain of the Los

Angeles Unified School District (LAUSD), the nation's second largest school district, on behalf of the Algebra Project.

Working with existing relationships within the district two high schools were identified as target locations at which to establish the first two Algebra Project cohorts in the Los Angeles area. Reflecting the mission of Moses and Cortes to promote math literacy with the most underserved and underprivileged students, the target schools are located in Highland Park and South Los Angeles, two local neighborhoods riddled with underperforming schools, low levels of math literacy, high dropout rates, gang activities, youth incarceration, and poverty (National Center for Educational statistics [NCES], 2007).

To create an opening for youth leadership as part of the LA Algebra Project campaign for social justice and math literacy, the LA cohort of the Young Peoples' Project (YPP) formed at Horton Charter School. The Young People's Project is an effort to promote social activism and community participation by providing opportunities for local college and high school students to collaborate and exercise their leadership. These students become peer teachers and facilitators of math literacy workshops and community organizing activities.

Being peer teachers and facilitators of community events are the cornerstones of the function of the Math Literacy Workers of the Young People's Project. These community events are incorporated as part of the strategy for the Algebra Project to grow in LA. The Math Literacy Workers host varying events referred to as math literacy

workshops, as an opportunity to engage students and their families in participating in the math literacy campaign of the Algebra Project. It is the training, planning, facilitating, and reflection of these math literacy workshops conducted by the Math Literacy Workers at Horton Charter School that were the focus of this research and the grounds from which the research questions grew.

Research Questions

1. How does the Young People's Project motivate students to participate in the math literacy campaign of the Algebra Project?
2. What are the teaching and learning practices of the Young People's Project that assist youth in developing *criticalmathliteracy*?
3. How does the Young People's Project cultivate young leaders and organizers as part of its Math literacy campaign?

Research Design and Methodology

To answer the research questions, I have designed a qualitative study exploring methods, practices, and social learning experiences of the Los Angeles cohort of the Young People's Project (Guba & Lincoln, 1994; Hatch, 2002; Marshall & Rossman, 2006; Wenger, 1998). The research questions chosen for this inquiry demand a qualitative study because they are capturing participant voices and experiences as they engage as Math Literacy Workers. The focus of this study is to highlight and document the experience of the individual participants in their natural setting.

Due to the fact that at the time this study began, the LA cohort of the Young People's Project at Horton Charter School was the only cohort in the area, the participants were chosen by using a convenient sampling method. The LA cohort is made up of 12 youth participants, students enrolled in Horton Charter School between grades 9 and 12, 3 students from local colleges, and the program coordinator who works as the trainer of the after-school program. The after-school program is facilitated by Beverly (Pseudonym), a former graduate of the Algebra Project in Mississippi and a participant and founding member of the Young People's Project.

I studied the Young People's Project use of a grassroots, social organizing peer-learning model as a pedagogical framework to cultivate social participation, mathematical literacy, student agency, and critical consciousness (Acevedo, 2008; Freire, 2004; Lave & Wenger, 1991; Management Consulting Services, 2008; Moses & Cobb, 2001; Watts & Guessous, 2006). Being a participant observer of the Young People's Project allowed me to provide a balanced analysis, recording the experiences with both emic (insider) and etic (outsider) perspectives. Placing myself as the researcher in the natural setting, using myself as a "Primary data-gathering instrument" (Lincoln & Guba, 1985, p. 39), allowed for the data collected to more accurately portray the myriad of variables that occur as the multiple realities of individuals interacting with each other in what Wenger (1998) referred to as a community of practice. Using the methods of semi-structured interviews, observations, field notes, participant journals, document analysis, and participant feedback the data was collected.

The use of a situated social practice of learning theory (Lave & Wenger, 1991; Wenger, 1998) assured that the research was conducted in a manner that remains truthful, authentic, and trustworthy to the honor of the participants and integrity of their relationships (Hatch, 2002). Judith Moschkovich explained that “a situated-sociocultural perspective is useful for avoiding deficiency models of bilingual learners, developing detailed descriptions of the resources students use to communicate mathematically, and helping teachers build on these resources during instruction” (p. 191).

In alignment with a constructivist paradigm, this researcher “assume[s] a world in which universal, absolute realities are unknowable, and the objects of inquiry are individual perspectives or constructed realities” (Hatch, 2002, p. 15), with a critical understanding that there is a historical narrative of injustice that influences individual perspectives of said constructed realities as they relate to mathematics education and social empowerment (Guba & Lincoln, 1994). As explained by Hatch (2002), constructivist research emphasizing qualitative analysis “...include enough contextual detail and sufficient representation of the voices of the participants that readers can place themselves in the shoes of the participants...” (p. 16).

Honoring a qualitative research tradition designed to document participant voices, a reflective practice of dialogical data generation was embedded as part of the research experience (Hatch, 2002). The research included participant feedback which intentionally provided space and opportunities for myself and participants to share, reflect, redesign, and repair any unintended and intended consequences resulting from the

data collection processes of the research study (Hatch, 2002; Marshall & Rossman, 2006). An inductive analysis was necessary for this research study because the inquiry was designed to “emphasize the discovery of cultural meaning” of the Math Literacy Workers at Horton Charter School (Hatch, 2002, p. 179)

Inspired by the math research of Boaler (2002, 2008a, 2008b), De Freitas (2008), Gutstein (2003, 2007), and Krishner (1997) this study is focusing on the social learning theories of the Young People’s Project after-school math literacy-training program at a charter high school in the Los Angeles area. Framed by the above research practices the study will explore the experiences of the 14 participants to identify the strategies for motivating students to participate; the pedagogical practices that are used to teach and learn math literacy, community organizing and youth leadership; and the impact participation has on individual identity, social relationships, and student agency.

Significance of the Study

With such an over reliance in California schools on teaching for memorization of mathematics (Boaler, 2008b; Wilson, 2003), this study provides empirical evidence to support educators in an effort to create collaborative and balanced math education for the 21st century and beyond. Using a situated research perspective, this study contributes empirical evidence that highlights the significance of the social learning factors that played a role in the learning experiences of the Young People’s Project participants (Davis, et al., 2007; Freire, 1970, 1973, 2004; Moses & Cobb, 2001; Moses et al., 1989; Silva et al., 1990; Watts & Guessous, 2006; Wenger, 1998). The focus on the Young

People's Project peer education and youth leadership model provided additional research for the collective understanding of educators as agents of social change as we continue exploring this emerging paradigm of teacher as facilitator and the student as an active participant in their learning.

The results of this study contribute to the ongoing dialogue on how to refocus research toward the social factors of mathematics education, to reconceptualize the teaching and learning of mathematics education, and to recreate instructional practices that support the emerging paradigm of teacher as facilitator. A key aspect that emerged from the collected data was the positive impact that leadership opportunities had on participating student self-image, social participation, and academic achievement. The findings related to youth leadership highlight the need for math educators, site administrators, and policy makers to take seriously the role of a socially responsive pedagogy in our efforts to transform math literacy in American education. This research provides a platform for further study of the efficacy of the Math Literacy Workers training program of the Young People's Project.

Limitations

Sample size.

The Math Literacy Workers' training program at Horton Charter School is made up of 16 participants. It may be difficult to make generalizations relatable to other YPP Math Literacy Workers across the nation, or to the millions of students in the city of LA, let alone California or the entire nation, from such a small sample group.

Sample population.

The student participants of the Young People's Project made a commitment to participate in the experience by volunteering to enroll as a literacy worker in this special after school training program while attending high school. When looking at the collected data and attempting to draw meaning from documented student experiences, it is possible that the students' initial voluntary will and commitment to participate in the program may make it difficult to transfer participating student experiences to students who have not or will not choose to participate.

Timing of the research study.

The LA Cohorts of the Algebra Project and Young People's Project had newly formed and this study coincided with this initial phase. Research and analysis was limited to the formation period of the LA cohort of the Young People's Project at Horton Charter School. Because the research fell at the beginning of the project, this study focused on how the Young People's Project engaged participants in its effort to transform the mathematics learning experience for all. This research provides a building block for future longitudinal research that can examine the impact of participation on student performance and community involvement.

Definition of Terms

Agency: The ability for individuals to act independently and cooperatively while making their own free choices to act in the world in a socially conscious and responsible manner.

Criticalmathliteracy: The ability to use mathematics as a tool to deconstruct social reality in a manner that allows one to clearly see the mathematics behind and imbedded in the politics of social inequalities. *Criticalmathliteracy* sheds light on inequality while at the same time provides individuals with a relative course of action to transform the inequality (Frankenstein, 1983, 2008).

Critical Praxis: The mapping of social inequalities and injustices, the time given to identify and reflect upon the sources of the inequalities and injustices, and the actions taken to remedy the inequalities and injustices.

Identity of Mastery: “Moving toward full participation in practice involves not just a greater commitment of time, intensified effort, more and broader responsibilities within the community, and more difficult and risky tasks, but, more significantly, an increasing sense of identity as a master practitioner” (Lave & Wenger, 1991, p. 111).

Math Literacy Workers: “Young people, known as Math Literacy Workers (MLWS) conduct math institutes and workshops and strive to make these events a part of civic and community life” (Watts & Guessous, 2006, p. 1). Math Literacy Workers are the direct expression of the Young People’s Project whose mission is to “organize young people to work to radically change their education, and the way they relate to it” (Watts & Guessous, 2006, p. 1). With the desire to create a youth-led effort, the Young People’s Project was formed as an opportunity to build relationships between college and high school students. The collaborative relationships are formed around their effort to

coordinate, organize, and facilitate community based, civic minded, math literacy workshops, classes, and educational experiences.

Delimitations

This research project was focused on the social relationships and learning practices used by the Young People's Project. During observations and interviews specific attention was given to the manner in which the learning environment supported and cultivated participation and localized leadership.

Summary of the Study

The purpose of this research was to explore ways in which the emerging paradigm of teacher as facilitator could be supported with the use and application of a classroom-based, peer-learning model. With the aim of cultivating student participation, leadership, community involvement, and sense of agency, this study documented the efforts of the Young People's Project and the experiences of youth participants in their efforts to support the national math literacy campaign of the Algebra Project as Math Literacy Workers. This study contributes the basic research necessary to support a full study of the efficacy of the Young People's Project, possibly creating a template for successful initial steps for schools to integrate peer learning models into their learning environments while generating a method to compare the initial stages of similar projects and the resulting outcomes of those projects.

This chapter includes an introduction to the overarching concept and need for a reconceptualization of mathematics to include a socially relevant and reflective

experiential learning model specifically designed to support the emerging paradigm of teacher as facilitator and the students as efficacious. The introduction of this study has highlighted historical concerns associated with American mathematics education, the emerging paradigm of student as an active participant and co-creator of the learning experience it has also clarified the cultural formatting power of mathematics and its function in the world of the future. Further, it defines the mission of the Los Angeles cohort of the Young People's Project.

Chapter 2 includes a review of the literature drawing parallels, intersections, guides and possible models, while focusing on the need to critically assess the nature of school mathematics and its involvement in transforming social inequality. The historical roots of the Algebra Project are highlighted through the traditions of organizing with Baker, education with Horton, and literacy with Quine. In addition to identifying the traditions of the Algebra Project Chapter 2 illustrates the ongoing movement of the Algebra Project by reviewing its curriculum framework and experiential learning model.

Chapter 3 includes a detailed description of the methodology and socio-cultural theory by which the research was conducted, illustrating the need for reflections on and consideration of socio-political relationship within and outside the classroom. The framework set up by Chapters 1 through 3 sets up Chapters 4 and 5 relating to the data collected during the course of research and the conclusions reached.

Chapter 4 contains the results and main findings from the research conducted with the Los Angeles cohort of the Young People's Project at Horton Charter School. It

provides an organization for the researched data along with explanations about the data analyzed, highlighting any key relationships, patterns, trends, or unexpected results and outcomes. Chapter 4 culminates with identifying the key discussion points that arose from the data analysis in regard to the initial research questions.

Chapter 5 includes a discussion of the key points established by the research analysis in Chapter 4, more deeply exploring the significance of the findings, possible generalizations, and offering recommendations for future research.

CHAPTER 2: REVIEW OF THE LITERATURE

Influential Critical Math Educators

The duality of the math wars ignores the work of critical math educators, who emphasize learning mathematics as part of a system of empowerment, community involvement, and developing technical skills necessary to participate fully in the information society. Although this new paradigm of critical math education has not been fully realized, there has been considerable research in the area.

Instead of focusing on this new paradigm, the public discourse on math education in America has become polarized into a duel between traditional versus reform approaches (Boaler, 2002; 2008a, 2008b; Schoenfeld, 2004; Wilson, 2003). Locked into the oppositional nature of a duel, the expectations were set for there to be only one victor: the reform educator or the traditional educator, leaving no room for the critical educator.

Diverging from the common interest for student success, the last several decades in California saw a wave of educational campaigns that further reinforced the oppositional nature of mathematics education by polarizing the public discourse into debates between a teacher-centered pedagogy versus a student-centered pedagogy, as well as a focus on procedural fluency versus conceptual understanding (Boaler, 2002; 2008b; Schoenfeld, 2004; Wilson, 2003).

Unfortunately, much time, energy, and resource continue to be wasted on this polarized debate. In her groundbreaking longitudinal comparative analysis of two math programs characterized by their traditional and reform pedagogies, Boaler (2002, 2008a, 2008b) reminded us of the impact the teacher has on the curriculum and how his/her own

skill, proficiency, and efficacy have a greater impact on student success than whether or not a student experiences a traditional or a reform math education. For Boaler (2002), the fundamental difference between the two European schools in her study was that the traditional program emphasized the teacher as a transmitter of knowledge and the student as the receiver practicing skills with the aim of developing procedural fluency for the national exam. The reformed program emphasized the teacher and student as part of a community of learners working on open-ended problems that help students to personally develop mathematical understanding and literacy related to problems they can experience.

This distinction drawn by Boaler (2002) parallels those drawn by Freire (2004) as he described the difference between the experiences of an oppressive (traditional in nature) educational system and a liberating (reformed in nature) one. For Freire (2004), a liberating education is characterized by the use of a problem-posing pedagogy with the explicit aims of developing student political awareness, critical understanding, and social activism.

The public discourse on math education has largely ignored a group of educators who explore how teachers can use mathematics as a tool for sustaining democracy and ensuring social transformation. Their aim continues to be to create opportunities for students develop their political awareness, critical understanding and social activism while developing a *criticalmathliteracy* and a sense of agency as participants in their communities.

In the 1970's a group of German educators, inspired by the work from Adorno (2003a) and his colleagues from the Frankfurt School of Germany, began to emphasize the political dimensions of mathematics education by exploring the reflective and socially conscious practice of what later became critical mathematics education. Providing a glimpse into the complexities of their experiences, Skovsmose (1994) summarized their work as the development of the frameworks for critical competence, critical distance, and critical engagement.

Critical competence is described as a resource that is developed by active participation with a living curriculum. The competencies are the fundamental ways of being that are necessary for one to participate in a critical manner and relate to intellectual capacities, emotional states of being, and one's spiritual balance. Critical distance refers to the time and space a student needs in order to develop critical competencies as a product of active social participation with learning in the classroom. The theme of critical engagement refers to the role of a culturally relevant problem-posing pedagogical practice that cultivates direct participation with one's local community (Skovsmose, 1994).

Skovsmose (1994) describes how the second generation of critical math educators of the 1980's to 1990's produced new thinkers who ushered in the study and practices of culturally relevant pedagogy and critical mathematics. This new wave emphasized an "anti-racism, anti-sexism, and anti-imperialism" pedagogy (Skovsmose, 1994, p. 61). Some of the influential educators of this second wave of thinkers that have laid the groundwork for this research project are Marilyn Frankenstein (1983, 2008),

Frankenstein and Powell (1994) Ole Skovsmose (1994, 2005, 2007), U'biritan D'Ambrosio (1979, 1992, 1993, 1998a, 1998b, 2000), Eric 'rico' Gutstein (2003, 2007), Moses and Cobb (2001), Moses et al., (1989), and West, Davis, & Currell (2006).

Criticalmathliteracy.

Frankenstein (1983, 2008), a student of Freire, focused on the significance of statistics and what she referred to as the form of a number as it relates to the context of literature. Emphasizing reading comprehension as an aspect of math literacy, she described the need for teachers to work with students to assist them in decoding the mathematics in print, understand what numbers in context mean, and develop quantitative argument skills that increase their capacity to participate in a democracy. She referred to these skills as *criticalmathliteracy*. An example provided by Frankenstein (2008) comparing military to domestic spending showed students that the billion dollar cost for one Navy destroyer is the same as the annual home-heating assistance program for low-income families in the U.S. Another example was that if minimum wage had risen since 1990 at the same rate that executive pay increased, minimum wage would be over \$25.00 an hour, resulting in the average high school graduate worker earning over \$120,000 as opposed to the \$26,000 presently earned (Jackson, 2001).

Skovsmose (1994) defined *criticalmathliteracy* as using one's mathematical literacy, "to make explicit the actual use of mathematics hidden in social structures and routines" (p. 95). In a classroom, critical mathematical literacy implies curriculum content that allows students to see, question, and reflect on modern social structures, their impact on human well-being, the role mathematics may play in the establishment of

social inequalities, and its use in transforming these very social inequalities into experiences of social justice. Developing students' *criticalmathliteracy* as part of an experiential learning model creates space and opportunity for students to investigate issues relevant to their everyday lives while using the skills associated with school mathematics (D'Ambrosio, 2000; Frankenstein, 1983, 2008; Gutstein, 2003, 2007; Gutstein & Peterson, 2005; Moses & Cobb, 2001; Skovsmose, 1994, 2005, 2007).

The type of mathematical learning space Skovsmose (1994) described, requires the students to develop their own hypotheses about situations, and to use various mathematical reasoning strategies to explore possible outcomes, interpretations, solutions, and conclusions for real-world situations. Frankenstein and Powell (1994), building off the work of the Brazilian educational theorist and mathematics educator, Ubiratan D'Ambrosio, reminds us of the "need to learn about how cultural practices—daily practice, language, power, and ideology—constitute people's views of mathematics and their ways of thinking mathematically" (p. 1).

Ethnomathematics.

D'Ambrosio (1979, 1981, 1992, 1993, 1998a, 1998b, 2000), who was influenced by the work of Freire, coined the term "ethnomathematics" which describes the intersections of culture, communication, and mathematics, transforming our notions of math literacy and culturally conscious pedagogy (D'Ambrosio, 1979, 1981, 1992, 1993, 1998a, 1998b, 2000; Iseke-Barnes, 2000). As the reform educators of the 1980's were calling for culturally relevant pedagogy, D'Ambrosio was exploring the existence of mathematics outside the classroom and its relationship to the mathematics that is found

inside the classroom, specifically drawing attention to the historical struggles of indigenous peoples and the oppressive nature of the dominant cultures of the colonial era.

“Beside this anthropological character, Ethnomathematics has an indisputable political focus. Ethnomathematics is imbued with ethics and focused on the recuperation of the cultural dignity of human beings” (D’Ambrosio, 1998a, p. 9). A focus of Ethnomathematics was to ensure that the voices, stories, experiences, and mathematics culture of historically marginalized peoples are represented and incorporated into the mathematics curriculum with the goal of developing a globally conscious math literacy.

The work of Ethnomathematics parallels the work of reform educators like Boaler (2002, 2008a, & 2008b) who documented the negative impact on conceptual understanding of mathematics when students are instructed in a manner that focuses on receiving, filing and storing the rules and steps associated with procedural fluency. As Boaler (2002 & 2008b) and Gartman (2006) documented, this limited focus can have drastic effects on a student’s perception of mathematics and the ability to relate what they know to what they are being asked to learn.

As reform educators remind us of the need to allow students to experience multiple ways to solve problems, Ethnomathematicians remind us that we must consider the multiple expressions of mathematics, most of which occur in the everyday lives of our children and their families outside of the classroom.

The earliest forms of documented mathematics arose 3,000 years BC as early structured systems of explanation began to emerge from human activity. In 1557, the first book published that was not a religious text was about arithmetic to support the

economic growth trading provides a nation. Numeracy, geometry and religion interweave to form many of our systems of explanations related to calendars, astronomy, design, art, economics, social order, law, ceremony, and faith (Bishop, 1988; Gates, 2000; Greer & Mukhopadhyay, 2003; Moses & Cobb, 2001; NMAP, 2008; Obama, 2009; Reyna & Brainer, 2007). D'Ambrosio (2000), Frankenstein (1983, 2008), Moses and Cobb (2001), and Skovsmose (1994, 2005, 2007) suggested as civilization continues to modernize with the aid of technology, that the role of mathematics and the need for its understanding play a more active role in sustaining social equality, equity and prosperity.

For D'Ambrosio (2000), mathematics educators must take special care to avoid supporting both irresponsible creativity and docile submissiveness. Understanding the *cultural formatting power* of mathematics and recognizing its role as a civil right and a key ingredient for social transformation, Robert Moses founded the Algebra Project in the mid 1980's. The social learning theory of Lave and Wenger (1991) is being used to allow the theory of a cultural formatting power to be studied as an actual practice of the Young People's Project. The learning experiences of participation, practice and reflection are examined as they relate to what Wenger (1998) describes as the elements of a community of practice.

Gutstein's culturally relevant mathematics.

As described by D'Ambrosio, ethnomathematics is embedded with a political awareness and cultural consciousness. It is this very practice of cultivating students' political awareness and cultural consciousness that brings us to another influential educator of our time, Eric 'Rico' Gutstein (2003, 2007).

The work of Gutstein (2003, 2007) has brought specific attention to the use of culturally relevant pedagogy and project-based learning as a means to nurture math literacy and promote student agency in a manner that allows students to deconstruct the social inequalities of our communities. Documenting his work over several years with a Chicago middle school, he provided an example of using the mathematics-of-scale calculations to analyze historical maps to deconstruct the inappropriate use of scale, allowing students to explore concerns related to why older maps place the U.S. in the middle of the world, or why the U.S. was drawn to appear bigger than Africa. This provides students with opportunities to use mathematics as a means to explore issues of representation, power and expression. Gutstein (2003, 2007) illustrates how teachers can systematically incorporate project-based learning, culturally relevant pedagogy, and political awareness as part of a mathematics classroom for middle school students. Youth need to be provided with opportunities to deconstruct and reflect on our present social realities in an effort to use mathematics as a tool for social participation and transformation.

Bob Moses and the Algebra Project.

Participation is a crucial element for sustaining democracy. It is this need for social participation that brings us to the work of Moses and Cobb (2001) and the Algebra Project (Moses et al., 1989; Moses, West, & Davis, 2009). Bob Moses, a civil rights activist, worked as a Freedom Rider in 1960's in segregated Mississippi. Working together Ella Baker, Amzie Moore, and Medgar Evers, developed a literacy campaign as the center of their work for voter registration and civil rights activism.

To combat the oppression of southern white supremacy and the remnants of Jim Crow laws, the *Freedom Riders* saw reading and literacy as the fundamental keys to accessing educational, political, and economic power for poor Southern blacks.

In the 21st century and in the face of continued oppression and social inequality, Moses and Cobb (2001) have continued a literacy campaign as a means to attain educational, political and economic power with a new twist, The Algebra Project and the Young People's Project. Targeting poor, disenfranchised, minority youth, The Algebra Project and the Young People's Project are experiential learning models, designed to promote the integration of games, fun, real-world math applications, and community participation as part of the learning experiences of students. For Moses and Cobb (2001) algebra is a gatekeeper for a college education, which is a pathway to access, use, and sustain economic, political, and social power. Moses and Cobb (2001) declared math literacy is a new civil right and demanded that educators, policy makers, community members, parents, teachers, and students to treat the study and practice of mathematics with appropriate reverence. The mission of their math literacy campaign is to bring an end to the experience of students who feel that school math has nothing to do with their lives. In the wake of the industrial revolution and with the rise of the digital age, access and understanding of technology has become an indispensable entry point into the global workforce; people who do not have strong math skills in the digital age are like the sharecroppers who could not read and write in the industrial age and will be unable to fully participate in our global economy, politics, and society (Gatto, 2001, 2003).

Philosophy of Critical Mathematics

Rooted in a belief that critical educational practices “address the conflicts and crises in society” (Skovsmose, 1994, p. 22), Skovsmose (2005) proposed five guiding questions to be used as the pillars for a philosophy of critical mathematics (a) How does the process of globalization frame mathematics education? (b) What does it mean to go beyond the assumptions of modernity? (c) How should “Mathematics in action,” be interpreted? (d) What forms of suppression can be exercised through mathematics education? And (e) How could mathematics education provide empowerment?

There are no straightforward paths. Inventions, rather than implementation is the task [of teachers]... teachers, [whom] themselves [are] products of the very system they now aim to change, need opportunities to revisit and reconstruct their own understandings of mathematics. Teachers need chances to reconsider what it means to *understand* something in mathematics, and how such understanding can be fostered. (Schifter & Fosnet, 1993, p. xi)

There is an undeniable link between mathematics and a technology-based civilization, which is the entry point for educators to consider the capacity of mathematics to influence and shape culture and society. It is our obligation as educators and our responsibility as citizens to relate the practice, study and education of mathematics in an interdisciplinary manner involving philosophy, ethics, history, language, morality, culture, and projections of our future referred to as *matheracy* or *mathemacy*” (D’Ambrosio. 2000; Gates, 2000; Gatto, 2001 & 2003; Greer &

Mukhopadhyay, 2003; Moses & Cobb, 2001; Reyna & Brainer, 2007; Skovsmose, 1994, 2005, 2007).

Skovsmose (2005) talked of the structural flexibility necessary for critical math literacy to develop. As an interdisciplinary approach, students must experience math as it is in the world, in action. Rooted in the civil rights movement, Moses and Cobb (2001) further elaborated on the responsibility of mathematics educators, insisting that teachers develop critically reflexive practices that nurture and promote an ethical and moral community consciousness.

Integrating Critical Pedagogy and Socio Cultural Theory in the Teaching of Mathematics

Communities of practice.

Wenger (1998) stated:

[A] third type of interpretation of the zone of proximal development takes a “collectivist,” or “societal” perspective. [Engeström] defines the zone of proximal development as the distance between the everyday actions of individuals and the historically new form of the societal activity that can be collectively generated... (p. 174)

Wenger (1998) described modern educational institutions as “largely based on the assumption that learning is an individual process, that it has a beginning and an end, that it is the result of teaching” (p. 3). The core of Wenger’s (1998) theories regarding communities of practice center around the assumptions that humans are social beings, that “knowledge is a matter of competence with respect to valued enterprise” (p. 4), that

“knowing is [a] matter of participating [in collective experiences]...” (p. 4), and it is with these shared experiences that humans create meaning of life (Lave & Wenger, 1991; Tharp & Gallimore, 1988). Wenger’s (1998) relationship-based learning model is supported by Freire’s (1973, 2004) critique of the banking method of education, in which he warned educators of the destructive nature of the educational narrative that sets up the teacher as the active giver of knowledge and the student as the passive receiver of knowledge.

In the recent decades situated learning perspectives have challenged previously held educational beliefs and practices that attempted to separate knowing from doing, teacher from student, procedural fluency from conceptual understanding, practice from wisdom, and participation from agency (Brown, Collins, & Dugid, 1989; Lave & Wenger, 1991; Lobato, 2008; NMAP, 2008; Roschelle et al., 2008; Tharp & Gallimore, 1988; Wenger 1998).

With a more inclusive focus on the community experience along with concerns for the knowledge being learned, a situated social practice of learning theory provides this research with an opportunity to focus on how teachers use mathematics and creative expression to create an atmosphere of authentic learning, beyond the abstraction of standardized test proficiency. Under such societal interpretations of the concept of the zone of proximal development researchers have tended to concentrate on the processes of social transformation (Lave & Wenger 1991, p. 49).

As Brown et al. (1989) explained it, “people who use tools actively rather than just acquire them, by contrast, build an increasingly rich implicit understanding of the

world in which they use the tools and of the tools themselves” (p. 33). In their critique of traditional schooling Brown et al. (1989) drew distinctions between authentic activity and school activity.

In basic terms authentic practices are the ordinary practices of any given culture, while school activity “too often tends to be [a] hybrid of [activity], implicitly framed by one culture, but explicitly attributed to another” (Brown et al., 1989, p. 34). He illustrated this point by describing how classroom math word problems “are generally encoded in a syntax and diction that is common only to other math problems. Thus the word problems of a textbook of the year 1478 are instantly recognizable” (p. 34). Brown continued to clarify this distinction by highlighting the reality that traditional textbook word problems “are as foreign to authentic math practice as Miller and Gildea’s example of dictionary (what is this?) learning is to the practices of readers and writers” (Brown et al., 1989, p. 34).

For Wenger (1998) learning experiences are a constellation of events comprised of the four components of meaning, practice, community, and identity. Meaning is defined by learning as experience and refers to “a way of talking about our (changing) ability – individually and collectively...” (Wenger, 1998, p. 5). Practice is defined by learning as doing and refers to “a way of talking about the shared historical and social resources, frameworks, and perspectives...” (Wenger, 1998, p. 5). Community is defined by learning as belonging and refers to “a way of talking about the social configurations in which our enterprises are defined...” (Wenger, 1998, p. 5).

Identity is defined by learning as becoming and refers to “a way of talking about how learning changes who we are and creates personal histories of becoming...”

(Wenger, 1998, p. 5).

Knowing as active participation.

For Lave and Wenger (1991) and “in contrast with learning as internalization, learning as increasing participation in communities of practice concerns the whole person acting in the world” (p. 49). The theory of learning as active participation “emphasizes the relational interdependency of agent and world” (Lave & Wenger, 1991, p. 50) focusing attention on the intrinsic nature of negotiation as part of developing and sustaining social order. Therefore it is essential for schools, the social spaces where learning is to occur, to create opportunities for students to develop their ability to negotiate experiences (Freire, 1970, 1973, 2004; Lave & Wenger, 1991; Wenger, 1998).

Understanding the historical, socio-political relationships related to mathematics education (Anyon, 1980, 2005; Bowles & Gintis, 1976; Bourdieu, 1977; Freire, 1970, 1973, 2004; Giroux, 1983, 1988; Giroux & Simon, 1988; McLaren, 1989, 1999; Moses & Cobb, 2001) enabled this research to use Wenger’s (1998) description of participation, as a means for understanding the points of invitation and negotiation necessary for students from traditionally underserved and marginalized communities to become active participants in the learning process. For Wenger (1998) relationships within communities of practice are negotiated through experiences of participation (what we do) and non-participation (what we choose not to do).

Negotiation occurs as a meeting of the worlds of the outsiders (newcomers) to a community and the insiders (long-standing members). Wenger (1998) continued to elaborate on this relationship of participation and non-participation by outlining six sources from which we are able to define learning identities.

These sources relate to; (a) one's ability to locate one's self in a social context, (b) are framed by what one care's about and what one neglects, (c) are influenced by what one attempts to understand and what one chooses to ignore, (d) are enabled by the individuals one seeks partnership with and whom one avoids, (e) is exemplified by how one engages and directs their energies, and (f) is evidenced by how one chooses to navigate one's social trajectories.

Working within Freire's (2004) description of learning as the experience of agency, provided this research with an opportunity to apply Wenger's (1998) "learning architecture" (p. 270) to the development of Math Literacy Workers. Within a framework of engagement, imagination, and alignment, Wenger (1998) outlined the needs for identity development as the creation of opportunities for student engagement, the material and experiences necessary to support the building of a personal and communal image, and the ability for their experiences to impact and change one's environment.

Reflection as an opportunity for meaning making.

Wenger (1998) described the duality of meaning as being comprised of elements of participation and elements of reification. Participation refers to both the actions and the connections that are experienced while one takes part in social enterprise.

“Participation is an active process” (Wenger, 1998, p. 56) involving the “doing, talking, thinking, feeling and belonging” (Wenger, 1998, p. 56) of the whole person. Reification occurs as a continuous and interwoven experience with participation and refers to the moments one is able to give form to their participation. Wenger (1998) describes reification as,

Writing down a law, creating a procedure, or producing a tool is a similar process. A certain understanding is given form. This form then becomes a focus for the negotiation of meaning, as people use the law to argue a point, use the procedure to know what to do, or use the tool to perform an action. (p. 59)

Critical pedagogy: Education as a practice of social justice.

The call for social justice is perhaps one of the oldest and most central tenants for critical practitioners (Adorno, 2003a, 2003b; Anyon, 1980, 2005; Apple, 2000; D’Ambrosio, 1998b, 2000; Gale & Densmore, 2000; Frankenstein, 1983, 2008; Freire, 1970, 1973, 2004; Giroux, 1983, 1988; Giroux & Simon 1988; Gutstein, 2003, 2007; Gutstein & Peter, 2005; McLaren, 1989, 1999; Moses & Cobb, 2001; Tharp & Gallimore, 1988; Wenger, 1998). As a fundamental element of civil rights, democracy, and peace, the role for social justice in education is exemplified by the work of Leo Tolstoy (2000) who in 1859 opened a free school on his property so that peasant children and their families could learn; Francisco Ferrer (as cited in Avrich, 1980) who in 1901 founded La Escuela de Moderna (The Modern School) in response to what he viewed as the destructive nature of an industrial revolution education on the working class and poor social identities; by the work of Freire (1970, 1973, 2004) who developed a liberatory

pedagogy for critical consciousness for marginalized people, by the work of Myles Horton (1998; Horton & Freire, 1990) who developed the freedom school movement for democratic education, and by the work of Moses and Cobb (2001) who in developing the Algebra Project highlighted the role of mathematical learning as a civil right, and the math classroom as a tool for community empowerment and social transformation.

The notion of the whole person is the focal point for Freire's (1974) design of a liberatory pedagogy aimed at supporting a student's ability to read (understand) the word and read (create) the world. Freire (1970, 1973, & 2004) and many that follow (Anyon, 1980, 2005; Apple, 2000; D'Ambrosio, 1998b, 2000; Frankenstein, 1983, 2008; Giroux, 1983, 1988; Giroux & Simon, 1988; Gutstein, 2003, 2007; Gutstein & Peterson, 2005; McLaren, 1989, 1999; Moses & Cobb, 2001; Skovsmose, 1994, 2005, 2007) focused on social justice concerns related to co-creating authentic opportunities for social participation for all groups that are marginalized by any social order. The intention of critical pedagogy is not for an emancipatory education to be created for the oppressed class but rather for an education to be created with the oppressed and marginalized class regardless of their social status, racial identity, disability, sexual orientation, primary language, and educational achievement. "The ultimate goal of critical literacy is to help students become empowered to analyze their position in society and, if they choose, to create a more just social system" (Noonan, 2006, p. 12).

Learning as the formation of social identity.

Freire (2004) stated:

The pedagogy of the oppressed, which is the pedagogy of people engaged in the fight for their own liberation, has its roots here. And those who recognize, or begin to recognize, themselves as oppressed must be among the developers of this pedagogy. (p. 54)

For Freire (2004) participants in a pedagogy for the oppressed experience two distinct stages. The stages are the experience of an identity in which the oppressed individual exposes the world of oppression and through reflexive action commits to its transformation. This process of developing critical understanding as part of a “Humanist and libertarian pedagogy” (Freire, 2004, p. 54) begins with revealing the world of injustice and oppression and through active reflection the learner “commits themselves to its transformation” (p. 54). Once a commitment is made and reflective action is taken “this pedagogy ceases to belong to the oppressed [thus becoming] a pedagogy of all people in the process of permanent liberation” (p. 54). A focus for the first stage of developing a critical consciousness must deal with the dualistic nature of the consciousness and violent reality of the relationship between the oppressed and oppressor. “As the oppressed fighting to be human, take away the oppressors’ power to dominate and suppress, they restore to the oppressors the humanity they had lost in the exercise of oppression” (Freire, 2004, p. 56).

Teaching as a tradition for nurturing agency.

Defining agency as the actual experience of learning is rooted in the critical pedagogy of Freire (1974), the holistic education of Horton anchored in the Freedom School's movement and the situated social practice of learning theories (Bond, 1966; Brown et al., 1989; Gutstein, 2003 & 2007; Gutstein & Peterson, 2005; Lave & Wenger, 1991; Manke, 1999; Nelson, 1997; Trueba, 1999; Wenger, 1998; Woodson, 1990).

Gutstein (2007) describes Freire's problem-posing pedagogy as the means by which teachers can create authentic opportunities for students to acquire a critical literacy as they develop their ability to read the word and the world. Gutstein (2007) suggests, "That one starting point for developing agency is to teach students how to use analytical tools—like mathematics—to learn about social realities so that they can begin to understand the contradictions in what they have learned" (p. 437). From a critical perspective the experience of agency occurs as one engages with a curriculum that is designed to provide opportunities for students to authentically act in the world by nurturing political awareness, understanding and social activism.

Freire (2004) proposed the use of a problem-posing pedagogy as the means by which educators could create opportunities for students to *authentically* engage with the learning experiences, so that "students would become *subjects* in the world—people who see themselves as historical actors, capable of remaking society" (Gutstein, 2007, p. 422).

Knowing one cannot reveal the world to another, Freire (1970, 2004) saw it as the responsibility of the teacher to create learning opportunities that would allow the students to reveal the world to themselves as they participated in the classroom activities.

Gutstein (2007) documented his experiences with a middle school math class and his efforts to create a project-based learning environment that provided his students with opportunities to reflect on what he referred to as the “politics of knowledge” (p. 437).

In December of 1997 Gutstein provided his students with some of their first exposure to real-world math projects. Keeping the content as localized and relevant as possible, the project focused on collecting, analyzing and interpreting data generated from observations of the school neighborhood.

Gutstein (2007) asked his students to use their numeracy and critical literacy skills to consider the real problem of gentrification and how with its close proximity to downtown, developers were requesting city permission to rezone and redevelop local properties, which would force many of the low-income families to move away. Posing a problem from their local community created an opportunity for students to use mathematics related to reading maps, measuring, working with scale, planning trips, converting values, working with basic arithmetic, calculating percentages and statistical measures, in a manner that allowed students to “understand many complicated issues: whether development would benefit or harm the community, how many jobs would be created, what would and would not be affordable, and what were the trade-offs” (Gutstein, 2007, p. 430). Beyond developing the above knowledge enabling the students to read the word, Gutstein, brought his students to meetings at city hall to meet with local politicians and business owners in an effort for them to read (interpret) the world as they use their newly acquired classroom knowledge to directly participate in the democratic process.

Participation as an experience of critical consciousness.

Referring to it as *conscientização*, Freire (1974) described critical consciousness as an integration of social activism and political awareness that supports students' reading of the word and the world. He claims *conscientização* as the purpose of a liberatory education, emphasizing, "the more accurately men and women grasp true causality, the more critical their understanding of reality will be" (p. 82). He identified three stages of consciousness as intransitive, semi-transitive, and critical. These stages exist as a spectrum of consciousness that ranges from intransitive consciousness, which ignores human agency to critical consciousness, which highlights change and transformation by developing awareness of the connections between personal and local problems and their social and global context (Freire, 1970, 2004). He asserted that dialogue must be present for critical consciousness to develop, dialogue framed around a problem-posing pedagogy supporting learning as an understanding of the individual's location and relationship within one's communities.

Designing a Pedagogy for Critical Mathematics

Rooted in Adorno's (2003a) fear of another Auschwitz, and Freire's (1973 & 2004) critique of what he referred to as the banking system of education, Skovsmose (2005) warned educators of the assumption of modernity by reminding us that, "progress is also accompanied by horror" (p. 8). It is with this cue that this research is framed with a critical perspective in looking for ways the Young People's Project nurtures, supports and cultivates participant reflexive knowing (Skovsmose, 2005). D'Ambrosio (2000), Pink (2005), Moses and Cobb (2001), Skovsmose (1994, 2005 & 2007) agree with

Nordlung (2006) who stated "...Our future belongs to creators, empathizers, and big-picture meaning makers who can mediate in and through what [Pink, 2005] termed *The Conceptual Age*; where abilities to construct new knowledge and integrate concepts across disciplines becomes necessary" (p. 4).

A review of the literature supports a pedagogy that views math class as a place to develop competencies related to critical literacy, technology, and reflexive knowing. Suggesting a transformation of learning as a critical act will ensure that all students are able to participate in the new age as full citizens who are prepared to face the many challenges, obstacles and wonders of tomorrows history with an imaginative spirit, ethical heart and critical mind (D'Ambrosio, 1979, 1998b, 2000; Dewey, 1915, 1961; Frankenstein, 1983, 2008; Freire, 2004; Gutstein, 2003, 2007; Gutstein & Peterson 2005; Moses & Cobb, 2001; Nordlund, 2006; Pink, 2005; Roschelle et al., 2008; Skovsmose, 1994, 1995, 2007; Vithal, 2000).

The meaning of problem-posing pedagogy math education.

In mathematics, "problem-posing refers to both the creation of questions in a mathematical context and to the reformation, for solution, of ill-structured existing problems" (Pirie, 2002, p. 929). The practice of presenting and co-creating open ended problems for and with students establishes a learning environment that requires students to develop mastery and demonstrate proficiency with procedural fluency and conceptual understanding. For Freire (1970, 1973, & 2004) a problem-posing pedagogy is an educational practice that allows teachers and students to co-create open-ended situations for mathematical learning in which students must hypothesis, observe, reflect, dialogue,

imagine, analyze, synthesize, and test as they construct their response to the established and identified social problem. For Freire (1970, 1973, & 2004) the intent of problem posing is for the teacher to provide students with an opportunity to explore societal problems related to social inequalities, injustice and oppression in a manner that allows students to apply the subject matter competencies from the classroom to real world dilemmas; thus, engaging students as critical citizens and makers of our future history.

A problem-posing pedagogy is necessary to balance the stifling of standardized learning, which Freire (1970, 1973, & 2004) referred to as the banking system of education. Students (receivers) are the empty repositories while teachers (givers) place the appropriate information in the students' minds, depositing only what has been preapproved and sanctioned by the present power structure. For Freire (1970, 1973, & 2004) an education that only provides students with already answered problems, situations in which students only options is to not be inventive but to simply master what has already been done before, is an education that destroys the spirit, inhibits will and deadens possibility. When students are continuously presented with already answered problems, whose answer they must simply match, school becomes a game of seeking external approval rather than developing an internal imagination and confidence.

“Problem-posing education, responding to the essence of consciousness... embodies communication. Liberating education consists in acts of cognition, not transferal of information” (Freire, 2004, p. 29). A problem-posing pedagogy is a practice that allows for the mythical walls separating teacher and student to be dismantled as teacher and

students “become jointly responsible for a process in which all grow” (Freire, 2004, p. 29).

The responsibility of educators of mathematics is multi-fold. Along with Freire’s (1970, 1973, & 2004) call to work as community organizers and social liberators promoting student engagement in the community, there lies the responsibility to ensure that all students are academically prepared for the rigor and challenges of a college education and civic participation.

Mathematical literacy.

D’Ambrosio (2000), Frankenstein (1983, 2008), and Skovsmose (1994, 2005 & 2007) define literacy and the understanding of mathematics in the new age as inclusive of reading media print, applications of numeracy skills, statistical analysis, interpreting graphical representations, translations between form (percent, fractions, decimals) of numbers to analyze text base usage, and the application of moral mathematics and ethical problem-solving. “Knowing the most effective form in which to present those quantities in arguing for creating a just world, is an important skill to teach in a *criticalmathliteracy* curriculum” (Frankenstein, 2008, p. 2).

Technology in the age of technoracy.

The new age is an age of technology whose entry point exists for anyone who possesses the skills of Algebra (Moses & Cobb, 2001). D’Ambrosio (2000), referred to it as *technoracy* and described it as a responsibility of educators to ensure that students and their families are familiar with technology from an early age. D’Ambrosio (2000) expressed that it is of essential importance that math educators infuse moral and ethical

reasoning situations regarding the applications of technology to combat what Skovsmose (2005) referred to as going beyond the assumptions of modernity. “Scientific progress does not simply bring about ‘wonders’. Progress is also accompanied by ‘horrors,’ implying that the very meaning of ‘progress’ becomes obscure” (Skovsmose, 2005, p. 8).

Matheracy and mathemacy: Reflective knowing.

Referred to as *Matheracy* by D’Ambrosio (2000) and *Mathemacy* by Skovsmose (2005), reflexive knowing “is the main intellectual instrument for the critical view of the world” (D’Ambrosio, 2000, p. 150). D’Ambrosio (2000) refers to *Matheracy* as an educator’s responsibility to ensure students use a mathematical framework as a tool to deal with social issues. Skovsmose (1994) outlines six entry points for reflexive knowing to be used as guides as students interact, dialogue, and reflect on their experiences with mathematics. Two entry points relate to reflections on the mathematical procedures being used and are questions addressing mathematical aspects of the problems solving process such as: (a) have we done the calculations correctly and (b) how do we know we chose the right calculations? Beyond reflections on the procedures, Skovsmose (1994) identified three entry points that relate to reflections on the actual situation. Examples of these entry points are questions like (a) how may we know our answer is or is not a valid and reliable solution, (b) how may we have answered the problem without using mathematics, and (c) what may be socio-political relationships and social justice concerns of the situation? The final entry point identified by Skovsmose (1994) relates to the development of meta-cognitive thinking and is a question such as: What are possible ways our reflections have influenced our knowing?

Historical Context of the Algebra Project

Background of the Algebra Project.

The Algebra Project Research and Evaluation (West, 2007) report highlighted the project's history. The initial seven cohorts of 112 middle school participants (1991-1997) from Cambridge, Massachusetts enrolled in high school geometry at almost double the rate of their non-participating peers, with more than 60% going on to pass 11th grade trigonometry in preparation for advanced placement calculus (West, 2007, unpublished). In 1992, largely spurred by the organizing efforts of the Algebra Project, the public school district of Cambridge, Massachusetts mandated that all eighth grade students be offered Algebra I. In 1993, a San Francisco middle school adopted the Algebra Project generating similar results with project participants being twice as likely to pass their high school math classes (West, 2007).

In 1994, with efforts focused on Weldon, North Carolina, one of the state's lowest performing districts, the Algebra Project took root and began to organize a community movement for math literacy and academic achievement (Moses & Cobb, 2001; West, 2007). Spurred on by a growth "from 48% proficient in 1998 to 74% proficient in 1999" (West, 2007, p. 3) and a flurry of student and parent advocacy, a new middle school and community center were constructed (West, 2007, p. 3). In the fall of 2003, 15 of the original 22 students from Weldon were located. Twelve were enrolled in college, many had won scholarships, two were in the armed services, and one had no current plans. One of them is in graduate school and serving on the Algebra Project board. While working with fifth graders from St. Helena Elementary school in South Carolina, who typically

scored 20 percentile points below the state average, in five years (1999-2004) the Algebra Project was able to help the students improve to 25 percentile points above the state average (West, 2007, unpublished).

Community organizing with Ella Baker.

Crawford, Rouse, and Woods, (1993) stated, “strong people don’t need strong leaders” (p. 51), and described Baker’s activism as helping to sustain the efforts of the 1960’s civil rights movement. Guided by principles of direct action, grassroots leadership and the minimization of hierarchical social structures, Baker worked with civil rights leaders such as W.E.B. DuBois, Thurgood Marshall, A. Philip Randolph, and Martin Luther King Jr. During her work with these leaders opportunities arose to mentor younger civil rights activists such as Diane Nash, Stokely Carmichael, and Bob Moses.

As a grassroots community organizer focused on personal relationships as the foundation for social reform, Baker (as cited in Crawford et al., 1993) helped to sustain the need for building alliances and partnerships as a fundamental aspect of the social and political elements of the civil rights movements. “[H]er concept of leadership, that it should emerge from the community and be helped in its growth by grassroots organizing,” (Moses & Cobb, 2001, p. 34) was a central tenant for the civil rights movement and is a key aspect of what is now today know as the Algebra Project. With an understanding in the 1960’s that the relationships between the young and the old were essential to the sustainability of the *Freedom Riders* movement in Mississippi, so too have the cultivation of personal relationships and the building of community alliances

become critical elements of the formation and sustainability of the Algebra Project and the Young People's Project.

With a focus on local community and family leadership the Algebra Project works on a grassroots level to build alliances with elementary, middle, and high school teachers; administrators, parents, and students; college professors and college students; community organizers and community businesses and community leadership; political activists, policy makers, and educational researchers, as a means to build social networks that support youth in their ability and right to develop mathematical literacy, cultivate social participation, and experience political freedom (Moses & Cobb, 2001; Moses et al., 1989; Payne, 1995).

Libratory education with Myles Horton.

Over time a literacy campaign emerged as a central focus for the 1960's *Freedom Riders* movement. It was during his time as a literacy campaigner with the *Freedom Riders* that Moses worked with the Freedom Schools of the Student Nonviolent Coordinating Committee (SNCC). The Freedom Schools of the Student Nonviolent Coordinating Committee (SNCC) grew from the Citizenship Schools model developed by Bernice Robinson, Myles Horton (Highlander School) and Septima Clark on John Island of South Carolina (Horton, 1998; Horton & Freire, 1990; Manke, 1999). Hailed as the most successful adult literacy program in the nation, the Citizenship Schools model was designed with the intentions of nurturing adult literacy and cultivating local community leadership. The model demonstrated a means to create opportunities for poor disenfranchised Southern blacks to access political power through voter registration. The

Citizenship Schools of the 1960's had only one graduation requirement, which was voter registration.

As reading literacy was necessary in the 1960's for access to educational, political, and economic power, Moses argued that in today's world, reading and numeracy literacy are the fundamental means by which individuals and communities will be able to access and wield educational, political, and economic power (Horton & Freire, 1990; Moses & Cobb, 2001).

For Horton, "it was a school to help people learn to analyze and give people values, and they [then] became the organizers... It wasn't technical. We didn't tell people how to do things. [W]e wanted them to be educators as well as organizers" (Horton & Freire, 1990, p. 123). The Citizenship Schools were based on a radical shift, which reoriented the dynamics of conventional classroom relationships. For Horton, the conventional authoritarian learning model by which the teacher is seen as the possessor of knowledge and the students the receivers was understood as an educational practice that worked to sustain present social norms and realities, which in the twentieth century were riddled with social injustice and inequalities (Horton & Freire, 1990). "[It] has to be done with the purpose of having democratic decision making, having people participate in the action," (Horton & Freire, 1990, p. 124) where the teacher learns *with* the students.

As an organizing campaign, the Algebra Project has the expressed aim of ensuring that all citizens develop math literacy so that human beings may all live to their fullest potential. As an educational model, the Algebra Project emphasizes the desire to

nurture and cultivate in participants “ways [to] analyze, perform and relate to people” (Horton & Freire, 1990, p. 116) and experiences as part of a permanent process of human existence and democratic citizenry.

Mathematical literacy with Willard Van Orman Quine.

As a philosophy of Mathematics student at Harvard University Moses’ understanding of mathematics and the learning of mathematics was greatly influenced by the work of one of his professors, Willard Van Orman Quine (Quine, 1960 & 1986). Noted as one of the premier mathematics philosophers of his time, Quine impressed upon Moses the notion of “regimented discourse” (Moses & Cobb, 2001, p. 97). Quine argued that historically, mathematics developed as individuals began to formalize and structure natural language, allowing for the creation of the conceptual language of mathematics that is in use today. It is not a natural language, meaning, “no one speaks it, but it is the language that undergrids the symbolic representations” (Moses & Cobb, 2001, p. 97) of mathematical discourse. For Moses, the curriculum of the Algebra Project focused specifically on building pathways for students so that they may acquire, learn, understand and use the non-natural regimented discourse of mathematical thinking, analysis and representations as it relates and connects to their every day personal experiences.

With an approach to mathematical learning emphasizing language acquisition and development, the Algebra Project provides an educational model that builds students’ understanding and use of this regimented discourse of mathematics as a process that begins with students experiencing a physical event. After the experience of an event the students must then be given time, using their present understanding to draw pictures and

or models of the event. Once students have been able to draw connections between their present understanding and their personal experiences of the event, Moses and Cobb (2001) explained, it is then important to provide opportunities for students to tell stories, incorporating and highlighting their present literacy of the event. Once the students' present literacy is drawn out from within them, it then becomes possible for the teacher to build what Moses and Cobb (2001) refer to as "featured language (math language) of the event" (Nelson, 1997, p. 36). The building of "featured language" allows for the fifth and final stage of the learning model in which opportunities arise for students to attach, through guided instruction with a knowledgeable other, the symbolic representations of the event to their newly acquired featured language that is drawn from their personal experiences, pictures, models, and storytelling.

Theoretical Framework for the Algebra Project

Rooted in the Mississippi organizing tradition of Ella Baker (*Freedom Riders*) and the libratory educational practices of Myles Horton (Highlander School) the Algebra Project has been developed with the underlying principles of:

The centrality of families to the work of organizing; the empowerment of grassroots people and their recruitment for leadership; and the principles of "casting down your bucket where you are," or organizing in the context in which one lives and works, and working the issues found in that context. (Moses et al., 1989, p. 425)

Centrality of families.

The Algebra Project is designed to build consensus between three constituencies, one of which is parents, in a manner that nurtures and cultivates student academic achievement and educational participation. In light of the reality that many children who are growing up in poor and disenfranchised communities have parents or caregivers who themselves do not possess high levels of mathematical proficiency, “teaching algebra to parents empowers them not only to grasp mathematical concepts that may have been unfamiliar to them and reduce any associated mathematics anxiety but it also equips them to be active partners in their children’s mathematics education” (Silva et al., 1990, p. 390). With efforts focused on parent involvement and parent education the Algebra Project hopes to ensure parents are able to “advocate for change” (Silva et al., 1990, p. 390) so that they can guarantee their children are provided with access and opportunities to experience the educational content that will ensure full participation in society.

Shortly after the federal law, The Family Educational Rights and Privacy Act (FERPA) was enacted, it “was amended to give parents and guardians the right to inspect instructional materials and request exemptions from material they found objectionable for their children” (Kemerer, Sanson, Kemerer, 2005, p. 386). The convergence of attention on parent education by the Algebra Project and the amendment to FERPA created an opportunity for sustained participatory democracy by ensuring parents have the right to advocate and demand educational opportunities for their children as well as the necessary knowledge to know for what to advocate.

Grassroots leadership.

Along with parents, the other two constituencies the Algebra Project is designed to support are teachers and community members. Modeled after the organizing and educational tradition of Myles Horton the status of teacher is elevated to educator and community organizer. The on-going professional development training model developed by the Algebra Project, in collaboration with the Efficacy Institute, is designed to provide its teachers with a means to cultivate critical analysis of learning experiences so that the teacher, in collaboration with others, can explore, create, implement and reflect on instructional lessons that are best suited for their specific learning environments. Understanding that all learning environments pose unique circumstances and challenges, the Algebra Project does not provide a scripted curriculum for its teachers, but rather cultivates their understanding of the fundamental aspects of supporting students in their ability to acquire the regimented language of mathematics in an experiential learning model. This approach in many ways contrasts with some of the recent efforts in the standards movement which has resulted in the creation of numerous scripted curriculum resources that tell teachers what to say, how to say it, when to say it and what and when to expect students to say what they are going to say.

The third constituency targeted by the Algebra Project is the community, and this group is comprised of college students, professors, mathematicians, local business owners, community organizers, community agencies, political activists, philanthropists, and educational researchers. This broader collective is a necessary component to ensure alignment with educational practices and community needs. With attention focused on

community involvement, students of the Algebra Project are guaranteed access to educational opportunities connected to the local community by creating pathways for direct community participation and involvement as an integral component of learning experiences. Creating such pathways provides disenfranchised students with authentic educational opportunities that nurture their identity as community participants, cultivating their sense of citizenship and social belonging.

Working localized issues in a global context.

The Algebra Project is rooted in the belief that one must learn to “cast down your bucket where you are” (Moses et al., 1989). As a grassroots movement, the Algebra Project is designed to support the development of local leadership and local community action that supports national and international efforts for mathematical literacy, social justice, equality and equity. This principle is emphasized by the very formation and creation of the Algebra Project. The project itself was born from the efforts of Robert and Janet Moses’ attempts to teach their eldest daughter mathematics. With the difficulties, struggles, and typical youth resistance inherent in attempting to teach their daughter advanced mathematics, which reflected larger issues of mathematics education and course offerings at the middle school level, it made sense for Moses to enter her eighth grade classroom in an effort to ensure she would be on a path for college level mathematics (Moses et al., 1989). In 1982 Moses began teaching algebra to his daughter and several of her eighth grade classmates. It was in this very humble and simple beginning with concern for his own children that Moses found the impetus, need, and desire to create what is now know as the Algebra Project.

Efficacy and Reflexive Teaching

In response to the National Mathematics Advisory Panel's (2008) recommendation for a complete overhaul of America's math education system, it is crucial to cultivate and nurture within teachers, their own sense of self and a belief that they will be able to be a part of and support for this movement towards educational transformation and social equality (D'Ambrosio, 2000; Freire, 1973; Horton & Freire, 1990; Moses & Cobb, 2001; Nelson, 1997; Skovsmose, 1994, 2005, 2007). Teachers must be provided with an education that fosters craftsmanship and expands capacity so that students learn how to think, not memorize, how to problem solve; not pick the correct answer, but to think critically rather than be obedient, and most of all to learn using the styles that best suit individual learners (Nelson, 1997).

In a collaborative effort between the *Efficacy Institute* and Moses, the Algebra Project "adopted a position of [learning as] mutual inquiry" between teacher and student (Silva et al., 1990, p. 428). Aimed at providing an alternative to the more traditional model of learning that dominates educational philosophy and practices, an efficacy model of learning "assumes" all children "endowed to master the fundamentals of language" are "fully capable of learning mathematics" (Silva et al., 1990, p. 437). For Moses and the Algebra Project it becomes essential for teachers to demonstrate, by modeling for their students, the learning practice of working with "commitment, focused attention and [using] reliable strategies" (Silva et al., 1990, p. 437). The efficacy model perceives learning as related to "effective effort" and approaches struggling learners with a desire

to “seek factors inhibiting” effort, as opposed to identifying “disabilities that disallow learning” (Silva et al., 1990, p. 437).

Teacher preparation.

It is a mission of the Algebra Project to ensure that teachers develop their craft so that all students experience the “freedom to learn” (Moses & Cobb, 2001, p. 127). It was with this mission in mind that Moses partnered up with the *Efficacy Institute* to develop a teacher professional development program that “encourages [teachers] to develop habits of concentration, patience, and perseverance in approaching their daily math work” as a teacher learns to shift from being a “lecturer” to a “coach” for his or her students (Moses et al., 1989, p. 431). Moses designed the *Transition Curriculum* as an experiential learning model that “acknowledges the social construction of mathematics” (Silva et al., 1990, p. 383), requiring the professional development to “emphasize the curricular process [of learning] along with how to teach the mathematics” (Silva et al., 1990, p. 383).

As the Algebra Project calls for more culturally sensitive pedagogy, a recent study of the Young People’s Project (YPP) in Chicago revealed that, “clearly, the relationship between racial identity and math confidence remains a potent one... math self-doubt may be a greater worry than modest plans for math education” (Watts & Guessous, 2006, p. 21). As a key element of the efficacy model and the cultural empowerment model of the Algebra Project, teachers must become aware of the socio-political context of learning in their classrooms. Approaching students with an efficacy model for learning the professional development designed by the Algebra Project and the Efficacy Institute is

aimed at supporting all educators in reflecting on their instructional practice. Teachers' reflections need to encompass educational philosophies, personal understandings and belief systems as they relate to the cultural and social context of developing math literacy and sustained math achievement. In working with the Algebra Project an awareness is nurtured that allows for educators to see the manifestations of subtle forms of educational oppression that are modeled after generations of social inequality, exploitation, and stereotyping (Horton & Freire, 1990; Kozol, 1991, 2005; McLaren, 1989, 1999; Moses & Cobb, 2001; Moses et al., 1989; Silva et al., 1990; Watts & Guessous, 2006). Moses and Cobb (2001), and Silva et al., (1990) claimed that this heightened awareness of a student's social-learning context enables an Algebra Project teacher to recognize existing ability as the teacher helps to demystify personal learning barriers for individual students.

The Transition Curriculum

Recognition, recall and assimilation.

The Algebra Project is designed with learning objectives that require understanding as a process of a students' ability to recognize and comprehend classroom experiences. With understand, students may be able to *recall* prior learning experiences with the goal of assimilating new knowledge to novel ideas for new situations (Silva et al., 1990, p. 384). "Students participate in frequent discussions which engage them in the twin processes of creating mathematics and integrating their mathematics with the physical world" (Silva et al., 1990, p. 382).

Learning counting as a matter of which way and how many.

Intent on understanding the challenges that appear to be inherent with the learning of mathematics, Moses set out to develop a curriculum that would more readily support all students to make the conceptual leap from arithmetic to algebra, the leap from concrete thinking to abstract thinking, and from counting as a matter of how many, to include counting as a matter of which way (Moses et al., 1989; Moses & Cobb, 2001).

Moses described this conceptual leap as the need for students to be able to reorient their understanding and efforts to use numbers to include a more abstract qualitative nature, “Which way?” (represented by the number line) along with their existing concrete quantitative nature of, “How many?” (Moses et al., 1989).

Identifying a students’ ability to make this generalized shift of counting to include qualitative properties is described by Moses as an entry point for targeted instruction that cultivates literacy development with and for all students (Moses et al., 1989; Moses & Cobb 2001; Silva et al., 1990).

Experiential learning model.

The Algebra Project emphasizes the use of an experiential learning model that ensures students’ “personally constructed symbolic representations enter into a system of mathematical truths that has content and meaning” (Moses et al., 1989, p. 433), while “encouraging greater [student] self-reliance in finding answers to [localized] problems” (Moses, 1989, p. 432). Moses and Cobb (2001), Gibbs (1988) and Skovsmose (1994, 2005, 2007) spoke of mathematics as something that is in action. They emphasized the need for the study of mathematics to be treated as a living discipline, one which students

use to participate in the reading and writing of their worlds (Freire, 1970). “Collaborative and peer-assisted social learning strategies also seem to be particularly useful for students on the wrong side of the achievement gap” (Roschelle et al., 2008). This type of participation is a core component to an experiential learning model and is the means by which Horton and Freire described the practices of liberatory education (Horton & Freire, 1990).

Convinced “that what existed in schools wasn’t working, [and] that traditional schooling was inadequate for equipping our students to function in today’s society” (Moses & Cobb, 2001, p. 116), Moses developed the Algebra Project and its *Transition Curriculum*, as a means to ensure that math educators develop curriculum that enables students to acquire a literacy of mathematics through a culturally responsive and socially liberating pedagogy (Moses et al., 1989; Moses, & Cobb 2001; Silva et al., 1990). Framed by an *efficacy model of learning* the Algebra Project focuses its efforts on raising the achievement floor. Struggling in the early years of the Project Moses found himself grappling with concerns related to questions of “what students bring to their encounters with the mathematical symbols and signs contained in textbooks and purveyed by teachers in mathematical classroom” (Moses, West, & Davis, 2009, p. 6). Teachers desire to “develop a demand for math literacy in those most affected by its absence—the young people themselves... providing a quality mathematics education to those who have not been reached by existing curricula” (Moses et al., 2009, p. 4).

With twenty years of experience data is beginning to accumulate regarding the impact of the Algebra Project on mathematical literacy and overall academic

achievement. Studies of the Algebra Project in Jackson Mississippi by Davis et al., (2007) and West et al., (2006) and West (2007) were used to draw a comparative analysis. The findings indicated that middle school Algebra Project participants were twice as likely to pass a high school college preparatory math class than their peers who were in the same school district and did not experience the Algebra Project. As a professional development model, the Algebra Project in collaboration with the efficacy Institute has worked with over 700 teachers throughout the southern and eastern United States with its success measured by the fact that “31% of teachers committed more than the minimum hours recommended by NSF, and 17% participated voluntarily for 2-4 times the minimum” (Moses et al., 2009, p. 3). In the recently successful first ninth grade Algebra Project cohort from Jackson Mississippi, 56% of their students passed the state Algebra I exam on their first attempt, compared to the average of 38% for all ninth graders in the state (Moses et al., 2009). With the unfortunate reality of student migration at Lanier High School, only 41% of the original ninth grade cohort remained through graduation. However, of those 41%, 85% chose to be participants in the Algebra Project throughout their high school career (Moses et al., 2009).

The five steps of the *transition curriculum*: a physical event, modeling the event, describing the event, reducing the event to featured talk, and finally using formal mathematics symbols to describe the experience, are framed by a four-stage experiential learning model. The model is rooted in the “cyclical experiences in which people try something, then think about what they did, then make improvements, then practice their improvements” (Moses & Cobb, 2001, p. 198).

The physical event.

The Algebra Project believes in the use of a culturally relevant pedagogy. For today's classroom teacher the most accessible and universal form of culture is the shared everyday experience of the students. One of the more highly regarded examples is the use of the T metro train in Massachusetts as an opportunity to teach the early Algebra Project students about integers, displacement and counting on the number line. Learning as direct action provides students with a common experience by which the teacher can then facilitate engagement and mastery of necessary literacy, allowing students to “construct for themselves a basic evidence for mathematics” (Moses et al., 1989, p. 433; Moses & Cobb, 2001; Nelson, 1997; Silva et al., 1990; West, 2007). The use of a common physical event supports learning by functioning as a “base to which [students] can return as they assimilate [new] concepts” while operating as a bridge, linking “the physical world and the abstractions of mathematics” (Silva et al. 1990, p. 380). The remainder of the curriculum is designed for students to become conscious of mathematics as part of their lived experiences (Moses et al., 1989; Moses & Cobb, 2001; Nelson, 1997; Silva et al., 1990).

Modeling the event.

For the Algebra Project abstraction begins with students making pictorial representations or models of the physical event as a means for students to experience learning in the context of what they already know and understand (Moses et al., 1989; Moses & Cobb, 2001; Nelson, 1997; Silva et al., 1990). Along with creating universal access, the next step of the *transition curriculum* creates instructional opportunities for

incorporating the humanities into the thematic interdisciplinary instruction (Silva et al., 1990) that demonstrates “the relationships between mathematics and other forms of knowledge” (Silva et al., 1990, p. 380). In regards to the T metro trip in Boston to learn about the number line, this stage in the lesson allows students to create visual representations of the experience along the T metro. Students are allowed to represent the part of the trip that they recall.

Talking about the event.

Anchored by the event and their pictorial representations and models, students are then provided with an opportunity to share their experiences with each other. Before symbolic representations can become understood and assimilated into one’s base of knowledge, the teacher must make sure the students are able to understand the event. The “talking and/or writing about the event in their own language introduces students to the concept at a conscious level” (Silva et al., 1990, p. 381). During this time the teacher is not listening for formal language usage, but rather “the language the students uses in informal social conversations” (Silva et al., 1990, p. 381). Students are able to practice their communication skills as they participate in small groups and whole class discussions related to their experiences of the physical event. This not only provides them with an opportunity to express what they know, but it also allows students to see that others may experience the same thing differently and the importance of listening to all the members of a community (Moses & Cobb, 2001; Moses et al., 1990; Silva et al., 1990). Once students have had an opportunity to personally recreate the T metro trip with their visual

representations, the discussions in the small groups and with the whole class provide an opportunity for students to re-create their shared experiences with each other.

Regimenting the language.

The use of the physical event as a problem-posing pedagogy allows learning to “emphasize [the] *using* of mathematical language to describe and model physical events” (Silva et al., 1990, p. 381). It is during this time that the teacher may need to coach the students with guiding questions that lead them to describe particular aspects of the event that relate to the core concepts of the intended lesson (Moses & Cobb, 2001; Moses et al., 1990; Silva et al., 1990). In the example of learning about integers, displacement and the number line by an event on the T metro line, it would be the teacher’s responsibility, for example, to lead a conversation about the movie posters and advertisements students saw to conversations about the relationships of stops to each other and thinking about a start and finish point so that students can “mathematize” the experience in relation to the motion of the train as, ultimately, the experience of counting (moving) along the number line (Moses & Cobb, 2001, p. 199).

The *Transition Curriculum* provides opportunities for students to develop their own symbols for various operations, quantities and mathematical objects. In this way they come to understand that standard mathematical symbols were created by people to represent physical events just as they have done. Only then are standard notations and symbols introduced. (Silva et al., 1990, p. 381)

Formalizing the language.

Once students have been able to assimilate the event, it then becomes time to introduce the use of formal symbols as a means of describing the experience. It is during this phase of the learning model that the teacher introduces the traditional, symbolic and formalized language of mathematical discourse. This learning model creates opportunities for the students to learn mathematics as a means to express and describe things they already know and experience, as opposed to describing things they don't know. Once the students and teacher are able to work together to mathematize their shared experience along the T metro, the final stage of the lesson introduces the formal symbolic language of mathematics as another way to describe the experience with the symbols, notations, and expressions students were able to create with each other. At this point, as a result of the previous four steps students are then asked to consider the formal abstractions of mathematical thinking as a direct application to a shared cultural experience.

The Young People's Project

Engaging civic imagination.

Rooted in the "spirit of intellectual and social empowerment" of the Algebra Project, Moses' son, Omo Moses co-developed The Young People's Project (YPP) (Watts & Guessous, 2006, p. 1). Acknowledging the need for a "Youth-led effort that put young people at the center of their own development" (Watts & Guessous, 2006, p. 1) the Young People's Project builds relationships between college, high school, middle and elementary school students to develop "math institutes and workshops [while] striv[ing]

to make these events a part of civic and community life” (Watts & Guessous, 2006, p. 1). Developing partnerships with churches to sponsor family math nights, neighboring schools to organize math fairs, and relationships with local community centers to host community education events are some of the strategies and tactics used by the organizing model of the Young People’s Project. These activities provide students with opportunities to develop capacity as a “community organizer” while cultivating math literacy, “political consciousness,” and social activism (Watts & Guessous 2006, p. 1). Watts and Guessous (2006) described the goals of the Young People’s Project as the: training of college and high school students as community organizers for a math literacy campaign, growth of math literacy among elementary and middle school workshop participants, stimulating a school culture for math literacy, and encouraging Math Literacy Workers (MLW) “to develop life-long interest in math, community development and social change” (Watts & Guessous 2006, p. 1).

Limited by time and resources, Watts and Guessous (2006) abandoned their plans for a longitudinal comparative analysis on the Young People’s Projects (YPP) in Boston, Massachusetts and Jackson, Mississippi, settling on a simple cross-sectional design, which focused the analysis on the newly forming Chicago Young People’s Project site. Watts and Guessous (2006) aimed “to better understand how the political and historical elements of the Young People’s Project influence the young people who participate.” (p. 5) Beginning in November of 2004 data was collected from the summer Young People’s Project training sessions with eighth grade, high school and college Math Literacy Workers and their Young People’s Project peers. In February of 2005 additional data

was collected from the above participants in an effort to establish possible trends over a short period of time. In the summer of 2005 the final round of collection occurred with additional performance data gathered from a comparison control group of students from three different high schools within the same district as Young People's Project participants (Watts and Guessous, 2006). In the end the researchers collected and analyzed data from 196 surveys that were using a numerical Likert scale. Young People's Project participants completed 105 of the surveys and 91 were completed by non- Young People's Project participants.

Watts and Guessous (2006) organized the participants into the three groups: "novice" Young People's Project participants (1st year of participation); "veteran" Young People's Project participants (more than 1 year participation); and their control group counterparts who do not participate with the Young People's Project. "of all the variables in the study, only four significant differences existed between novices and their peer controls" (Watts and Guessous, 2006, p. 7). The lack of "consistent absolute differences" led the researchers to conclude that the "self-selection [process of participating with the Young People's Project] was not a major factor in the results" (Watts and Guessous, 2006, p. 7).

In regard to the themes of "Sociopolitical development and mathematics education" Watts and Guessous (2006) uncovered a positive relationship between sense of agency and math self-confidence, revealing a negative relationship for sense of agency and math self-doubt while being able to highlight how a "commitment to societal involvement activities were negatively related to math self-doubt... and cultural pride

reinforcement was found to be positively related to math self confidence” (p. 22).

Although the overall findings from the study in Chicago were not as expected, they provided an opening for educational researchers and math educators to acknowledge the impact of sociopolitical development as an integral component in literacy development. Watts and Guessous (2006) leave us to explore “ways that we can create greater synergy between sociopolitical development and academic achievement” (p. 22).

Empowerment as math literacy workers.

The Algebra Project is a grassroots effort “to enable students, teachers, parents, and the broader community to understand, control, and master both the academic and social context in which mathematics learning takes place” (Silva et al., 1990, p. 389). For the Algebra Project an *identity of mastery* is exemplified by the actions of the Young People’s Project in their efforts to encourage Math Literacy Workers (Moses & Cobb, 2001; Moses et al., 1989; Silva et al., 1990; Watts & Guessous, 2006).

The idea here is that feelings of competency associated with mathematical expertise—stemming from an ability that is scarce in many low-income communities of color—contributes to a sense of intellectual agency and accomplishment. (Watts & Guessous 2006, p. 3)

The instructional framework that provides the pathway to empowerment as a *Math Literacy Worker* is related to the cornerstones that students “must develop the expectation and confidence that they *can* and *will* learn algebra” (Silva et al., 1990, p. 387). The curriculum must be designed to address the conceptual gap between concrete and abstract thinking. The learning experiences must build literacy rooted in a localized and

personalized context that “acknowledges and supports the social construction of mathematical knowledge” while supporting students in “setting goals, taking risks, and assessing their own progress relative to [set] goals” (Silva et al., 1990, p. 389).

In regard to the theme of “mathematics attitudes and aspirations” the data analysis revealed “consistently disappointing” results (Watts & Guessous, 2006, p. 21).

Expecting to see Young People’s Project participants report a significantly stronger inclination towards math-oriented futures, the findings “between-group differences were mixed” (Watts & Guessous, p.21). On two of the three math indicators the Young People’s Project participants had more favorable scores than their control group, but within Young People’s Project novice and veteran differences were hard to determine. In fact, Watts and Guessous (2006) reported that one of the most striking differences between novice and veteran participants was that “Veterans said they were less likely to use math in the future than their novice counterparts” (p. 21).

A Trans-Generational Movement

Understanding human history as experience that bends towards justice, Moses et al., (1989), Moses and Cobb (2001), and Silva et al., (1990) described the Algebra Project and the Young People’s Project as part of a trans-generational movement committed to math literacy and social equality for all. Rooted in the organizing tradition of Ella Baker and the diligent efforts of the *Freedom Riders*, Moses expresses the need for Algebra Project participants to develop humility, patience, community awareness, agency, social activism, critical math literacy and perseverance as means to build a sustainable and just future (Moses et al., 1989).

Chapter Summary

Today's America continues to be filled with social injustices and economic inequalities. With a purported shrinking middle class, disparities between the rich and poor continue to grow at unabated rates (Anyon, 1980, 2005; Bowles & Gintis, 1976; Domhoff, 2006; Kozol 1991, 2005). Americans are part of a global economic, environmental, and social crisis unlike any our ancestors have experienced.

As President Obama expressed during his inauguration speech, it will take leaps of scientific imagination and social transformation to ensure we “meet the demands of a new age” (Obama, 2009). Once considered to be one of the wealthiest states with one of the finest educational programs, California has become a bankrupted government with a dysfunctional educational system (Wilson 2003). In a time when the National Mathematics Advisory Panel (2008) warns the public of a looming educational crisis and need to redesign the entire delivery system of mathematics education, a group of educators have been working outside the mainstream discourse of math education to provide us with a pathway to connect the teaching, learning and doing of mathematics as a means of building sustainable social equality and equity. The situated learning theories of Brown et al. (1989), Lave and Wenger (1991), and Wenger (1998) are used in this research to frame the experiences of teaching and learning mathematics as a cultural and social practice. Mathematics framed as a sociocultural practice enables this research to explore what Skovsmose (1994, 2005) called the cultural formatting power of mathematics. This highlights the description by Moses and Cobb (2001) of mathematics as a key leverage point for civil rights and social transformation.

In an attempt to broaden the conversation regarding the direction of mathematics education to include culturally relevant pedagogy, the work of D'Ambrosio (1979, 1981, 1992, 1993, 1998a, 1998b, & 2000) and Frankenstein and Powell (1994), around the field of ethnomathematics, provided this research with a framework for deconstructing the dominant social narrative of mathematics education. The research from Boaler (2002, 2008a, 2008b), Gutstein (2003, 2007), Frankenstein (1983, 2008), Moses and Cobb (2001), and Skovsmose (1994, 2005, 2007) has been used by this researcher to provide guidance to math educators in developing a critical practice that provides students with opportunities to read the word and their world as they become shapers of their own histories (Freire, 1973, 2004).

CHAPTER 3: METHODOLOGY

Introduction

Using a qualitative methodology this research study focused on (a) the experience of participation with the Young People’s Project; (b) the practices used to promote peer leadership, student engagement, and cultivate mathematical literacy; and (c) reflections on the impact participation has on self-identity, family involvement, community participation, and sense of leadership. As a high school math teacher I conducted this study to investigate the strategies used by the Young People’s Project in its effort to cultivate youth leadership as an integral component of a national math literacy campaign. Focusing on its use of a peer-to-peer tutoring model, the aim of this research is to inform curricular practices, illustrating ways to incorporate a community based learning model in creating a balanced learning environment. This model represents shifting from the teacher as the giver of knowledge and the student as receiver to the emerging paradigm of teacher as facilitator and student as active participant.

Guided by the National Mathematics Advisory Panel (2008) call for a redesign of the educational “delivery systems,” and the recent California SBE mandate for all eighth graders to study Algebra, California mathematics educators have an overwhelming responsibility to transform an educational system that presently is one of the most diverse, under-funded, and lowest performing mathematics educational programs in the Nation (NAEP, 2007). California ranks among the bottom seven states. With budgets decreasing and pressures increasing to meet the No Child Left Behind educational mandate this research study was designed to explore the question posed by Nasir and

Cobb (2006), “How can the research community theorize about teachers’ content knowledge in ways that reflect a view of mathematics as a social practice and a culture with aesthetic values, metacognitive strategies, and social norms?” (p. 614).

Why Qualitative Research

The research questions chosen for this inquiry demanded a qualitative study because they were designed to capture participant voices and experiences as they engaged as Math Literacy Workers. The focus of this study was to highlight and document the experience of the individual participants in their natural setting. In order to document individual experiences a naturalist inquiry was required. “Naturalistic ontology suggests that realities are wholes that cannot be understood in isolation from their contexts, nor can they be fragmented” (Lincoln & Guba, 1985, p. 39). This ontology required me, as the researcher, to take on the role of participant observer so that the evidence gathered would be reflective of the participant (emic) experiences. Without conducting this style of inquiry, the findings related to these research questions would not be reliable or valid. Placing myself as the researcher in the natural setting, and using myself as a “Primary data-gather instrument” (Lincoln & Guba, 1985, p. 39), allowed the data collected to more accurately portray the myriad of variables that occur as the multiple realities of individuals interacted with each other in what Wenger (1998) referred to as a community of practice.

Methodology of Qualitative Research

Guba and Lincoln (1994) described qualitative research as being organized into four paradigms: belief systems of positivism, postpositivism, critical theory, and

constructivism. In 2002 Hatch included poststructuralism as a fifth major paradigm of all qualitative research designs. All of these belief systems and worldviews are rooted in the common desire to create scientific research that documents authentically the voices of participants. It was with this common root that I designed a research study that was a blend of the critical and constructivist paradigms. As outlined by Guba and Lincoln (1994) this study was designed with the critical aim of critiquing present educational practices and structures so that researchers may develop a constructivist understanding of the situation with the ultimate goal of transforming mathematics education. The Algebra Project and the Young People's Project are intended to radically alter youth experiences with mathematics education. The programs are designed to cultivate a new generation of mathematically literate and socially conscious young people, who may choose to be proactive in creating their future.

Designing Critically Constructivist Research

Hatch (2002) described the constructivist research paradigm as a framework in which to explore the world with a belief that experience is comprised of multiple realities. He explained that constructivist educational researchers approach their inquiry with a desire to nurture a co-constructed understanding of knowledge and experience. In order to facilitate a more genuine and authentic account of such a process it becomes necessary for constructivist research projects to emphasize a qualitative methodological approach (Guba & Lincoln, 1994; Hatch, 2002; Patton, 1980). Hatch (2002) described the critical research paradigm as one that is rooted in a world view, "the material world is made up of historically situated structures that have a real impact on the life chances of

individuals,” Guba and Lincoln (1994) continued to elaborate by saying “these structures are, in the absence of insight, as limiting and confining as if they were real” (p. 16).

In alignment with a constructivist paradigm, this researcher “assume[s] a world in which universal, absolute realities are unknowable, and the objects of inquiry are individual perspectives or constructed realities” (Hatch, 2002, p. 15), related the view that a critical understanding is needed of a historical narrative of injustice that influences individual perspectives of socially constructed realities as they relate to mathematics education and social empowerment (Guba & Lincoln, 1994). As explained by Hatch (2002) constructivist research emphasizes qualitative analysis that “...includes enough contextual detail and sufficient representation of the voices of the participants that readers can place themselves in the shoes of the participants...” (p. 16).

Framed by Wenger’s (1998) constellation of learning, I organized a research focus on the three aspects of participation, practice and reflections. Participation referred to the initial forming of relationships regarding participants to any given learning experience. The term newcomer included newly enrolled participants to the whole community and any veteran participant working in a new situation or new capacity within the community. The interviews, observations, participant journals, field notes, document analysis and participant feedback were used to capture the experiences of participants of the Young People’s Project at Horton Charter School in the project’s efforts to create an inclusive, socially just, experientially based, rigorous, and efficacious learning environment for mathematics in the city of Los Angeles.

For this research project, practice referred to the elements Wenger (1998) defined: learning as doing, learning as belonging, and learning as becoming. Inspired by the sustainable leadership movement (Hargreaves & Fink, 2006) this research examined specific efforts made by the Young People's Project to sustain a family oriented, grassroots, localized leadership model. I assumed that the goal of any educational setting is for the student to be able to use what is learned as one navigates through the path of one's life, ideally with a social consciousness for justice, liberty, equity, and equality (Blaisdell, 2000; Gale & Densmore, 2000; Freire, 1974; hooks, 1994, 2003; Illich, 1970; Kozol, 1991, 2005; Sizer, 1984). With this in mind, I defined Wenger's (1998) description of *learning as experience* to characterize the strategies, practices, and norms utilized by the Young People's Project that supported math literacy workers to engage in a critically reflexive learning practice.

Research Questions

This study responded to the following questions:

1. How does the Young People's Project motivate students to participate in the math literacy campaign of the Algebra Project?
2. What are the teaching and learning practices of the Young People's Project that assist youth in developing *criticalmathliteracy*?
3. How does the Young People's Project cultivate young leaders and organizers as part of its Math literacy campaign?

Setting

Horton Charter School: The training site.

The location for this research study was Horton Charter School. This was the location of the training, planning and debriefing sessions. Horton Charter School is a member of the One LA/AP collective and the home of the LA Cohort of the Young People's Project Math Literacy Workers training program. Doors opened for Horton Charter School in the fall of 2005 with its first sixth and seventh grade classes for a total of 120 students. Adding one class of 60 students per year, full capacity will be reached in the fall of 2010 with 420 students. Horton Charter School is a free, independent public school for grades 6-12 with an academic program that emphasizes advanced college career preparation. With an expressed desire to develop life-long learners, Horton Charter School has developed an experientially based program with the key elements of small school learning environments, the use of interdisciplinary project-based learning, internships, and community based multi-cultural experiences.

On their 2008-2009 Accountability Progress Reporting (APR), the California Department of Education (CDE) reported Horton Charter School with a Base API of 701 and compared to schools with similar student demographics Horton ranked 9 out of 10. It was reported by the California Department of Education that Horton Charter School met all federal accountability criteria for Adequate Yearly Progress (AYP) as measured by English language arts and mathematics standardized test results, and related to participation rates and proficiency levels. Of the measured student demographic subgroups the three groups that were numerically significant for Horton Charter School

were their Hispanic or Latino (97%), socio-economically disadvantaged (94%), and English Learners (73%). The California Department of Education in 2009 reported that the base Academic Performance Index (API) rankings for the Horton Charter School subgroups were 723, 724, and 713, respectively, exceeding its target API score of 706 in comparison with similar schools with an 2009 API of 680.

Horton Charter School is designed with a traditional school year calendar of 179 instructional days with an extended block bell schedule. The academic year begins and ends with special learning sessions devoted to multi-cultural, experientially based learning projects that offer students a “rigorous academic preparation with the development of real-world skills.” There is a special mid-year session that emphasizes college readiness, college admission, and college life. The curriculum for Horton Charter School is designed around a developmental approach to education that supports students as they navigate and grow through the three stages of School Prep, College Prep, and Life Prep. School Prep is the frame for the first three years of study with Horton Charter School. It is designed to “set the culture of the school and student and parent expectations. The [Horton Charter School] habits of learning are drilled to set the foundation for the College Prep stage” (Mireles, 2005). College Prep is the frame for 9th through 11th grades when “the complete UC/CSU course requirements will be covered, but personalized to fit the academic career choice of the student” (Mireles, 2005). Twelfth grade is designed as the Life Prep stage and “is set as a guided transition to engage participation in the real-world. As a precursor to college life, the emphasis is on

demonstrating learning that is related to one's community and culminates in senior projects that "encapsulate [their] work" (Mireles, 2005).

As a member of the One LA/Algebra Project collective, Horton Charter School was interested in supporting the newly forming LA cohort of the Algebra Project. Attracted to the Young People's Project's, flagway curriculum and their youth driven effort to develop civic engagement and community literacy, Horton Charter School inquired within the collective about developing a sustained partnership with the Young People's Project. With the organic nature of the grassroots movement known as the Algebra Project, Horton Charter School's inquiry corresponded with an outreach from the Young People's Project to the One LA/Algebra Project collective. Horton Charter School developed their presence as part of the LA cohort in an effort to support the development of the Algebra Project in Los Angeles.

Roosevelt Elementary School: Site of the math literacy workshops.

Roosevelt Elementary School is an elementary school in the local neighborhood of Horton Charter School. This is the site where the Math Literacy Workers from Horton Charter School conducted a series of regularly schedule math literacy workshops. Due to lack of funding in the past and recent funding that coincided with the beginning of this study, the literacy workshops at Roosevelt Elementary School were the first experience the Math Literacy Workers from Horton Charter School had at facilitating a regularly scheduled workshop for four days a week for several months in succession.

With a student enrollment in 2008-2009 of 470 students, Roosevelt Elementary services a similar demographic to Horton Charter School, with 96% of the students being

Latino, 2% African American and 2% White or Filipino. Ninety five percent of the students are economically disadvantaged, 61% are English Learners and 16% are Special Education students. For the academic year of 2008-2009 Roosevelt Elementary achieved all of its API growth goals with an API score of 755 and is not a program improvement school. In 2008-2009, 60.2% of their students scored proficient or above on their grade level math CST, a growth from 57.3% in 2007-2008. During this same year, 61% of the Hispanic students, 60.2% of their socio-economically disadvantaged students, and 54.5% of their English Learners scored proficient or placed in advance of their grade level math on the California Standardized Test.

Due to the inconsistent nature of the Math Literacy Workshop conducted by the students from Horton Charter School at Roosevelt Elementary School, which is explained in detail in Chapter 4, the Roosevelt location did not have a specific group of elementary students that worked with the literacy workers. As stated in Chapter 4, around 30–40 different elementary age students randomly rotated through the workshops. A roster was generated after several weeks of the workshop, but it was never consistent with the students that participated. This was due largely to the logistics of creating a brand new after-school workshop at Roosevelt, after many of the students were already scheduled to participate in other events. In addition the students would stay and leave at varying times, based upon family need.

Participants and Sampling Criteria

The research site was chosen using a convenience sampling strategy. Horton Charter School was the only site of the Math Literacy Workers training program in Los

Angeles at the time of developing this study. Horton Charter School made it possible to conduct this study and therefore was the only option available. The participating youth had all previously volunteered to be Math Literacy Workers.

A former Algebra Project student and Young People's Project Math Literacy Worker from Mississippi, Beverly, the program coordinator, met with the principal from Horton Charter School in the school year 2007-2008 to establish Horton Charter School as the LA training site for Math Literacy Workers. With the guidance of Beverly there 15 participants were enlisted with the Math Literacy Workers training program. Twelve high school students, 9th through 12th grade, were supported by three college students in their Math Literacy Workers training program. Several 4-hour Saturday workshops were scheduled throughout the year. Some of these trainings, workshops and events involved additional participants from target high schools of the Algebra Project cohort in Highland Park, Crenshaw and Los Angeles.

Data Collection

For this study, the data collected from students and their families was limited to the participants of the Young People's Project at Horton Charter School. The Young People's Project has been developing in LA for the past two years and provided the researcher with an opportunity to talk with newcomer (less than 6 months) and veteran (more than 6 months) College and High School Math Literacy Workers. All participants received consent forms. Observations were conducted of the Young People's Project after-school math literacy workshop at Roosevelt Elementary School, its first regularly schedule math literacy workshop, which began at the time of this study.

The participant group of the LA cohort of the Young People’s Project at Horton Charter School is comprised of the following 16 people, as shown in the following table:

Table 1.

Math Literacy Workers at Horton Charter School

Person	Position	Grade	Participant Experience
Beverly	Program Coordinator	Adult	6 years (veteran)
Raymond	College Math Literacy Worker	College	2 years (veteran)
Paul	College Math Literacy Worker	College	8 months (veteran)
Elijah	College Math Literacy Worker	College	2 years (veteran)
Yasmin	High School Math Literacy Worker	11	2 years (veteran)
Jose	High School Math Literacy Worker	10	8 months (veteran)
Karen	High School Math Literacy Worker	11	2 years (veteran)
Deivi	High School Math Literacy Worker	12	1 year (veteran)
Jessica	High School Math Literacy Worker	9	2 months (newcomer)
Anahi	High School Math Literacy Worker	12	5 months (newcomer)
Paula	High School Math Literacy Worker	11	5 months (newcomer)
Stephaine	High School Math Literacy Worker	10	4 months (newcomer)
Samira	High School Math Literacy Worker	10	2 years (veteran)
Yessenia	High School Math Literacy Worker	10	4 months (newcomer)
Max	High School Math Literacy Worker	11	1 year (veteran)
Cynthia	High School Math Literacy Worker	10	5 months (newcomer)

Interviews.

To ensure a broad range of responses I interviewed eight participants: the program coordinator, two college students, one high school new comer (less than six months participation), and four high school veterans (more than six months participation). All interviews were conducted with a focus on the literacy workers' experiences related to their participation, practice, and reflections as Math Literacy Worker's. The initial interviews with the program coordinator and one of the High School Math Literacy Workers were followed up with a second round of questions.

All interviews were semi-formal in nature and evolved in a spontaneous manner over time to reflect updated questions related to the initial findings of the preliminary analysis. Informal conversations that occurred as part of my experience as an active participant observer, allowed me to design interview questions that highlighted the program elements of the LA cohort of the Young People's Project at Horton Charter School.

As outlined by Hatch (2002) the interviews used four types of questions, referred to as descriptive, structural, contrast, and essential. The descriptive questions allowed me to paint as clear a picture as possible of a day in the life of the Young People's Project as it formed its first cohort of Math Literacy Workers at Horton Charter School. The structural questions allowed me to explore how the Math Literacy Workers organized their experiences, allowing me to look for any cultural / social patterns related to the formation of Young People's Project at Horton Charter School. The contrast questions supported my efforts in an attempt to highlight the meaning behind the pedagogical

actions of the Math Literacy Workers and their learning and teaching experiences as they facilitated their first regularly scheduled math literacy workshop at Roosevelt Elementary School. The essential questions allowed me to strategically target core concerns related to personal experiences and accounts of participants at Horton Charter School of the LA cohort of the Young People's Project math literacy campaign.

Observations and field notes.

During the course of this study, I was able to observe planning meetings, training sessions, literacy workshops, and debriefing sessions. A series of weekly observations were conducted of the Math Literacy Workers as they facilitated their first peer-to-peer math literacy workshop at Roosevelt Elementary School. Conducted as participant observations (Hatch, 2002) the goal was "to understand the culture, setting [and] social phenomenon" (p. 72) of the Young People's Project and their efforts to train Math Literacy Workers at Horton Charter School. All observations were debriefed with participants to ensure accuracy of the descriptions, authenticity of the details, and integrity of the possible interpretations and meanings (Denzin & Lincoln, 1994).

Raw field notes were generated from observations and were "converted into research protocols through a process of 'filling in' the original notes" (Hatch, 2002, p. 77). Using a template generated as a word document, all raw field notes were "filled in" by the evening of the observation. A coding system was developed and by "bracketing certain sections" (Hatch, 2002, p. 77), I began a preliminary analysis of the data. Using a reflexive research practice the data collection process was aligned with a naturalistic

research strategy ensuring that I looked for outlier responses describing the unexpected results generated from the personal narratives of qualitative data.

Guided by the work of Emerson, Fretz, and Shaw (1995) a style of writing field notes was used that “brings to the fore the interconnections between writing, participating, and observing as a means of understanding another way of life” (p. 19). The method of jotting was used to record the continual stream of data that occurred during the observations. Jotting key words, phrases, and ideas was used as a technique to capture significant moments that I later described in more detail shortly after the observations were completed. The use of jotting enabled my presence as a participant without conflicting with my presence as a researcher. Jotting allowed me to add more detail as I reflected on individual observation experiences (Emerson et al., 1995). A mixture of open and private jotting occurred during the observations. Using a reflexive practice to prevent any participants from becoming influenced or “triggered” (Emerson et al., p. 24) by my observing and jotting notes helped me to “remain sensitive to and avoid jotting down matters which participants regard as secret, embarrassing, too revealing, or which puts them in danger” (p. 25).

Document analysis.

The document analyzed as part of this study was a recent report titled *Developing Agents of Change: The Young People’s Project* (Management Consulting Services, 2008). This report was a program description and outline of the pedagogical model used by the Young People’s Project and was used to establish the validity of the findings as they related to the intentions of the program.

The use of document analysis provided me with an unobtrusive and “stable” data set “that could be analyzed and reanalyzed without undergoing changes in the interim” (Lincoln & Guba, 1985, p. 277). Concerns related to possible “lacking in objectivity” related to the use of a static document was alleviated by the fact that the document was reviewed multiple times to establish “internal consistencies” along with findings triangulated with findings from additional sources, to ensure reliability, trustworthiness, and integrity of conclusions (Lincoln & Guba, 1985). The document analyzed provided the researcher with a “sense of history related to the context” of the Young People’s Project in Los Angeles (Hatch, 2002, p. 117).

Researcher and participant journals.

Journals were used to track personal accounts and experiences while conducting the research. The journals evidenced a reflexive practice and were used on a regular basis from the first to the last day of research. Reflexive research journals were an opportunity to “display the investigator’s mind processes, philosophical position, and basis of decisions about the inquiry” (Lincoln & Guba, 1985, p. 109). The researcher’s journal was used as a measure to record data related to the researcher to ensure integrity and reliability by keeping a steady log of “information about methodological decisions made and the reasons for making them” (Lincoln & Guba, 1985, p. 327). As outlined by Lincoln and Guba (1985), my research journal was organized into the three sections of (a) daily schedule and logistics, (b) personal diary, and (c) a methodological log.

Participant journals were kept for all of the 12 High School Math Literacy Workers. The use of participant journals was another method by which “individuals

[were able to show their] understanding [of] the social circumstances in which they operate” (Hatch, 2002, p. 140). The flexibility associated with keeping a journal allowed for the journal data to be collected in moments when the participants were most comfortable and willing to express their experiences. These free moments of expression allowed for honest reflections on their experiences and provided the high school participants with an avenue to speak not only of their experiences as Math Literacy Workers, but also of their experiences as participants in the research study. When working with participant journals the following were considered, (a) being clear with expectations, (b) providing clear directions for journal topics, (c) processing data in an ongoing manner, and (d) participants will receive credit for their work (Hatch, 2002).

Data Management

All interviews, field-notes, and participant journal entries were typed into electronic document files. As the five key findings began to emerge during the analysis, related text was highlighted to represent the finding it either supported or contradicted. Once the findings were identified as themes, the text was placed into a new document in the form of a table with five columns. Evidence supporting or contradicting the themes were grouped together for further analysis. The coding process and organization of themes and findings during the data analysis occurred as a result of processing worksheets in computer software.

Analysis of Data

Triangulation of data.

Triangulation of the data was achieved by using a collection of semi-structured interviews, workshop observations, and participant journals that were corroborated with document analysis and participant feedback. An inductive strategy was used to allow the analysis to evolve into grounded theory in “a search for general statements about relationships and underlying themes” (Marshall & Rossman, 2006, p. 152) of participant experiences.

Inductive analysis.

For this study, the analysis of the data fell within the nine procedural phases for inductive analysis as outlined by Hatch (2002): (a) Identifying frames of analysis, (b) creating domains based off semantic relationships, (c) identifying salient domains, (d) refining domains, (e) searching data for non-examples, (f) completing analysis of the domains, (g) searching for themes across domains, (h) creating a master outline, and (i) selecting evidence to support the key findings and themes organized by the outline.

This inquiry was designed to document the experiences of the Math Literacy Workers at Horton Charter School. The desire to document the experiences as they were, required an inductive analysis. Understanding the transformative process of turning data into findings as an “interpretive act remains mysterious” and the analysis is “a process of bringing meaning to raw, inexpressive data” (Marshall & Rossman, 2006, p. 157). An inductive analysis allowed for themes that could describe the phenomenon of being a Math Literacy Worker to emerge in a natural and uncontrived manner.

Positionality and Reflexivity

My identity as a participant and community member of the One LA/Algebra Project collective provided the research with an emic (insider) perspective and ensured the data collection process paid “special attention to the indigenous meanings and concerns of the people [being] studied” (Emerson et al., 1995, p. 2). The data was used to emphasize and detail the “social and interactional process” that made up the LA Cohort of the Young People’s Project at Horton Charter School with an emphasis on key factual, environmental and social indicators (Emerson et al., 1995, p. 11). The use of an open coding system created a fluid and reflexive practice for the data collection process that created an atmosphere of trustworthiness and reliability.

Negotiating access and gaining entry.

I am both a participant with the Algebra Project and a researcher of the Young People’s Project. My experience with the Algebra Project began as a community participant. Having followed the work of Moses and Cobb (2001) I jumped at the opportunity to attend a meeting and see if I could become involved when I heard through a colleague that the Algebra Project had moved to LA. I showed up for the first time in December of 2008. As I learned quickly, getting involved was a matter of my walking in the door. Immediately upon arrival I was asked to sit at the table with everyone and discuss the upcoming visit of Moses. Connections were made and events were planned and coordinated for the initial visit by Moses in January of 2009. Several, LA/AP collective meetings and community events in which I participated took place during the spring of 2009. These were designed to support the grassroots organizing effort and to

build a political base for the Algebra Project to begin at the target high schools in the fall of 2009.

During the spring of 2009 I approached the coordinator for the One LA/Algebra Project initiative by placing a phone call to propose the possibility of conducting my research on the LA cohort and community organizing effort of the Algebra Project. The call resulted in excitement on everyone's part and coincided with an upcoming LA cohort research committee meeting that would create the forum for everyone to hear the proposed research agenda. Upon meeting with the existing Algebra Project research committee and seeing the research agenda already in place, it became clearer that I should shift my focus as a researcher to specifically look into the efforts of the Young People's Project. In the summer of 2009 I made first contact with Horton Charter School and Beverly May regarding the possibility of researching the Young People's Project Math Literacy Worker's training program.

Rapport, trust, and researcher participation.

To balance my dual identities of a participant of the Algebra Project and researcher of the Young People's Project, my work as a researcher highlighted the role of the Math Literacy Workers of the Young People's Project at Horton Charter School. Their interest was in supporting the larger math literacy campaign of the Algebra Project as it settled into LA. My presence as a participant of the Algebra Project created a personal history between the research participants and myself that enabled me to quickly transition into a researcher of the Young People's Project.

Reflexive research practices.

As Hatch (2002) described the nature of qualitative data collection and analysis, he warned against the danger of not being able to separate one's ego, personal perceptions and experiences from one's observations and subsequent analysis. For this project and in the traditions of D'Ambrosio (2000), Freire (1970, 1973, & 2004), and Skovsmose (2005, 2007) I was in a constant state of reflexive practice by using a daily research journal and attending regular processing and debriefing meetings with participants.

Confidentiality, safety, and protection measures.

In accordance with the Loyola Marymount University Institutional Review Board (IRB) all safety, precautionary, and legal concerns were addressed. After I met with the program coordinator at Horton Charter School, a parent / caregiver letter was sent to all participating families to explain my presence, intention, and goals before the research project occurred. For the confidentiality and safety of the individuals and community involved pseudonyms were used for all names of participants and their schools.

All teachers and students participating in interviews and/or observations received an additional invitation as a *request for participation consent form*. Individuals were able to participate after a signed consent form was returned.

Research Procedures

Upon approval from the Loyola Marymount Institutional Review Board I met with the participants. Based upon their interests, participants were chosen using a purposeful sampling method. The participant group was made up of nine female and

three male Latino/a high school students, three African American male college students, and one African American female program coordinator.

The interviewed group consisted of eight different individuals. Two of the participants were interviewed twice for a follow up interview. They were Beverly, the program coordinator, and Deivi, one of the High School Math Literacy Workers. The first round of interviews began in mid-January 2010. To ensure a broad and diverse range of responses, I interviewed eight different individuals; five high school students, two college students and the one program coordinator. Of the five high school students, one was a newcomer (one Latina ninth grader) and four were veterans (two Latino, a 10th and 12th grader, and two Latina 11th graders). The two college student veterans were male African Americans. The program coordinator was a veteran, an African-American female.

A convenience sampling strategy was used for the selection of the two college students and the program coordinator. The five high school students were chosen using a purposeful sampling strategy to provide a representation of grade levels, newcomer and veteran perspectives, gender perspectives, and racial and ethnic perspectives that were present within the group of the 12 high school participants.

All High School Math Literacy Workers participated in writing in their journals. The journal group wrote on a bi-weekly schedule aligned with the observations. They were given writing prompts and reflection questions related to the preliminary analysis of the field notes, interviews, document analysis, and participant feedback.

Preliminary analysis began as soon as data was collected and was used in a reflexive manner to ensure authentic representations of participant experiences, as well as to make sure the collected data served to provide answers to the research questions.

Validity and Reliability

Construct validity.

Yin (2008) defines constructing validity as the researcher's ability to "identify correct operational measures for the concepts being studied" (p. 40). The three key elements defined by Yin (2008), "use of multiple sources of evidence, establishing chain of evidence, and having informants review drafts of study and report" (p. 41), are all embedded within this research project. Findings were triangulated with data collected from semi-structured interviews, participant journals, and field notes, and were corroborated by the use of document analysis and participant feedback.

Semi-structured interviews.

To ensure reliability and consistency among the interviews and to further establish a sense of validity, the questions followed the Schuman (1982) and Seidman's (1998) Three-Interview Series (as cited in Nordlund, 2006).

Phase one of the interview process consisted of establishing the context for experiences (Nordlund, 2006). During this phase I asked the questions Hatch (2002) referred to as descriptive and structural. This phase of the interview included questions such as, What was your first experience with the Young Peoples' Project? What does it mean to be a Math Literacy Worker? And, How is the after-school training organized?

As the interviews progressed, I shifted the focus to what Hatch (2002) referred to as contrast questioning, bringing the interview into what Nordlund (2006) detailed as phase two, when participants were allowed to reconstruct the realities of their experiences. Some of the questions that were asked during this phase are, What does a Math Literacy Worker do? How is learning math with the Young People's Project similar to and/or different from learning math in your regular classes? How do you use the flagway game to create different learning experiences for other students? How does being a Math Literacy Worker help you learn mathematics? What does it mean to be a community organizer? How do you help your peers learn mathematics?

Once participants were able to reconstruct their understanding during the interview process, the final and third phase happened. Participants were now encouraged to reflect on any meaning attributed to their reconstructions allowing for what Hatch (2002) referred to as the essential question to be asked. Some of the questions I asked during this phase were How have you grown as a Math Literacy Worker? What is math literacy? What has your family said about you being a Math Literacy Worker? What does your work as a Math Literacy Worker have to do with social change and civil rights, if anything? Are you able to bring what you learn as a Math Literacy Worker into your regular math class? What is the social issue YPP wishes to address, and How is your work as a Math Literacy Worker supporting this effort?

The use of the above model facilitated a flexible uniform interview process that allowed me to spontaneously respond to participant comments and accelerate the preliminary analysis of the data. This structure allowed for the creation of an interview

template that enabled me to refine the interview process by gathering data related to the social learning experiences of Young People's Participants while creating a process that could be replicated for future studies.

Observations.

All observation notes were recorded in a researchers journal and were organized to capture the way in which the Young People's Project engages members to participate in the transformation of mathematics education (Moses & Cobb, 2001; Moses et al., 1989; Silva et al., 1990). Debriefing sessions were conducted after observations to ensure accuracy of interpretation.

Sustaining reliability.

Yin (2008) explained that a researcher needs to “demonstrat[e] that the operations of a study—such as the data collection procedures—can be repeated, with the same results” (p. 40). The following measures were in place to ensure replication of research findings: research calendar, participant database, the use of participation and consent forms, research journal, and regular debriefing meetings.

Reliability in naturalistic settings.

As Denzin and Lincoln (1994) described it, an “inescapable problem of representation” exists when dealing with any type of qualitative analysis (p. 11) in natural settings. Rooted in a desire to “directly capture the lived experiences (Denzin & Lincoln, 1994, p. 11) of participants in their natural environment, the data analysis was framed by a reflexive practice that triangulated the data through the three measures of interviews, participant journals and observations. Working in alignment with the general goal of

qualitative research to “legitimate itself in terms of some set of criteria that allows author (and the reader) to make connections between the text and the world written about” (Denzin & Lincoln, 1994, p. 11), this research study was framed by a critically constructivist paradigm. A critical perspective provided me with a lens by which to analyze the Young People’s Project and to reflect upon the research, examining the degree to which YPP “provided a stimulus for action” (Denzin & Lincoln, 1994, p. 114), which could transform present educational social structures of injustice. The constructivist perspective provided me with a lens with which to analyze the Young People’s Project and to reflect upon the research, examining the degree to which it was trustworthy and authentic in regard to the integrity of the mission of YPP and my research agenda. A constructivist research model provided a theoretical lens through which to explore the credibility, transferability, dependability, fairness, educative, and catalytic authenticity of these experiences (Denzin & Lincoln, 1994; Guba & Lincoln, 1994; Lincoln & Guba, 1985).

CHAPTER 4: FINDINGS AND ANALYSIS

Restatement of the Purpose of the Study

Concerned with a history of U.S. mathematical underperformance, a persisting achievement gap and increasing social inequality and inequity, the purpose of this study was to delve into an exploration of the social factors that contribute to and influence the teaching and learning of mathematics. This study documented the experiences of youth working as Math Literacy Workers in the Young People's Project. Paying close attention to the pedagogical model and specific strategies used by the Young People's Project (YPP), the study aimed to understand the manner in which YPP transforms the learning of math into a community task for social justice. Rooted in a situated social practice of learning theory (Brown et al., 1989; Lave & Wenger, 1991; Lobato, 2008; NMAP, 2008; Roschelle et al., 2008; Tharp & Gallimore, 1988; Wenger, 1998), this study intended to illustrate that math education can be reconceptualized as engaging, community-based, and a conceptually challenging tool for social justice.

Research Questions

Inspired by the math research of Boaler (2002, 2008a, 2008b), Brown et al., (1989), De Freitas (2008), Gutstein (2003,2007) and Krishner (1997), this study examined the social learning practice of the Young People's Project after-school Math Literacy Workers program at Horton Charter School. This study explored the experiences of 15 participants in the newly launched math literacy program.

The intention was to identify the strategies for motivating students to participate, as well as the pedagogical strategies used to teach and learn math, community organizing, and youth leadership. The following are the research questions this study investigated:

1. How does the Young People's Project motivate students to participate in the math literacy campaign of the Algebra Project?
2. What are the teaching and learning practices of the Young People's Project that assist youth in developing *criticalmathliteracy*?
3. How does the Young People's Project cultivate young leaders and organizers as part of its Math literacy campaign?

The Context for Research Frames, Domains, and Key Findings

Using a qualitative research methodology this study examined and documented the experiences of 16 participants in the YPP Math Literacy Workers training program in their natural setting, collecting evidence through observations, interviews, participant journals, and participant feedback. Using an inductive analytical process enabled me to look into the specific practices of 12 High School Math Literacy Workers, 3 College Math Literacy Workers, and the program coordinator. Through a rigorous inductive process of data analysis I was able to identify five general themes that characterize the overall experiences associated with launching the LA chapter of the Young People's Project.

Searching for parallels, points of congruency, and contradictions between the data set and literature review, the five key findings that emerged as the framework of analysis were: a) the program invites participation, b) math literacy as a cultural / social activity,

c) agency, d) critical consciousness, and e) using after-school spaces outside of the classroom to stimulate leaders inside the classroom.

A key element from the literature review used during the analysis was the Young People's Project Model of Excellence (see Appendix A) which identifies the program's core themes as, a) how one sees self and other, b) the creation of we, c) being of service, and d) communicating in and with mathematics (Management Consulting Services, 2008, p. 3). This programmatic model, along with the theories of situated social learning practices (Brown et al., 1989; Lave & Wenger, 1991; Wenger, 1998) and critical math education (D'Ambrosio, 1979, 1981, 1998b, 2000; Moses & Cobb, 2001; Skovsmose, 2005, 2007) was used as the context of comparison and contradiction between the literature review and collected data. As the research process unfolded, these findings were further analyzed to discover a series of 12 domains that emerged to characterize the five themes of a socially constructed critical math pedagogy. These domains are discussed in greater detail later in this chapter.

Summary of Key Findings

These key findings are framed by their 12 domains and verified by the triangulated data that comprise the experiences of the participants of the LA cohort of the Young People's Project. These findings are the result of a 4-month research process that began with interviews and ended with participant feedback of the analysis. This feedback ensured reliability, trustworthiness, and validity (Guba & Lincoln, 1994).

1. The program invited participation because becoming a Math Literacy Worker was seen as a paid job with specific responsibilities. Motivation to participate was rooted in the opportunity to have fun and to be a part of something larger than one's self.
2. Math as a cultural / social activity was an outcome of a pedagogy designed by the Young People's Project to provide experiential learning via math games and interactive problem solving. Math literacy workshops were planned and facilitated by the Math Literacy Workers. They did grassroots organizing to involve community members in math literacy workshops, reconceptualizing in this way the teaching and learning of mathematics.
3. Agency is the act of being a Math Literacy Worker. A Math Literacy Worker is a youth leader who chooses to engage, support, and contribute to the development and facilitation of peer-to-peer community-based math literacy workshops with the aim of generating a critical mass for social justice.
4. Critical consciousness grows as one participates with the Young People's Project. Rooted by an understanding and awareness of social inequalities and the inequity of math literacy in their local community, YPP participants see their work as creating an opportunity for struggling students to achieve academic and social success. By working directly to support the learning of struggling students in a peer-to-peer learning model, Math Literacy Workers are brought face to face with the impact of poor math literacy, providing them with an opportunity to read the word, as they engage in self-generated activism that allows them to read the world.

5. Using after-school spaces outside of the classroom to stimulate learning inside the classroom occurred as High School Math Literacy Workers developed empathy for their classroom teachers as a result of being teachers themselves. They accomplished this by co-creating and co-facilitating their community based math literacy workshops.

The Research Process

The study began in January 2010 with the interviews of the College Math Literacy Worker and the Program Coordinator. These interviews allowed me to get a deeper understanding of the history of the newly launched Los Angeles chapter of The Young People's Project (YPP). It helped me understand its pedagogical practices, framework, the youth participants and the overall program operations. During these interviews I learned of a new partnership YPP had developed with a local elementary school several blocks from Horton Charter School. The partnership enabled the High School Math Literacy Workers participating in this research project to conduct their first regularly scheduled after-school literacy workshops. These were conducted for elementary age students every Monday through Thursday afternoon for 75 minutes. Weekly debriefing, planning, and training sessions facilitated by a college Math Literacy Worker and the program coordinator, supported the literacy workshops. These new workshops at Roosevelt Elementary School began at the end of January 2010, therefore, this place was the location for the observations.

The research experience was as follows: The observations were for an average of 75 minutes each. In total, I completed 1125 minutes of observations. The math literacy

workshops had two basic components: icebreakers and math literacy games. For each workshop there would be 1-3 icebreakers and 1-3 math literacy games in varying combinations.

The workshops at Roosevelt Elementary School were held in the outside playfield, except on rainy days when they were held in the school's auditorium. The observations of the literacy workshops at Roosevelt elementary school included observations of planning meetings, literacy workshops, debriefing sessions, and training sessions of new recruits, and were facilitated by the High School Math Literacy Workers. The participant journals were completed and collected on a bi-weekly cycle. The two College Math Literacy Workers were interviewed over the Internet, using the skype video conferencing software. The program coordinator and one of the High School Math Literacy Workers were interviewed in the YPP office at Horton Charter School.

Two of the High School Math Literacy Workers were interviewed on the outside play field at Roosevelt Elementary and the other two were interviewed in the classroom meeting space of YPP at Roosevelt Elementary School. The interviews lasted from 45-60 minutes each. In total I completed 550 minutes of interviews.

The interviews for the College Math Literacy Workers and the program coordinator were held in mid January. The observations at Roosevelt Elementary began in early February 2010 and lasted through April 2010. During these four months I was able to observe the early stages of the Math Literacy workshops forming at Roosevelt Elementary School. I began interviewing the High School Math Literacy Workers after several weeks of observations. I also began examining the student journals.

I began the inductive analysis with the first set of interviews from the College Math Literacy Workers and the program coordinator. I also analyzed the field notes from the observations and participant journals from the first several weeks of observations. This initial analysis directed me to collect additional data in the form of interviews of the High School Math Literacy Workers and new entries in their journals. From this data analysis five themes of a socially constructed critical math pedagogy emerged and the 12 domains that characterized the nature of these five themes surfaced. The document analysis and participant review of the analysis were then used to confirm the triangulation of data from observations, interviews and participant journals and attend to the criteria for trustworthiness and authenticity as described by Lincoln and Guba (1986). The integrity, validity, reliability, and authenticity of the data, the inductive analysis and its subsequent key findings were achieved by the prolonged contact with the participants, persistent observations, cross checking of the data, member checking, and participants' feedback on my findings (Lincoln & Guba, 1985, p. 77).

The Algebra Project and the Young People's Project

Twelve years after the birth of the Young People's Project, Omo Moses, its co-founder and son of Bob Moses explained how, "in the same way that Ella Baker helped fashion a space for the students who sat-in to think and organize for themselves, the Algebra Project provided a space for YPP to grow and develop" (Moses, 1995).

Founded in 1996 by the children of Bob Moses, Taba and Omo Moses, along with Khari Milner and nine eighth grade Algebra Project students from the Brinkley Middle School in Mississippi, the Young People's Project emerged as a social organizing vehicle

and an opportunity for youth leadership to develop within the Algebra Project. The project was rooted in a belief that youth can and must take direct action in their communities in order to address the present conditions of suffering and inequality that exist throughout the world. As expressed by the founding members, “math literacy work was a good place to start” (Moses, 1995).

The Algebra Project is designed as a program that occurs during school hours as an alternative-learning model to traditional classroom mathematics learning. Facilitated by the teacher, the Algebra Project is designed to promote the creation of socially relevant and experientially based learning opportunities that allow students to acquire the regimented language of mathematics as it is applied to the context of their shared experiences in the classroom. The Algebra Project curriculum is designed around the five phase experiential learning model developed by Bob Moses, (a) the physical event, (b) modeling the event, (c) talking about the event, (d) regimenting the language, and (e) formalizing the language.

The Young People’s Project is designed as an after-school alternative-learning model for traditional remediation and support curricula. Trained by a program coordinator, College and High School students, known as Math Literacy Workers, develop, organize, and facilitate math literacy workshops for elementary age students, middle school students, high school students, family members of Algebra Project participants, and community members at large. The Young People’s Project is designed around the flagway curriculum. For the elementary age students the math content of the flagway curriculum revolves around prime factorization, multiplication, addition,

subtraction, pattern recognition, and problem solving and relates to a series of interactive team games the students are able to play.

Flagway was developed by the founding members of the Young People's Project, and is modified and adapted by localized Math Literacy Workers as they interpret the curriculum and reflect on the learning and social needs of their peers. The three Flagway games played at Roosevelt elementary were Octopus, colors race game, and flagway, which are described in detail later in this chapter.

The Math Literacy Workshops

The planning meetings for the math literacy workshops lasted between one to two hours. The High School Math Literacy Workers facilitated their own planning meetings with additional support given by the College Math Literacy Workers and Beverly, the program coordinator. The main support provided by Beverly and the College Math Literacy Workers was to remind the high school students of their objective, time management, and to insist the high school students practice what they were planning to say at the actual workshops. The planning meetings focused on two things: a) identifying the icebreakers and math literacy games that were going to be played, and b) making sure everyone was familiar with the chosen activities and was able to facilitate the workshops. These meetings were light hearted, filled with lots of side conversations and often extended beyond scheduled time due to the relaxed nature and enjoyment of the participants.

The math literacy workshops facilitated by the High School Math Literacy Workers each lasted about 75 minutes and were held Monday through Thursday

afternoon at Roosevelt Elementary School. Each workshop was broken up into two main types of experiences, the icebreakers and flagway. The icebreakers would last 10-25 minutes depending on the level of student engagement. During an interview in March with Yasmin, a veteran High School Math Literacy Worker she expressed the way a workshop began:

Usually in games or anything in a regular classroom if you're a student the first thing that pops up is oh no one is going to talk to me. So the icebreaker kinda gets you into the mood, into the setting. And then that's where we teach them what they need to learn.

During the several months of observation one of the regularly used icebreakers I saw was The Cynthia game, named after the High School Math Literacy Worker who created it. The students sat in a circle with their hands open to their side. Once the game began they would have to count around the circle as quickly as they could until they got to 100. Each time a person counted their number they would clap the hand of the person to their left. The rule for counting to 100 was that you had to skip a number, like any number with three in it, for example you had to skip like 3, 13, 23, 30, or with a three or seven like 13, 17, 23, 27. A variation was to use multiples, which is something I borrowed from an observation and used as a warm up in my regular math classroom.

The second game they played included several variations of name games including favorite cartoons, places to visit, favorite shows, and favorite things to eat. I remember one afternoon in February when I was sitting on the bench observing a name game, Jessica, one of the High School Math Literacy Workers called over to me, “what’s

your name, what's your favorite food, and where do you want to travel?" I responded, "Michael, Italian, and Hawaii."

The third game was the worm tag game, a favorite with the elementary age students, when one person is "it" and they tag someone. They form a worm of people that becomes bigger and bigger until everyone becomes a part of the worm and is tagged. This game was played a couple of times a week and the students and Math Literacy Workers always enjoyed it. Usually kids that were not on the roster would play the worm game, and then go back to their other activities after the game was over.

The fourth game they played was Zip, Zap, and Zop, which is a fast-paced game that never really went over well with the elementary students. The students stand in a circle and as fast as they can slap their hands together and point to anyone in the group and say Zip, then that person quickly looks for someone else and says Zap and then that person finds someone else and says Zop. This continues until someone slips up and says the wrong thing. The game is played until only one person is left.

The fifth game was the pulse game, which took a few attempts over several observations for the kids to get the hang of it and even for me to understand what was happening. The students would form two teams that each stood in a line facing each other. At one end was a High School Math Literacy Worker next to the students and at the other end, about 15-20 feet away from the students, was another High School Math Literacy Worker standing by a ball or a cup on the ground. While the game was played all the students had to have their eyes closed, except the two that were standing at the end next to the High School Math Literacy Worker. When the game began the literacy

worker closest to the students called one student from each line who was closest to him together and flipped a coin. If it landed on heads, the students would go back to the line, grabbed a person's hand and squeeze. The squeeze (pulse) then got sent down the line to the other end and once it was received, that student at the end would open his or her eyes, let go and run to pick up the cup or ball at the end. If the flipped coin landed on tails they would go back to the line and do nothing.

The sixth game was Simon says, which was played often and the kids really enjoyed it. Sometimes the elementary students were able to call out what Simon says to do. One afternoon when interest in Simon says was dissolving and the High School Math Literacy Workers could not think of a game to play, several of the elementary age students said, "London Bridges" and began explaining the rules to everyone as they played London Bridges as an ice breaker that day.

The seventh game was a race game that just had the students in two teams and gave them a chance to run. This was a typical race game that the kids really enjoyed, since they were able to run across the yard.

The eighth icebreaker that was played was the human knot. This is when the students would get into groups and interlock hands with each other, making a knot of their arms and then had to work together to unravel themselves. One afternoon the students were so into this that they got into different teams to race each other and then had the students race the High School Math Literacy Workers. Some of the older boys would cheat and let go of their hands to quickly un-wind, but everyone was having fun.

The ninth icebreaker that was played was the rumors game. In this game students were in two teams all facing the same direction. A High School Math Literacy Worker stood at the back of the lines and would whisper a number to the two students standing in the back of the line. These students would then trace the number they heard on the back of the students standing in front of them. Once they were finished the High School Math Literacy Worker would call out an operation, like add 10, subtract five, multiply by three and so on and then the student would have to do the operation in their head and write the new number on the back of the person in front of them. This would continue until they got to the person at the front of the line and they would see what the final number was and then see if they could work backwards to see what the original number was. This was another activity that I borrowed from the observations and used as a warm up for one of my math classes and my students really enjoyed it.

The tenth icebreaker that was played was called steal the bacon. In steal the bacon students' stand in two even numbered lines about 20-25 feet apart facing each other and they count off. A High School Math Literacy Worker calls out a number and those two people race into the middle to pick up the cup that was on the ground. Each person gets one chance to pick up the cup and if the other person tags you, then you have to drop the cup immediately. A variation of this game is to call out expressions or equations that the students have to solve in order to figure out what their number is. This was another game I borrowed from the observations and used as part of a game day for a problem solving math course I am teaching. The variation I used for my high school students was that I would call out complex multi-step expressions, equations or various

mental math facts for the students to know if their number was called. The students really liked this game and especially enjoyed being able to play outside. We spent around 15 minutes of class time with this activity.

To maintain order, balance and control during the icebreakers, one High School Math Literacy Worker who was the leader for the workshop would call out most of the rules and directions for the activities and math games. The other High School Math Literacy Workers would spread themselves out amongst the students from Roosevelt Elementary and play the icebreakers and math games with them. If the icebreaker needed smaller groups, the different High School Math Literacy Workers would lead those smaller groups, like with human knot or name games. If individual students were struggling with directions, there would be a High School Math Literacy Worker close by to support their understanding. The icebreakers were about building rapport and inciting energy. During the icebreakers two of the High School Math Literacy Workers would be busy setting up the materials for the day, like making color and/or number cards, laying out the sticks for flagway, writing the number sequences on paper or on a portable white board for the flagway math games that took up the second part of the workshops.

The icebreakers were designed, like a warm up in a regular class, to build excitement and engagement for the workshop. These were simpler activities that required minimal instruction, allowing for the people in the group to get a chance to interact with each other and know each other. The icebreakers are commonly thought of as team building and culture building activities. After the icebreakers the students would then play the flagway curriculum. The flagway curriculum, like a regular class is the main

lesson for the day, and is the opportunity in the workshops when the Math Literacy Workers were able to expose the participating students to the math concept of the day.

The three-flagway race games that were most commonly played with the students from Roosevelt were:

(a) Octopus, where three colored hula hoops (red, yellow and blue) were placed on the ground as the vertices of a triangle. All the students were then organized into two teams with one student being chosen as the Octopus. The Octopus would have to stand in the center of the triangle and try to tag any of the students that came near him or her. If the Octopus tagged another student they would have to stop immediately where they were, and like the worm game, they became a stationary Octopus that could tag someone else. The rules of the game were simple the teams would race to place the most correct amount of number cards into their correct color hoop. On a poster paper or white board was drawn a three column table with the following number groups, red (2,3,5,7,11,13,17,19,23,29), yellow (4,8,9,12,16,18,20,24,25,27,28) and blue (6,10,14,15,21,22,26). The students would pick up one number card at a time read the board and race to put the number into the correct hoop.

While two to three High School Math Literacy Workers stood by the board and the teams to make sure everyone understood what was going on and followed the directions, another two High School Math Literacy Workers stood around the colored hoops to provide immediate feedback to let the students know if they were correct or not. The purpose of this game was to introduce the students to the number groups and their corresponding colors.

(b) The colors race game was another game to get the students familiar with and aware of the number groups and their corresponding colors. Similar to Octopus the students would be split into two teams and one at a time race each other to pick a number card from a pile. They quickly looked at the chart to match the color group with the number and then race 20-30 feet to where three High School Math Literacy Workers were standing next to three different colored boxes: red, yellow or blue. On one occasion they used the colors of orange, yellow and green. Like Octopus the purpose of this game was to introduce the students to the color patterns so that they could become familiar with the number groups.

(c) The third math literacy game, and the one most often used, was Flagway itself. Flagway, the main central learning piece for the YPP curriculum, is set up on a playing board on the floor, in the shape of a semi-circular space with a radius of about 10-15 feet. A total of 27 two-foot 1/4 inch sticks are used, representing all the possible colors combinations from the three colors of red, yellow and blue. Spread out in a semi-circle like a probability counting tree, the students see a series of pathways that represent all the possible patterns for choosing three colors or numbers. The High School Math Literacy Workers introduced the students to the colors and number patterns using Flagway during the first observations. As with octopus and the colors racing game the students were split into two teams. Beginning with the colors only, the students picked a card from a pile. Each card had three colored dots. The students read the sequence of the colored dots, for example, red, red, blue, or yellow, blue, yellow and then race to the starting point of the flagway board and walk along that colored path. After students were familiar with the

color paths they were introduced to the number patterns only with the number 1-10, red (2,3,5,7), yellow (4,8,9), and blue (6,10). After playing with 1-10 for a couple of workshops the students then played with numbers going up to 29, red (2,3,5,7,11,13,17,19,23,29), yellow (4,8,9,12,16,18,20,24,25,27,28), and blue (6,10,14,15,21,22,26).

During the game one to three High School Math Literacy Workers would be standing around the edges of the board to provide immediate feedback to the students to let them know if they were correct. If they made an error they were told to go back to the starting point. Two High School Math Literacy Workers stood around the teams and the pile of cards to make sure everyone understood what they needed to do and another High School Math Literacy Worker just moved around to make sure everything and everyone was okay.

On the days when more High School Math Literacy Workers participated typically one or two would be playing in the background with any students that did not want to play the icebreakers or the flagway game. On some occasions the math literacy games were supported with traditional worksheets to provide the students from Roosevelt with an opportunity to drill their basic math skills. Usually the High School Math Literacy Workers organized the students into teams and had races with a prize for the fastest and most accurate.

The debriefing sessions occurred informally after a workshop when the High School Math Literacy Workers or myself had questions or comments about the day's experience or when Beverly wanted to talk with someone or the whole group. The

formal debriefings occurred two to three times a month with a larger group and were accompanied with time to write in the participant journals as they reflected on their experiences.

Roosevelt Elementary School

As expressed by the program coordinator in her interview, “This is the first time to get funding, so we will be able to do regular outreach.” With the support of this new funding, the literacy workshops at Roosevelt were the first regularly scheduled and continual literacy workshops conducted by the High School Math Literacy Workers from Horton Charter School since the Young People’s Project began over two years ago. Prior to the workshops at Roosevelt Elementary, the High School Math Literacy Workers would conduct one day to week-long literacy workshops at various schools in their local community.

During my first visit in February one of the High School Math Literacy Workers explained to me that they had developed a rotating schedule to balance the workshops at Roosevelt Elementary and a workshop at Horton Middle School (this is the home school of the students participating in this study). The plan was to break the 12 High School Math Literacy Workers into two groups. One group would conduct the workshops at Roosevelt Elementary School on Monday and Wednesday and the other group would conduct the workshops at Roosevelt Elementary School on Tuesday and Thursday. This forced me to rethink the data collection strategies and timeline to assure effective and abundant data. This new schedule led me to change my observation plan of once per week to visit Roosevelt Elementary school to visit at least two times per week. After the

second month of observations I began showing up all four days of the week at Roosevelt Elementary.

On the first day scheduled for my observation it rained. I arrived early to find the location of the Math Literacy workshop at Roosevelt Elementary School. I asked the principal where YPP was beginning their workshop and he directed me to the auditorium and explained “rainy days cause many parents to pick up their children early,” which resulted in the auditorium having only 15 students of various ages, who already engaged in games as apart of LA’s Best After-School program, two site staff members, and me. Four High School Math Literacy Workers showed up about 10 minutes later to conduct the first workshop. A specific roster of elementary students to participate in the literacy workshop had not been established, so the High School Math Literacy Workers spent the first 15-20 minutes talking to various site staff members, the principal and elementary students to organize a group of participating students. Even after a roster was developed, the beginning ritual of every workshop became looking for student participants. On some days as few of 2-3 students showed up, and on other days as many as 25-30 would be there. This inconsistency of participating students continued throughout the entire course of the research study and was one of the key obstacles I observed. About 20 minutes into my interview in late February, Deivi, a veteran High School Math Literacy Worker, described the situation vividly:

Well, we have our good days, we have our bad days. Cuz we don’t get the kids, it makes us look bad, because now we have trainees, it makes us look bad and we don’t want them to quit. And then sometimes the kids are hardheads and don’t

want to join us because we force them supposedly. And it's hard to know which kids are with us, which are not with us, cuz there's a couple groups, we have LA's Best and then we have this one, I forgot what it's called. And it affects us pretty bad sometimes, because we can be sitting here doing nothing because the kids are busy doing something else, they're not here, or sometimes we get two or three kids and that's what we have to work with. And then other days, we have 20 kids and then when we plan, so it throws off our planning because we plan for so many kids but we get so little. It throws us off a lot sometimes.

The unsteady participation of students in the after school program at Roosevelt Elementary made every day unpredictable. During one such observation in mid February I recorded the following field notes:

Deivi: "See this isn't goin smooth."

As he gets on his phone to call the YPP office and ask Elijah, a College Math Literacy Worker to bring the sticks for flagway, three High School Math Literacy Workers were talking with each other about where the kids were going to come from. At two different times in the beginning of this workshop High School Math Literacy Workers asked different elementary students to help gather the students that they were playing with them from the other day.

Deivi: "Do you remember who was in our class the other day?"

Student: "Uh, uh."

Deivi: "Go get them."

Eventually another student was asked to gather other students as well. On this particular day within 10-15 minutes 22 students were ready to participate in the program. It was during my fourth observation that Beverly (program coordinator), spoke with the after-school coordinator at Roosevelt Elementary School to set up a specific roster of students for the Young People's Project, after learning of the frustration of the High School Math Literacy Workers.

The roster helped identify participating students, but at the beginning of every workshop the High School Math Literacy Workers would continue to spend 15 minutes gathering the students from around the yard. In addition to the difficulty of gathering their roster of students, once site teachers became aware of their presence they would show up during the middle of the workshop with 10 or more students to participate:

Teacher: "It's a large group. Is that OK?"

Another issue that emerged was that when parents arrived, students' left and activities and the literacy workshop had to continue. This made it difficult for the High School Math Literacy Workers to engage students in the structured debriefings they had planned around the math games they were playing and the number patterns they were seeing. I began interviewing the High School Math Literacy Workers after several weeks of observations. I also began examining the student journals.

Five Themes of Socially Constructed Critical Math Pedagogy

Through inductive analysis (Hatch, 2002) I was able to identify five key findings that I have conceptualized as "Five Themes of Socially Constructed Critical Math Pedagogy." They are:

1. Inviting participation, characterized by the domains of (a) Knowing everyone matters; (b) it belongs to us; and (c) enthusiasm and engagement.
2. Math literacy as a cultural / social activity, characterized by the domains of (a) math's cultural formatting power; (b) math as a social activity; (c) building pathways to math literacy; and (d) reconceptualizing the teaching and learning of mathematics.
3. Agency, characterized by the domain of (a) generating critical mass.
4. Critical consciousness, characterized by the domains of (a) student voice; (b) reflective knowing; and (c) transformation of social identity.
5. Using after school spaces outside of the classroom to stimulate leadership inside the classroom, characterized by the domain of (a) empathy.

Theme 1: The program invites participation.

Being a Math Literacy Worker provides traditionally underserved and marginalized students with a choice to participate and contribute to each other's education (Freire, 1973, 2004; Gutstein, 2003, 2007; Management Consulting Services, 2008). This choice is part of the design of the socially constructed emancipatory pedagogy of the Young People's Project. The experiences of inviting participation of the Math Literacy Worker of the LA cohort of YPP are rooted in a practice related to knowing that everyone matters, it belongs to us, and enthusiasm and engagement. Framed by historically low levels of academic achievement (Moses & Cobb, 2001) and student participation in the field of mathematics (Schoenfeld, 2004), YPP is designed to create a purpose for students to engage in their education in a manner that highlights "the

centrality of their own direct participation in creating a responsive educational system” (Management Consulting Services, 2008, p. 1).

Knowing that everyone matters.

The Young People’s Project pedagogy is rooted in the belief that everyone matters. “YPP Helps me understand how to relate to people from a place of acknowledging where they are coming from and then to grow from there. As opposed to me being the one to bring the elixir” (Paul, College Math Literacy Worker interview). A roster of students who were scheduled to participate in the math literacy workshops was established, but as other students became interested in the games, any elementary age students were welcome to participate. This was evidenced in every workshop and one of the moments I recorded during an observation in early March confirmed that:

The coach from the school site brings another student over and asks the High School Math Literacy Workers “Can she play with you?” and the High School Math Literacy Worker quickly responds “Yeah.” On another day I see students stand outside the circles during an icebreaker. As a Math Literacy Worker invites the additional students to join the circle, she asked others to make room.

In the middle of the interview with a veteran High School Math Literacy Worker, Yasmin described the Young People’s Project as something that:

Gives an opportunity for everyone to try it. If they at least give you the time to try it and if you don’t think you’re going to be able to make it or something, then you at least have the chance to do it, because if you don’t at least try you never know how far you could go.

In her February journal, Karen, a veteran High School Math Literacy Worker explained, “My work contributes at least with helping one student understand one math concept.”

It belongs to us.

Many students, especially students of color, language learners, students with learning disabilities, and students from lower socio-economic status, have historically felt a sense of alienation and disharmony when attempting to participate in the traditional math curriculum (Resnick, 1988; Schoenfeld, 1989). This alienation and disharmony is often associated with a feeling of learned helplessness and a sense of mathematics as something that is disconnected from one’s real life experiences (Anyon, 1980; Hooks, 1994, 2003; Secada et al., 1995). When describing his experiences in regular math class, Deivi one of the veteran High School Math Literacy Workers explained at the end of his interview, “...cuz learning in a classroom you sit down and watch teacher teach. And after teacher is done with the lesson you do bookwork, which is no fun.” In an interview in January with Raymond, a College Math Literacy Worker he explained that YPP is here “to remind them [MLWs] that there is a way to alleviate the sense of alienation in most math classrooms.” He elaborated further:

The classroom was about teacher at the board giving knowledge to students, who simply had to willingly receive. The change for [High School] Math Literacy Workers is that it allows them to be a part of creating the curriculum, working within the process of teaching others.

The design of the math literacy workshops is fluid in nature. There was a rhythmic pattern to the experiences, sometimes seemingly chaotic but always functional.

As I noted during one of my observations, an elementary age girl danced away from the group as the game was being played and within 3 minutes made her way back across the yard and continued playing flagway. The boundaries are flexible, resulting in a constant ebb and flow of invitation, engagement, participation, and, ultimately, choice. A key element of the invitation to participate was predicated on building personal relationships. This was evident when 5 weeks into the literacy workshops in early March, Beverly, the program coordinator, canceled the literacy workshop for one afternoon and simply told the High School Math Literacy Workers to go find the kids and just play with them.

Paula: “But the kids are all scattered.”

Beverly: “So go find them.”

Paula: “And bring them together?”

Beverly: “No, play with them, whatever they’re doing. Get to know them and let them get to know you.”

When questioned further by the High School Literacy Workers, Beverly explained, “They’re starting to feel like they *have* to be with you, and it’s better if they *want* to be with you. When you come back I want you to know their names.” With that said we all went to find the kids and ended up playing a game of kickball for the afternoon, myself included.

Understanding that along with choice comes resistance, YPP designed a workshop experience that always begins with an icebreaker. Karen, a veteran Math Literacy Worker, described in the middle of her interview in late March:

We all sit at a table and we start with an icebreaker. There's always an icebreaker and I feel like that's so important because it's what motivates us to keep going because it's fun. So we all sit down and choose an icebreaker, we decided who is going to facilitate it explain it and we separate into groups, and that always seems to work.

The sense of belonging generated from being a Math Literacy Worker was captured clearly during an observation of a debriefing session between the Math Literacy Workers and a group of new recruits who had recently been trained and who had just facilitated their first math literacy workshop. As the recruits comment on the experience of teamwork, one of the new recruits explained, "...even though we did something wrong, someone said yeah, that's OK... I felt like I had someone there with me to back me up."

A salient characteristic that emerged from the data analysis was the presence of a sense of ownership in their experiences as Math Literacy Workers, which I have labeled as the phrase *it belongs to us*. In her March journal entry, Karen a veteran High School Math Literacy Worker wrote, "I love the kids here and I'm actually glad to spend time here. I think we should help them more with math problems, so I'm going to start talking with Deivi, Samira, and Jessica (High School Math Literacy Workers) about spending time on math problems." On most of the observations High School Math Literacy Workers facilitated the literacy workshops on their own with occasional visits from Beverly to check on their progress. During the March interview Yasmin, a veteran High School Math Literacy Worker, described one of the planning meetings:

And after that we go on with um then the next one, we pick the game we want to play, and we have like objectives of what we want them to learn. What's the point and why did we pick it? And someone facilitates that. And we make sure everyone has a group, and everyone is clear how to play the game and how to explain the game. So that just in case they don't understand then the other ones can explain to their team. After that we go over it, everyone says what they are going to say, we go step by step. After that we break and go home, and that's it.

When interviewing Jose in mid March he explained:

Beverly is always on our backs for our outlines and if she feels like it's not something that would benefit others then she would exclude that and put something else that would be helpful for others. And she lets us explain to her and convince her it's good, if she sees we're not able to explain it to her then she says, well how are you going to explain it to people that don't even know you?"

When observing a planning meeting, I noticed the constant ebb and flow of interaction between Beverly, the High School Math Literacy Workers, and a College Math Literacy Worker. They were preparing for a workshop for an upcoming weekend where the Math Literacy Workers from Horton Charter School were going to facilitate workshops for recruiting High School Math Literacy Workers from new sites in LA. Beverly continually asked them to probe further and think deeply about their role as facilitators as they prepared for the workshop. Beverly helped to structure the meeting by directing students: to choose the math activities they want to play, to explain why they thought it would be a good activity, and to explain how the games are going to be played.

Beverly asked the College and High School Math Literacy Workers to identify the materials that were needed, and to discuss the role of all the High School Math Literacy Workers during the workshop. The planning was largely left up to the Math Literacy Workers with Beverly simply providing support to remind them to stay focused, on task, to consider their audience needs, develop clear explanations, and to be responsible with their time.

On another day while reflecting in her February journal, Cynthia described how it belongs to her when she wrote, “although I did stop the game because I felt that none of the kids understood how to walk the structure, once I let everyone walk the structure one by one, I realized they understood the game.” Associated with this sense of it belongs to us, is a growing sense of responsibility characterized by an interaction I observed between two High School Math Literacy Workers in mid-March:

Deivi: “See what happens when you come after 4?”

Stephanie: “Tomorrow do we have to meet with Beverly?”

Deivi: “Yes.”

Stephanie: “For how long?”

Deivi: “As long as it takes us to plan.”

Participation with YPP has cultivated within the High School Math Literacy Workers a sense of responsibility and ownership of their community. In her March journal, Cynthia, a new High School Math Literacy Worker, described community activism work beyond facilitating math literacy workshops:

I think that a social problem would be the streets of our community, because they are so dirty. I don't think YPP has tried to help out in any way yet. We should go and sweep them up on a day when either we don't work or decided to not work at Roosevelt Elementary School and go do it.

The sense of responsibility of "It belongs to us," extends beyond the High School Math Literacy Workers to the students receiving the instruction in the literacy workshops. On one afternoon in late February during a flagway race game I observed the following interaction; as the race game began, two girls are asked to be in the line:

Student: "I wantta be a helper."

MLW: "OK."

The girls then stood by the board and helped the other students find the color of the number on their cards. The sense of belonging translates to many of the participants as a sense of ownership, responsibility and contribution (Freire, 2004; Gutstein, 2007).

Enthusiasm and engagement.

In an effort to sustain this sense of belonging a key element of the literacy workshops are the use of icebreakers and math games to build a sense of enthusiasm and an experience of engagement. During an interview in January with Raymond, a College Math Literacy Worker, he described a typical training day as the high school students "having fun, laughing, teasing each other, and doing their work." The effect of the games was evident when during an observation in late March I witnessed how, Jose, a High School Math Literacy Worker, was asking the students to get in line for the second round. A student said "This is boring." Jose didn't really respond and continued to get them

together. By the time the second round began this same student ran with the rest of the kids, smiling, giggling and having a good time, excitedly waiting for her next turn to run in the race and put her number card in the right colored box. At the end of the workshop she was the last one to leave, helping the High School Math Literacy Workers clean up and bring everything back into the office.

During an interview in late March with Jessica, a new, High School Math Literacy Worker, she explained, “Yeah it’s an easier and funner way like they’re not doing math, you know.” The games are an entry point for interaction, which allows the students to participate in the math, often without even realizing they are playing math. She continued to explain:

That’s just like a method we use just for the kids to have fun like they could get it. Like you see them looking at the chart before they go run and give it to the red, yellow, blue. I think that’s just one of the Young People’s Project’s methods, just to make things fun. That it won’t be boring like a traditional classroom.

When asked to reflect on this dynamic in their February journals, Cynthia explained, “I think the kids enjoyed themselves and they liked the prizes. I believe they would come back again,” and like Beverly, the program coordinator said during her initial interview in January, “This program doesn’t work magic.” Max, wrote in his February journal, “...and there were kids that just didn’t want to play and were being hard headed.”

Over the past decade reforms have touted the benefits of the voucher system and the charter school movement as creating opportunities for schools of choice. For perhaps

the first time in the history of public education, students and their families are beginning to have a choice with regard to the school they want to attend. No longer is a student required to attend their one local high school or to find a relative's address in a neighboring community to lie and say they live there. So as I analyze the parallels and generalizations that can be drawn between the collected data, education as a whole and regular classrooms, I am reminded of something Beverly, the program coordinator, explained in her interview in late January, "[it] can't be compared to learning in a classroom, it's not to be used in a classroom." Her comment and these questions give me pause to limit any analysis to apply directly to after-school programming, where student participation is often predicated by choice.

As an after school program rooted in choice, the Young People's Project had to create an environment that was enticing to high school students in a way that would make them want to do the work associated with being a High School Math Literacy Worker. As it is a driving force for adult life decisions, being a High School Math Literacy Worker is accompanied with a paycheck. The High School Math Literacy Workers are organized into two groups. One group is the Math Literacy Worker Leaders, who are the veteran most experienced High School Math Literacy Workers and are the main facilitators of the literacy workshops, and the other students are High School Math Literacy Workers who function as support facilitators for the workshops.

Funded by the National Urban League the High School Math Literacy Worker Leaders receive a stipend of \$30 per week and the regular High School Math Literacy Workers receive a stipend of \$20 per week. On average they work anywhere from 5-10

hours per week. When talking with the interviewees the responsibility and pride associated with earning money while doing positive work filtered into a transformation of family relationships and social responsibility (Acavedo, 2008). The students were able to use something they had learned in school, basic math, and apply it directly to an endeavor that allowed them to reap the benefit of generating income. Several districts across the nation over the past few years have taken to paying students for improved test scores to basically become better test takers. Why not pay students to participate in after-school program that cultivates leadership, stewardship and social responsibility?

Another key element of choice is that the Young People's Project's pedagogy is framed by an exploratory curriculum. The exploratory curriculum of YPP is a present-day model for the framework developed by the early critical math educators of the 1970's and described by Skovsmose (1994) as critical competence, distance, and engagement. Upon entering the research site I understood this framework as something that had to revolve around the specific application of math concepts being used as the tool to understand, deconstruct and transform society (Frankenstein, 1983, 2008).

As I began the preliminary analysis, I was not seeing anywhere in the program the students engaging with mathematics as a tool to understand, deconstruct, and transform society (Frankenstein, 1983; Gutstein, 2003; Skovsmose, 1994). Examples of this could be looking at statistics related to graduation, employment, unemployment, minimum wage, incarceration, mortgage, foreclosure, army enlistment, arrest, teen pregnancy, gentrification, media, environmental impact, and resource consumption or poverty rates to use as a context to practice in working with statistical data. Using mathematics in

context could help students develop a richer understanding of the social inequalities that plague our society (Frankenstein, 1993, 2008; Gutstein, 2003, 2007). Instead the Math Literacy Workers and their students crumpled up paper or used little balls and played a game of basketball, recording their results and analyzing the statistics behind their play. Upon my preliminary analysis my initial findings were telling me that YPP is not a critical math literacy program. However, upon a deeper analysis and reflection on my part of what a critical math program is and could look like, there is evidence of the framework described by Skovsmose (1994) of critical competence, distance, and engagement.

Critical competencies are described as the fundamental ways of being that are necessary for one to participate in a critical manner that relates to intellectual, emotional and spiritual states of being. All of the College and High School Math Literacy Worker participants at Horton Charter High expressed that being a literacy worker forced them to begin to think outside of the box and to problem solve in a manner that many of them had previously not attempted. This out-of-the-box thinking extended beyond their work as literacy workers and was showing in their regular classes and their family relationships. The grassroots organizing method used by YPP provided the youth participants with an experience that strengthened their critical competencies, enabling them to act with growing confidence and a growing sense of self as a community organizer and leader.

The exploratory pedagogy used by YPP is a model that honors and replicates the time and space necessary for critical distance to emerge as described by Skovsmose (1994) and established by early critical math educators as a fundamental aspect of critical

math pedagogy. Participants in the Young People's Project were allowed to take whatever time was necessary for their own comprehension and learning to master the content. Again, the content, to which they were taking the time to learn, may not have related to the use of actual math skills to deconstruct, but the time allowed to self-direct one's learning through the flagway curriculum supported all participating literacy workers at Horton Charter School in developing a sense of confidence, curiosity and ownership of their own and each other's learning.

As their learning grows they are given additional responsibilities, authority, and new problems and activities to consider. The exploratory framework allows all students to find their own footing as learners, subsequently not being left behind due to pacing plans, target goals and final assessments (Seceda et al., 1995).

The flexibility of the exploratory learning model encourages students to act from what they know and where they are, allowing them to gain more confidence in their thinking and actions, resulting in sustained participation (Gutstein, 2003, 2007; hooks, 1994; Moses & Cobb, 2001).

The community organizing and peer-to-peer learning model used by YPP enabled the participating Math Literacy Workers to experience critical engagement as a result of their roles as co-creators and facilitators of the math literacy workshops. All participants at Horton Charter School, newcomers and veterans, expressed that their experience with the living curriculum of YPP provided them with a culturally relevant, problem-posing pedagogy that cultivated direct participation with the community (Freire, 2004; Horton, 1998; Horton & Freire, 1990; Skovsmose, 1994; Wenger, 1998).

Theme 2: Math Literacy as a Cultural / Social Activity

Rooted in the civil rights tradition of building personal relationship to stimulate effective community organizing, the Algebra Project and the Young People's Project used the issue of poor math literacy as the means to generate purpose and meaning for the work of the Math Literacy Workers (Gartman, 2006; Freire, 2004; Lave & Wenger, 1991; Moses & Cobb, 2001; Wegner, 1998). The Young People's Project is an effort to provide space for youth leadership to emerge as part of the national literacy campaign of the Algebra Project (Management Consulting Service, 2008; Moses & Cobb, 2001; Moses et al., 1989; Nelson, 1997; Silva et al., 1990; Watts & Guessous, 2006).

As Karen, a High School Math Literacy Worker stated in her March interview:

Math literacy is just one small step. And you start small, bunch of small steps, and lead up to something big. And when something big gets going, something bigger gets going. And so on and so on and then after a while we're at a good stage. Just keep the flow going. (Karen, High School Math Literacy Worker March interview)

The experiences of math literacy as a cultural / social activity for the Math Literacy Workers of the LA cohort of YPP are categorized by the awareness of the cultural formatting power of mathematics, the experience of mathematics as a cultural / social activity, the focus on building pathways to math literacy, and a pedagogy that allows students to reconceptualize the teaching and learning of mathematics.

Cultural formatting power of mathematics.

The Young People's Project helped to illuminate a backdrop to civilization that is sewn together with mathematics.

As Jose, a High School Math Literacy Worker, stated in his second interview in late March:

Well like I was saying, math is in everyday life. YPP makes them realize what is math, it's like the basic building block of everything. Math is in the door, math is in the pencil, math is in a car, and everything that is around.

Yasmin, a veteran High School Math Literacy Worker captured this sentiment when talking about her peers in March. She explained how, "they may have had bad experiences when learning math and now they have a way to work on that. Building social culture." The building of social culture she talked about was witnessed during an observation of the debriefing session held after the new recruits facilitated their first workshop under the guidance of the High School Math Literacy Workers. Samira a veteran High School Math Literacy Worker explained during a training session with the new recruits in March, "In the rumor game Diana (a new recruit) did good." Beverly probed further, "be specific, verbatim. Can you say what she did or said? Diana has to know what she did so she can do it again and so we can all do it."

The understanding of math as a cultural formatting power for YPP participants, was framed by a pedagogy that organized the learning and doing of math into a social activity. As Jessica, a High School Math Literacy Worker stated in a late March interview:

Raising awareness that we need to do better in math. Teaching kids. Getting the parents involved, we have little meetings, we invite the parents over and have food for them, talk about what we do, how we do it, what their kids are doing, play a couple of games with them so they could see what we're all about. Make sure everything is going smoothly."

Math as a social activity.

The social activities (icebreakers and games) built a sense of community, an opportunity for belonging, a space for contribution and a possibility for expression. When I interviewed Beverly in January she explained, "maybe math isn't even the challenging aspect since the curriculum is geared towards younger struggling students. It's the social aspect of facilitating another's learning experience."

During an observation in mid-March I recorded the following notes, as the students started a racing game. Paula, a new High School Math Literacy Worker directed the students to "form two perfect lines." The students looked at the board and Jose, a High School Math Literacy Worker, as he pulled out a card "15. What color is 15?" "Green" was called out in a chorus of students. Jose continues, "Who sees the green box?" "Over there" explained the students. The race game was one of the variations for the flagway curriculum that helped the students familiarize themselves with a chart of numbers broken into 3 colors, red (2,3,5,7,11,13,17,19,23,29), yellow (4,8,9,12,16,18,20,24,25,27,28), and blue (6,10,14,15,21,22,26).

The purpose of the games for the flagway curriculum is to create social experiences that allow students to interact with each other in such a way that it gets them

thinking about the number groups. The use of an exploratory curriculum provided the students with an opportunity to consider these patterns and to look for the rules of concerning the way these particular numbers are grouped together, building foundational numeracy, reasoning skills, and problem solving skills while they are playing (Davis et al., 2007; Moses & Cobb, 2001; Moses et al., 1989).

In an April journal entry, Yessenia, a new High School Math Literacy Worker, described YPP as changing the math experience to a social experience when she wrote, “I think that YPP needs to solve that the kids see math and interact with other kids having fun.” During an interview in mid-March with Jose, he recounted his first experience with YPP:

And then came the games, the first game I remember was, there was this basket and we had to shoot basketballs into a trashcan. And we shot three times, three or five I’m not sure, and from there we tallied the score and they taught us how to do percentages and graph it, and with graph paper and all that.

Building pathways to math literacy.

The use of games to create a social learning atmosphere was designed to create access and build pathways for all students to achieve math literacy and excel academically. When interviewing Karen, a veteran High School Math Literacy Worker, in late March she explained:

But yeah it's just we try to introduce it little by little at first. And then we get to the bigger games, and so like the structure, we try to introduce the colors first, then color codes, then the number codes, and yeah. Just little by little.

When talking with Raymond, a College Math Literacy Worker, in late January he explained how they use, “simpler problems as a jump off point for more complex explorations and investigations.” During the first observation in February I recorded the following experience related to the patterns of the flagway board and the way they were introduced to the kids with a race game of the colors along the game board:

After playing with the colors only, the students were then introduced to how the colors used in flagway represent the three types of numbers. This particular observation was the first time this group of students were seeing the numbers so they were only introduced to the numbers 1 through 10, R (2,3,5,7) Y (4,8,9) and B (6,10). After 10-15 minutes of racing with cards with a three-color pattern on them, the High School Math Literacy Workers switched the cards to show a three number sequence. The students were then given a card with three numbers on it, they had to match the number sequence with their corresponding colors and then run the course. Once the students spent time thinking about these number groups, a guided investigation by the High School Math Literacy Workers ensued with the students to explore the question of why these numbers are together at all?

In an interview with Jose, a veteran High School Math Literacy Worker, in mid-March, he described an impromptu debriefing that occurred on another day with a participating student:

Like some of the kids here don't know their prime numbers. And that game really did help them out. The other day we were playing and they looked and one kid said Oh are these prime numbers? And I said yeah how did you figure it out? And

he said oh I don't know, my teacher was talking about it but I didn't understand until today. And that's when I was like, "Oh this actually does work."

When asked to reflect upon their experiences in her February journal Stephanie, a new High School Math Literacy Worker, wrote, "I think the workshop went well, we completed our mission which was to make sure the kids new and understood the structure, and by the end of the day they did." Responding to the same journal prompt as Stephanie, Max wrote, "The kids at first didn't get the hang of it but with explanations and patience they pulled through." These journal responses mirrored the long-term goals of the Math Literacy Workers expressed by Jessica, a new High School Math Literacy Worker, in her late-March interview when she explained:

Actual math that we work with is more like, geometry. In a way, or algebra. Well, Algebra Project. But yeah we try to get that concept, get them learning about exponents, prime factors, or just like consecutive numbers, just to get them so like if they're kids they'll know it by the time they're in high school.

In a debriefing session in March Beverly was asking a new recruit about their experiences:

Beverly: "Are they mostly second graders?"

New recruit: "We tried to change it at the last moment, since they couldn't multiply and divide we were like just add and subtract."

Beverly: "If you don't want to do again what you did this time, what would you do differently?"

New recruit: "I would teach them how division works."

The concern for building pathways to literacy goes beyond the elementary age students they presently work with in the program as Deivi explained during his late-February interview:

So another thing I think maybe come up with a high school YPP that involves higher math, you know, that way we're not just stuck to elementary kids but reach a whole range of kids that need help with math. That would be nice to see actually.

Reconceptualizing the teaching and learning of mathematics.

The final piece related to math literacy as a tool for social change is characterized by the capacity of YPP to flip math on its head, requiring Math Literacy Workers and students alike to thinking outside the box as they problem solve. When interviewing Raymond, a College Math Literacy Worker in January he simply explained, "their attitudes change." He further elaborated, "[Math] becomes flipped on its head, in terms of its instructional approach and the way it's presented. Allows for a reconceptualization." During an interview with Jessica a new High School Math Literacy Worker in late-March she explained:

I think that we come and, I think it's just really the games. I never expected to play math, like play math. I always thought it was math, just boring math. And I think every other school I'm pretty sure they don't play games. And they don't try getting around math in a different way. So I think that's what we bring them.

In a different interview in late-March Jose explained:

Yeah cause usually people think about it inside the box, because there is a traditional way to do it. YPP looks outside the box, it exposes you to something different. And now with YPP I don't see math, I see math as a way to help you in life, it's better than just guessing. And YPP is an example, it helps you – like sticks. Who knew you could learn math with sticks, hoops, basketballs, just games you know? That's what I think.

This experience was not universal. During his interview in late-February Deivi explained how, even though he's a veteran he did not really see it:

I don't really see any math. I mean I know it's there but I don't really see it. In our flagway, I don't really see any math. It's just basically, just thinking, capture the flag, numbers and colors, I don't see where the math is in that. I don't see any math. Maybe a few games we have that involve math. Steal the bacon, that's math cuz you shout out equations and then there's a couple other games that work with prime numbers and then there's the algebra form. But flagway itself, I don't see the math. I don't know what the structure involves with math. But I know it's in there somewhere.

The practice of thinking outside the box is a life-long endeavor for Math Literacy Workers. Even as they facilitate the learning of the elementary age students, they are continually faced with more challenging problems about the very curriculum they are teaching. During an observation in late-March I asked Max a follow up question from an interview with Karen the day before, “Why is 30 with the prime numbers (red)?”

“Beverly said there’s some special formula for that one but were still trying to figure it out ourselves.”

In American public education mathematics, specifically Algebra, is a gatekeeper to higher education. Stripped down to a series of math facts and algorithmic procedures the California State adopted mathematics standards largely focus on the attainment of test-taking procedural fluency (Boaler 2002, 2008b; Horowitz, 2005; Jacobson, 2000; Kriegler & Lee, 2008; Roschelle et al., 2008; Schifter & Fosnot, 1993). Concepts related to the social significance of mathematics are rarely discussed and learning related to the social applications of mathematics rarely occurs in a regular math class. Math classrooms are driven by an educational math culture that is focused on teaching students to solve abstract problems that have already been answered and must be checked by a higher authority, the teacher. The typical experience is to receive instruction, copy what you were told, solve similar problems and ask if they are correct.

Framed by an epistemology of Freire (1970, 1973, 2004), Frankenstein (1983, 2008) defined *criticalmathliteracy* as the practice of using mathematical content to achieve *conscientização*, a student’s ability to read the word and the world, which is what Freire (1973, 2004) considered to be the purpose of a liberatory education. Rooted in a Freirian tradition Frankenstein described *criticalmathliteracy* as the practice of providing students with an opportunity to decode mathematics that is in print. This contextual decoding develops a richer understanding of the form of numbers, allowing students to read the word as they critically analyze the manner in which numbers are being used to influence, validate, and instigate social activity (Frankenstein, 1983, 2008; Gutstein,

2003, 2007). In an analysis of the collected data from YPP at Horton Charter School there was no evidence of students engaging with numbers in the context of media print and literature. In reviewing the analysis (Management Consulting Services, 2008), nowhere did it state that YPP would be engaging students to use mathematical thinking and analysis in this manner. Further, when talking with Beverly, the program coordinator, she explained that this is not a part of the curriculum designed by YPP. The absence of this type of literacy will be discussed in Chapter 5 as I explore suggestions for the future of YPP in LA.

In a review of the analysis, I have taken the position that even though this brand of *criticalmathliteracy* was absent from the curriculum, there was ample evidence that the social action and community organizing pedagogy of YPP did provide the students at Horton Charter School with an opportunity to develop a deeper understanding of the injustices in their community as they are taking direct action as central figures in a national math literacy campaign (Management Consulting Services, 2008; Watts & Guessous, 2006).

In the review of literature an emerging aspect of a reconceptualized mathematics is rooted in the work of D'Ambrosio (1979, 1992, 1993, 1988a, 1988b, 2000) as he pursued the role of ethnomathematics in creating peace. Ethnomathematics is characterized by the ability of educators and community members to use teaching and learning as an opportunity to ensure that mathematical cultures and political presence of traditionally marginalized peoples are represented in society. The curriculum of YPP

does not directly engage students to experience a cultural mathematics outside of the dominant perspectives presently held within our colonized educational system.

However the experience of facilitating another's learning with the expressed purpose of "*math literacy + social change*," does create sustained opportunities for participants to reflect upon the social experiences of their community and to reflect on the nature of mathematical literacy and its role in alleviating injustices (Management Consulting Services, 2008).

The practices (Wenger, 1998) associated with being a Math Literacy Worker may not directly transform the content of mathematics that is being studied by looking into indigenous mathematics or its history, but it does honor the ethnomathematics tradition as a pedagogy that turns math into a social experience. This is something the National Mathematics Advisory Panel (2008) recommended for traditionally marginalized youth of color and lower socio-economic status (Roschelle et al., 2008). YPP may not study the way different cultures use math, but it does transform the culture within which the learning of mathematics traditionally occurs (D'Ambrosio, 1979, 1981; Gutsein, 2003, 2007; Management Consulting Services, 2008; Watts & Guessous, 2006).

For the participants at Horton Charter School, the Young People's Project flipped the experience of mathematics on its head. In YPP the literacy workers were trained to use a set of provided math games known as flagway and were supported in creating their own games. The math games, like investigations, were designed to create a social activity that stimulated interaction amongst the students and led to them questioning the

math that was embedded in the game. The rules and formulas came after the activity and engagement, not before it (Moses et al., 1989; Moses et al., 2009; Moschkovich, 2002).

Designed as a peer-to-peer learning model, the Young People's Project characterized a "third interpretation of the zone of proximal development" as developed by Vygotsky (1978) and described by Engerström (1987) as "a collectivist or societal perspective" (p.174). Wenger (1998) described modern educational institutions as "largely based on the assumption that learning is an individual process, that it has a beginning and an end, that it is the result of teaching" (p. 3). The Young People's Project reconceptualized mathematical learning as a social activity, a community task that placed the students as the center of the movement. Working as peer tutors, students were able to honor the developmental approach of Vygotsky's Zone of Proximal Development and the use of the more capable other, in that they studied with another student who was a learned *other*. Using peer relationships provided strong scaffolding needs for the diversity of struggling learners. When talking in late-March with Jessica, a new High School Math Literacy Worker, she described the absence of the capable other in her regular math class when she explained:

Well in a regular classroom you have one authority figure, the teacher, which is someone who is older than you and doesn't relate anything at all to you and you just have him telling you where the numbers should go or something like that. And you have books, and you're learning off of them.

Using math literacy as a social focus created an opportunity for the literacy workers to develop an understanding of the social significance of math literacy,

deepening their appreciation for the subject and their resolve to succeed academically. Even for the literacy workers, like Deivi, who does not see the math in their work, he still believed it was there and was waiting for the time to come when he could see it more clearly. The literacy workshops created an immediate purpose with tangible outcomes and sustainable participation for learning math. This purpose and the tangible outcomes for learning are often missing from mathematics education.

Theme 3: Nurturing Agency

When interviewing Beverly in January she simply explained, “we empower them to think.” Nurturing agency relates to YPP’s ability to support the building of positive personal and communal images that cultivate a belief within Math Literacy Workers that their presence can, will and does impact and change one’s environment (D’Ambrosio, 1979, 1981, 1998b; Freire, 2004; Giroux, 1983; Gutstein, 2003, Management Consulting Services, 2008; Moses & Cobb, 2001; Skovsmose, 1994, 2007; Watts & Guessous, 2006).

Presented with the problem of poor math literacy, Math Literacy Workers are driven to directly engage in an authentic manner with members of the community in a campaign for math literacy (Gutstein, 2007; Freire, 1973). With their reconceptualization of mathematics, Math Literacy Workers have come to understand that math can be used as a means for social transformation. This direct action is a fundamental element of what Freire (2004) described as *conscientização* and a necessary element for praxis to occur.

A Math Literacy Worker’s sense of agency was nurtured by their involvement with YPP. There was evidence of a growing awareness that their work as Math Literacy

Workers extended beyond their immediate surroundings and community in what has emerged as a practice of generating critical mass.

Generating critical mass.

The High School Math Literacy Workers at Horton Charter School saw themselves as offering an opportunity that many students need. They viewed it as an alternative approach that would help many struggling math students achieve success and they saw their work as growing exponentially, because they all believed it works. When interviewing Paul, a College Math Literacy Worker, in January he explained, “it works because you’re doing this to teach somebody. A different ideology to learning.” During her interview in March Yasmin, a veteran High School Math Literacy Worker, she explained:

A Math Literacy Worker is someone who helps try to understand mathematics.

Like not just, oh that's it, but also you kinda understand it and you show it to somebody else. You give your knowledge to someone else so they can give their knowledge to somebody else.

Karen, a veteran High School Math Literacy Worker, described in late-March critical mass as:

It could go pretty far. It could go pretty far but if there are more people around that want to help the community, it would be great to help it spread more. And it has to be people who actually do believe that people can make a difference in life, and if you believe that, anything is possible.

The principle of generating critical mass was not solely about the larger changes one was involved in making, it also related to the little moments, as expressed in an interview with a Jessica a new High School Math Literacy Worker, in late-March:

If you help others you feel good about it because you're not being selfish, and YPP, it like, helps you see that you could help others in little things you do, like just show an example or telling them you could do it, or anything. Little things like that, they help your community and make them feel better and makes them think that they're good to go to college or anything.

These little moments of critical mass were observed one afternoon in early March during a literacy workshop at Roosevelt Elementary School:

Student: "I don't get it."

MLW to another student: "Do you get it?"

Other student: "Yeah."

MLW: "Explain it."

On another day of observations, students who understood the flagway game were asked if they could model for the other students. In January when interviewing Raymond, a College Math Literacy Worker, he explained, "from the beginning it's about developing as a community organizer." As expressed by Jose, a veteran High School Math Literacy Worker, during his follow up interview in late-March:

For YPP we're trying to like help our community first and then once we've done it here and settled here, we'll branch out to other communities. Like in the summer, I wasn't here, but they told me they went to Crenshaw and Compton and other

places and they are even making a video game of it now. We're trying to settle here and help our community first and then help others.

When talking with Paul, a College Math Literacy Worker, in January, he expressed concern regarding the limitations of the college students to take their work with YPP beyond the couple of hours a week of service:

I definitely think a big thing at least on the college students' perspective is our perception of what we are doing here. I mean I would always say I had an understanding of obligations to world beyond myself, I always thought it as a giving sort of way... I know sometimes when I'm talking to some of the volunteers, oh its cool it's just a couple of hours a week, I can do this and then I gotta go study for my test. It's very much compartmentalized about what they are doing here and it does not pervade in their life fully.

This discussion with Paul highlighted an absence of a personal stake present in the College Math Literacy Workers regarding their involvement with YPP at Horton Charter School. The High School Math Literacy Workers had a personal stake in the program as it affected their home community that translated into a clear sense of ownership in the work of being a Math Literacy Worker. The College Math Literacy Workers, who are typically visitors to the community for the span of their college career with plans to move on, may lack ownership and sustained participation, especially college students who drop out of YPP once they receive their required service hours. This was evident in the fact that when my study began, six College Math Literacy Workers were involved with the program, but once Paul had to leave for a semester

abroad in February, three of the other college students simply stopped coming. This issue is discussed further in Chapter 5 as I explore recommendations for the future of YPP at Horton Charter High School.

Critical mass is the notion that once enough people believe in and act for social change, it will generate a global movement that will quickly include all human beings to believe in and act for social change (Freire, 2004). In her March journal entry, Anahi, a new High School Math Literacy Worker, wrote, “being a Math Literacy Worker means you’re helping the future generation be successful and hopefully understand math a little clearer.”

As Beverly said in January, YPP “doesn’t work miracles” but from analyzing the data, it stirred in all the College and High School Math Literacy Workers a sense of hope and invigorated the possibility that things can be changed and that justice is real (Freire, 2004; Gutstein, 2007; hooks, 2003; Horton & Freire, 1990; Horton, 1998; Moses & Cobb, 2001; Payne, 1995).

As Moses et al., (1989), Moses and Cobb (2001) and Silva et al., (1990) explained, the Algebra Project is a trans-generational movement. The fact that the participating high school students knew that Young People’s Project is part of a national math literacy campaign known as the Algebra Project, they felt immediately connected with a network of youth and adults that was bigger than anything they had previously witnessed.

During my final observation in late April I spoke with a High School Math Literacy Worker who had just returned with Beverly from a weeklong cross-country trip.

They went to North Carolina to attend the 50th anniversary of the Student Non-Violent Coordinating Committee (SNCC) in Raleigh. Jose, explained that they “drove into Tennessee, through the Appalachian mountains to visit The Highlander School, the birth place of many civil rights activists” (Horton, 1998; Manke, 1999; Payne, 1995).

As they made their way back to Raleigh for the 50th anniversary celebration of SNCC, Jose explained that they visited Duke University and stopped at a Cherokee Indian Museum where they learned that “it used to be their land, Indian I mean land before the British came.” Later during this last observation of the study Beverly, the program coordinator, explained that the students were able to “have a private meeting with Bob Moses where students representing mostly all of the YPP national sites attended.”

Framed as a grassroots movement that capitalizes on localized leadership and family involvement, the Math Literacy Workers were in a constant state of facilitating their own learning, each other’s learning, and training other youth to be High School Math Literacy Workers (Acevedo, 2008; Freire, 2004; Management Consulting Services, 2008; Skovsmose, 2007).

During my last observation in April Beverly announced to the College Math Literacy Workers, the High School Math Literacy Workers, and the new recruits, that for a week in June, a group of eight of them will be taking a trip to San Francisco to teach a class of Algebra Project students about YPP in preparation to launch the program at their school site in the Bay Area. This constant state of facilitation cultivated within the youth a sense of ownership not only in the workshops, but in society as a whole and in their

mission to address the problems related to poor math literacy and to social inequality that plague our communities. These opportunities to pass on their knowledge and to train new recruits within their local, state and national community is evidence of what Moses et al., (1989), Moses and Cobb, (2001), and Silva et al., (1990) described as a trans-generational movement.

The practice of College and High School Math Literacy Workers as facilitators, characterized praxis as described by Freire (2004). Breaking from the destructive nature of the “Banking concept of education” (Freire, 2004), that is, rather than being fed information to retain, Math Literacy Workers are empowered to think, act, reflect and transform their community as they develop their voice and agency as facilitators and leaders of math literacy works.

Key character values for the success of this trans-generational movement described by Moses and evidence provided from the data analysis were the cultivation in the Math Literacy Workers of humility, community awareness, agency, social activism, math literacy, perseverance and patience. “I can connect to that. Yeah, patience, that's it right there. That's like the golden one right there” (Deivi, veteran High School Math Literacy Worker, late-February).

Theme 4: Critical Consciousness

A core element of mathematics for social justice was framed by the declaration of Moses and Cobb (2001) that stated Algebra is a civil right and the classroom is a tool for community empowerment and social transformation. Civil rights were described as the rights of an individual and community to be protected from unwarranted actions and to

enable these individuals and communities to participate fully and freely in the social, political, cultural and economic life of their nation. This declaration mirrored the liberatory pedagogy of Freire (1970, 1973, & 2004) and reflects the tenants of critical pedagogy while creating an opening in the classroom for dialogue, consciousness, reflection, empowerment, development of voice and praxis to emerge.

In the 1960's a literacy campaign emerged as a core element of the *Freedom Riders* movement in the Southern States in an effort to eradicate the Jim Crow laws and racial discrimination (Bond, 1966; Horton & Freire, 1990; Horton, 1998; Manke, 1999; Moses & Cobb, 2001; Payne, 1995). The literacy campaign revolved around the notion that reading was the most powerful and effective way to grant citizenship, voting rights, and access to social, political, cultural and economic power in the United States. In this tradition, Moses, who himself was a freedom rider in the 60's continued this literacy campaign highlighting the significance that mathematical thinking and problem solving have in our modern technological world. The goal of the Young People's Project is to empower, traditionally marginalized and underserved students to develop the competencies, capacities and confidence necessary to participate in today's world (D'Ambrosio, 2000; Moses & Cobb, 2001; Skovsmose, 1994, 2007). The role of Math Literacy Workers as facilitators provided them with an opportunity to read the world as they applied energies and efforts to the transformation of our community. In executing their roles they grew in understanding, as they read the world and more deeply absorbed the meaning of social inequalities and inequities that plague modern civilization.

The Math Literacy Workers described their work as providing an opportunity for struggling students to experience math in a problem solving pedagogy as a fun, engaging, inter active, social activity, where many voices were heard and multiple ways were presented. Framed by this multiplicity, the Math Literacy Workers felt they were providing a space for marginalized youth to develop confidence with mathematics while at the same time providing them with an educational opportunity to keep them from the streets and direct them towards college and adult life (Gutstein, 2003, 2007; Horn & Nuñez, 2000; Management Consulting Services, 2008; Schoenfeld 1989; Seceda et al., 1995). As Paul, a College Math Literacy Worker, explained in January:

The [High School] Math Literacy Worker, working with younger [elementary] students can see the [academic] misfortune [when] working with a 6th grader that doesn't know their three times table. [The High School Math Literacy Worker] can say [to themselves] that if they were in another [more affluent] community that they wouldn't have this disadvantage. This awareness motivates them to want to change things [in their community].

When talking with Karen, a veteran High School Math Literacy Worker, in late-March, she elaborated further by explaining, "I felt empowered because, it's so amazing how people like want to make a change and how people want to help other people." The experience of empowering self and other as the identity of being a Math Literacy Worker of the LA cohort of YPP, is math being used as a tool for social transformation.

Framed by the social problem of math literacy the students are working in a collective manner to stimulate positive change in their local and global community

(Bowles & Gintis, 1976; D'Ambrosio, 1998b; Freire, 1973, 2004; Gutstein, 2003, 2007; Skovsmose, 1994, 2005). When talking with Paul, a College Math Literacy Worker, in January he explained:

To understand the history that has led to the inequitable situations and that we can change them. And math is the one thing often overlooked. It's not looked at as a systemic issue failure it is looked at as an individual weakness. YPP allows participants to look at the framework differently, looking at the larger social factors of opportunity, class, and privilege.

Within the larger context of "*math literacy + social change*" (YPP shirt slogan) Math Literacy Workers are presented with the daily problems of creating effective workshops and outreach opportunities for all participants to be engaged (Management Consulting Services, 2008). "It allows people to take charge, to be confident in their thought process about what they believe and know, what to know, what they want to know, inclusive and beyond the realm of academics" (Raymond, College Math Literacy Worker interview, January). The Young People's Project is designed as a reciprocal peer-to-peer learning model, stimulating a level of dialogue amongst the College and High School Math Literacy Workers framed by the purpose of their shared work as Math Literacy Workers. Guided by Freire's (2004) description of liberation as the process of developing an understanding of oppression and then using that understanding to create social transformation, I was able to record many of the College and High School Math Literacy Workers as they described this phenomenon. Many expressed that they felt society as a whole expected them and their peers to fail. They felt they were living in

dangerous communities with limited resources while they attended schools that were typically not helping them and their peers grow academically, socially, and professionally. However, they believed their work as Math Literacy Workers was creating positive change (Freire, 1973; Gutstein, 2007).

Working with YPP as a Math Literacy Worker provided the College and High School students with an unexpected opportunity to actively engage in their community in a manner that supports social change (Management Consulting Services, 2008). It is not a direct mission of YPP to educate the students on the reality of their oppression, yet in their interviews many expressed an innate understanding of these larger social dynamics and a curiosity to learn more. For example, during her interview in late-March, Karen a veteran High School Math Literacy Worker, asked me about Math Literacy and *criticalmathliteracy*, wanting to know more, becoming excited about how math literacy can be used to leverage social transformation (D'Ambrosio, 1998b, 2000; Frankenstein, 1983, 2008; Gutstein, 2003, 2007). She responded in her interview:

That's cool, that's what I meant like you learn something out of it and how it involves everything. Cuz they say math is everywhere and you'll use it everyday in your daily life. And you'll hear kids say why and that's not true, it's not involved in books or it's not involved in this but you learn that it kinda is.

Student voice, reflexive knowing, and a transformation of social identity categorized the experiences of being a Math Literacy Worker as an act of critical consciousness for the LA cohort of YPP.

Student voice.

Being a Math Literacy Worker provided student participants with continual opportunities to contribute to their experiences as they created, organized, and facilitated their math literacy workshops. These opportunities to contribute were the moments the College and High School Math Literacy Workers were supported to have, use, and create with their voices (Gartman, 2006; Gutstein, 2007).

A key aspect of voice that has emerged from this research was the impact of participation on the College Math Literacy Workers and the High School Math Literacy Workers in their confidence in public speaking. In her late-March journal entry, Yasmin, a veteran High School Math Literacy Worker, wrote, “as a student this experience will make it easier for me when I grow older and interact with other people.”

When talking about the impact of participation on himself, Paul, a College Math Literacy Worker, in January explained, “in the beginning I couldn’t speak in front of large groups.” YPP gave opportunity in helping him learn, “how to speak to people, getting over being shy.” When describing the impact on the high school students he explained, “speaking in front of people” was a big obstacle they overcame. “In [the] beginning they were real scared, not anymore.” He elaborated by explaining, “in [the] beginning [they were] very nonchalant. Now [they are] driven by more of a purpose of being. They have something they want to do, more of a sense of pride and motivation to get something done.” In her February journal, Paula a new High School Math Literacy Worker, described one of these opportunities when she wrote, “then the next game we played was walk my colors. I got a chance to explain it and I think I did pretty well.”

The opportunity for everyone's voices to be heard filtered into the workshops, sometimes generating confusion or disagreement. However, like any members of a good democracy, the Math Literacy Workers listened to each other as they made on-the-spot decisions that they could all agree upon (Dewey, 1961).

During an observation in early-March I recorded the following field notes:

There was lots a disagreement during flagway with the High School Math Literacy Workers about using the colors, selecting numbers to include, the student groups, and about whether or not they should use the numbers at all, or if they should just play with colors. After two minutes or so of back and forth exchanges an agreement was reached. Deivi, a veteran High School Math Literacy Worker, finally stated, "We're gonna use the numbers. It's their second time doing this, its OK." They broke up into small groups the High School Math Literacy Workers clarified any questions and reexplained the game.

The impact on voice extended beyond experiences with YPP and into the Literacy Worker's homes. During her March interview, Yasmin a veteran High School Math Literacy Worker, explained:

I think in a way it's gotten better because like as I said I was shy and like, I would talk to my parents and my siblings and stuff but I would never, like I had problems trusting them for some reason. And I think just communicating with other people has helped me trust even my own family, just like, I can talk about, guys with my mom or even with my dad. Or my sister. We've just gotten closer.

And cuz I help out the family in a way, with getting paid. I think that's matured me a little. So I won't be that immature little sister.

Beverly, the program coordinator, in January, described how her voice as a Math Literacy Worker continued to grow:

It's still growing. It was one thing to be a high school student Math Literacy Worker [when I was younger], but to now be a grown woman who believes in something and trying to see it through. It's a lot more layers being the coordinator, relaying to all the people.

Reflexive knowing.

To support their growth as Math Literacy Workers, community organizers, leaders, and agents of change, YPP has embedded a reflexive component into their program. The debriefings required College and High School Math Literacy Workers to reflect upon their experiences as they developed their knowledge, skills and capacities as community organizers and facilitators of math literacy workshops. Paul, a College Math Literacy Worker, explained in an interview in January, "it all depends upon a person's weakness and strength and how they grow on those. A constant journey." He elaborated further when he stated, "Math Literacy Worker means I am taking serious the role of privilege I have been granted and to know the best way for me to understand myself is to understand another by being a part of something bigger than myself."

Responding to questions about the impact of the work of Math Literacy Workers, Raymond, a College Math Literacy Worker, explained in January how being involved in YPP affected him:

Something I could be a part of. Something to help learn about the privilege of being a college student. To help understand more deeply the situation of students who have been denied access through the gateway of mathematics and to know there is a way to actually change.

In the follow-up interview with Jose, a veteran High School Math Literacy Worker, in late March, he explained:

Well, over time, you know a facilitator discovers his/her faults, like oh I did something wrong or like you realize what you're doing wrong by the kids' reactions. Like the other day there was a kid, they were running around and some people fell, and from that point on you realize oh you shouldn't make them run because they are going to fall.

During a different interview in late-February with Deivi, a veteran High School Math Literacy Worker, he explained his reflexive thinking process as:

It depends on what we did the other day before and then we'll go on from there if the kids are ready or not. Sometimes we'll have to go back to other things to make sure that they get it. And if we have time we'll do another workshop. Just something simple, crack the code, worksheets, and then after we got that down we check in with Beverly and we go around the group making sure everyone can explain the game. Just in case someone who was assigned to do it, doesn't show up, we could take over right away, and that's, uh then we go home. Oh we make sure we have our materials, that's like number one. You don't leave the meeting without our materials.

During an observation in early March, on the day the High School Math Literacy Workers were training the new recruits and just before they went into the classroom to debrief, the High School Math Literacy Workers talked amongst themselves outside. One Math Literacy Worker said to the rest, “it was sad,” talking about the low levels of student engagement. Before reacting to anything, another High School Math Literacy Workers reminded the others about when they started and their difficult first days and how this was the recruits’ very first workshop. When thinking about his own experiences in late-March, Deivi, a veteran High School Math Literacy Worker recorded in his journal:

The least effective thing that we do is improvising. After we end a game and have to add up points we don’t know how to keep the kids occupied. We have to come up with some micro-icebreakers when we make a transition between games.

Transformation of social identity.

Guided by the principle from the Algebra Project that math is a civil right, YPP views the community organizing aspect of being a Math Literacy Worker as an opportunity for social change and social transformation (Management Consulting Services, 2008; Moses & Cobb, 2001). Paul, a College Math Literacy Worker, during a discussion in January explained, “Math is what it is, it’s how it’s used is what’s gonna matter. How it’s put together, how it’s implemented is what’s gonna make the big change. Yeah. Yeah”. He further elaborated how, “Being a Math Literacy Worker allowed me to believe in tangible change.” Even though in her first interview in January with Beverly she explained, “it’s not something that YPP promotes, that math can be a

tool for change,” but there was an inherent understanding among the participants that their work as Math Literacy Workers was creating social transformation (Freire, 1970, 2004). Later in the same interview she went on to say, “now we are fighting for the same education as everyone else.”

When interviewing Jessica, a new High School Math Literacy Worker, in late-March she explained:

Um, when I say help our community I say like, cuz Highland Park is more of a Latino or Hispanic kind of community, people from an outside perspective they see us as failing or they see us as just violence or something like that. And we’re trying to help the students get out of that and help other people see that we’re not just about that.

During his interview in late-February Deivi explained in his interview:

There are a lot of kids who are below basic math, you know according to test scores and stuff. So YPP is here to like help teach them, the basic math, algebra, so they can move on. And then with that done, maybe you can improve the schools, get the math up, and then when people see that we improved with math maybe it can go onto a different subject: English, history, get those test scores up. And our community would be better.

Even though a fundamental element of public education is to develop a strong, intelligent and active citizenry, schools provide little to no opportunity for students to authentically engage in their community in a sustainable and mutually beneficial manner.

The literature review documented social trends of alienation in math classrooms and the collected data confirmed this sense of alienation as something real and tangible for the High School Math Literacy Workers participating in this project (Anyon, 1980, 2005; Freire, 1970, 1973, 2004; Gartman, 2006; Gates, 2000; Giroux, 1988a, 1988b; Gutstein, 2003, 2007; Seceda et al., 1995).

Analysis of the data revealed the positive impact the Young People's Project is having on the participants in providing them with an opening and an opportunity to vision and participate in the possibility for their communities to be safe, healthy, and productive (Management Consulting Services, 2008).

For the High School Math Literacy Workers, the literacy workshops became the space for youth leadership to emerge as a catalyst for social transformation. Even though the workshops at Roosevelt Elementary School were riddled with inconsistencies related to schedule and logistical details, the Math Literacy Workers were able to see their work as something that was creating an opportunity for supporting struggling youth to achieve social, cultural, and academic success (Gutstein, 2003, 2007; Management Consulting Services, 2008; Moses & Cobb, 2001; Watts & Guessous, 2006).

An outcome of participation with YPP as a literacy worker was for the participants to develop an understanding of their work as a Math Literacy Worker as stimulating, through critical mass, a transformation of social identity.

Karen, a High School Math Literacy Worker, in her late March interview expressed this point:

Because, well, well my history teacher says that we have a colonial mentality, so what that means is we think like Europeans do, we think we're not good people, that we can't be over the top and we can't achieve things that white people could do. And that affects around you, cuz other people ask you why are you even doing that, it's not worth it (Karen, High School Math Literacy Worker, late-March interview).

Yasmin, a veteran High School Math Literacy Worker, described in her March interview:

Well yeah I mean when we were at a local High School we'd be there Saturdays and there would be your stereotypical gangster cholo and he would be there instead of being out on the streets, um, maybe by us being there it could have kinda like I'm being dramatic but like save a life because they could be smoking or drinking or abusing someone or killing someone out there. I mean you never know cuz we had a girl, there was a girl killed on York and 64th by an Avenue, it's a gang, because of trying to shoot someone else and they shot her.

Jessica, a new High School Math Literacy Worker, explained in late-March, how being involved in YPP had impacted and changed her sense of self and presence as a community member:

It helped me because I never did anything to help the community. I mean we never had program to help the community. And here I think it's helping the community a lot, you know, to get our reputation on a better level, on a better status. That way we just won't be perceived as just Mexicans or Hispanics and

that's it. Or like, they're not going to graduate, so might as well just put them at McDonald's or something.

In the last journals collected in early-April, Jessica, a new High School Math Literacy Worker wrote: "The social problem that YPP is solving is to make the kids feel confident in themselves. A lot of parents make kids feel bad if they don't get math and YPP is helping the kids understand math."

Samira, a veteran High School Math Literacy Worker, elaborated on this idea in her last journal entry when she wrote, "to help others with math, and social awareness to make a difference in the community. To show that teenagers can be someone to show and teach others like the teachers and adults."

The practice of critical consciousness is not a clearly stated aspect of being a Math Literacy Worker of the Young People's Project (Management Consulting Services, 2008). However, the participating students at Horton Charter School developed an innate understanding of the historical conditions that led to the present circumstances (reading of the word) and a belief linked to direct action that their efforts are making a difference (reading of the world) (Frankenstein & Powell, 1994; Freire, 2004; Gutstein, 2007).

In an analysis of the data, even though the program did not intentionally promote *criticalmathliteracy* as described by Frankenstein (1983, 2008) and Gutstein (2003, 2007), it became clear that the program is aligned with a liberatory pedagogy (Freire, 2004). I believe it would be of benefit for the curiosity and empowerment of the College and High School Math Literacy Workers to draw more direct links to the ways they are using their mathematical knowledge as a tool to leverage social transformation

(D'Ambrosio, 1998b, 2000; Skovsmose, 1994, 2005, 2007; Gutstein, 2007). These intentional links would allow YPP to become a program that models critical pedagogy and praxis (Freire, 2004), fostering within its participants a critical consciousness that transcends personal gains while drawing explicit links to present actions as literacy workers within a historical context. The reflexive nature of the curriculum focused reflection on the experiences and practice as a facilitator, with limited directed reflections on the social implications of their work and the historical significance of their mission of “*math literacy + social change*” (Frankenstein, 1983, 2008; Frankenstein & Powell, 1994; Freire, 1970, 1973, 2004). This point is discussed further in Chapter 5 regarding recommendations for the future of YPP LA.

Theme 5: Using After School Spaces Outside of the Classroom to Stimulate Leadership Inside the Classroom

While conducting this research study I became increasingly curious as to the impact a program like YPP has on student behavior (Acavedo, 2008; Hegedus & Penuel, 2008; Schoenfeld, 1989). In an interview with Jessica, a new High School Math Literacy Worker, in late-March she explained:

Um, yeah it's like, you're in the shoes of the teacher. You're the one being responsible, you're the one being mature and everything. And so I think with those two concepts, they just helped me mature as a student that I need to do this.

Empathy, defined as one's capacity to understand another's feeling and emotions, is a character value cultivated through experience as facilitators of Math Literacy Workers, for regular teachers. Working as facilitators provided experience that allowed

these high school students to understand, comprehend, and relate to their regular math teachers in a way never before possible (Gale & Densmore, 2000; Gartman, 2006; Freire, 2004). It was with this new found understanding and appreciation that these high school students were able to, in varying ways, support their teachers and their classroom learning environments. They now know how seemingly little things and small decisions can have drastic impacts. The experience of using spaces outside of the classroom to create leaders inside the classroom was characterized by the Math Literacy Workers capacity to develop empathy for their classroom teachers and the effect this empathy had on their behavior choices as a student.

Empathy.

The impact of voice and agency extended beyond experiences with YPP and into their classrooms. During the first interview in January with Beverly, the program coordinator, she described a conversation she had with a teacher at Horton Charter School, “Quote unquote, he was the worst student, but he said I know how to do this, we learned it in YPP and he got in front of the whole class and taught something.” Karen, a veteran High School Math Literacy Worker, described in her late-March interview how she was now able to take a leadership role in her class and has pushed numerous other students to change their study habits by participating in study groups that she had worked to organize:

And they're always really grateful and they tell me that, like they say thank you. So I feel like it's helped my friends and me. And I try to tell it to other people but other people kinda get mad at it. But yeah the people that want to listen they're

just like yeah we're gonna start doing it. We get study groups and go to each other's houses or some of us have like started sessions after school and stuff like that and we try to promote it. And I tell my friends about it and stuff. I wouldn't have done that before, I would have stayed quiet and just gone along with everyone else. I would have not stood up and told my friends come on you have to do it.

An unexpected characteristic to emerge from this study was that their work as Math Literacy Workers enabled students to develop a richer understanding of their regular math teacher, often cultivating a new sense of empathy that in varying ways, largely positive, impacted their presence in regular math class. During an interview in mid-March with Jose, a veteran High School Math Literacy Worker, he described his developing empathy:

We literacy workers have our problems with kids not wanting to listen. So I kinda know the feeling the teacher gets when we don't listen, so using the leadership skills or the experience that a teacher gets, then I would just listen to what he has to say, maybe quiet down some other people and try to get the work done. Because I know that I wouldn't like that.

In an interview with Deivi in late-February he explained:

Yeah I'm a little calmer in the classroom. I used to give the teachers a bad time in the classroom sometimes. But now that I see they're the same as me I try to lay off, I try not to go so full throttle. But if a teacher leaves an opening, I will take it

but not as bad as I would, because I know how it is to be at that point where you'll pull out your hair. So yeah, it's changed.

The domain that emerged from this theme was the most unexpected. The data revealed consistent findings that the Math Literacy Workers developed a sense of empathy for their classroom teachers and this in turn cultivated a reflection on their behavior that they all expressed as a result of their participation (Acavedo, 2008; Gartman, 2006).

It is interesting to me that for the high school students, the improvement in class did not come from a direct experience of more practice or remediation on the math they were working on, but rather an experience of leadership to teach and facilitate another's learning (Management Consulting Services, 2008).

It was this experience of facilitating another's learning that stimulated self-reflection, responsibility, and ownership on the part of the High School Math Literacy Workers to make different choices as it relates to scholarly behavior, which in turn, anecdotally had a positive correlational impact on classroom grades. Jose, a veteran High School Math Literacy Worker expressed during his follow-up interview in late March, "if you could look at my report cards and look at my grades, that's one comment." It was not about working on more grade level math, but being provided with an opportunity for social engagement, leadership and empowerment that shifted the attitudes of participating students in their regular math classes (Lave & Wenger, 1991; Wenger, 1998; Brown et al., 1989). Their experience as leaders of math literacy workshops, facilitating another's learning consistently translated to their being leaders in their classrooms.

My Journey Becoming a Math Literacy Worker

It was about four years ago and three schools ago when a colleague first shared with me, *Radical equations: Civil rights from Mississippi to the Algebra Project* (Moses & Cobb, 2001). Around this time my mind had begun to wander more and more into critical math education, finding more and more intriguing the role mathematics plays in social development and that as teachers we can use math to either sustain or transform social inequality, enacting or stifling social change and educational justice (Anyon, 1980, 2005; Apple, 2000; D'Ambrosio, 1979, 1998b; Dewey, 1961; Gatto, 2001, 2003; Giroux, 1983, 1988; Greer & Mukhopadhyay, 2003; Gutstein, 2003, hooks, 1994; Illich, 1970; Kozol, 1991, 2005; McLaren, 1989; Skovsmose, 1994). As a newcomer to the practice of teaching mathematics for social justice, the work of Moses and Cobb (2001) opened my mind, body, and spirit to its calling. Once I read this book I knew this was the work I wanted to join. It's like what Paul, a College Math Literacy Worker, said about the High School Math Literacy Workers during his January interview, "I think it's ingrained in who they are. Being involved in a structural thing outside of the classroom that has a positive effect." As soon as I finished reading about the story of Bob Moses and the Algebra Project, it connected me to something deeply ingrained in my being and I knew this would be it.

So, after several years and through a different colleague at the school where I am presently working, I learned that the Algebra Project, and the Young People's Project were working in LA. At first I became an involved community member offering to participate in a curriculum committee; that never got going and then I began participating

in a research committee, which opened up the door for my research study on the formation of the Young People's Project in Los Angeles. With these relationships built I became an active participant researcher and with this study complete, I have recently begun to speak with the national organization of YPP to explore the possibility of setting up a Math Literacy Workers training program at my own high school, to further explore the questions, possibilities, and recommendations offered by this study.

Chapter Summary

Using a rigorous inductive analysis, Chapter 4 details the findings of the evidence as it relates to the research questions pertaining to motivation, pedagogy, and youth leadership. Drawing parallels and contradictions to the reviewed literature, the analysis revealed logistical inconsistency with the workshops that hindered the outcomes, but in no way prevented the desired outcomes from occurring.

Students were motivated to participate in the Young Peoples Project (YPP) with the incentive and pride of earning an income along with the empowerment of being able to take direct action as a community organizer and leader as they developed strategies to address the social problem of poor math literacy that plagues their communities. Through involvement with YPP's national network students were able to feel a sense of belonging, enthusiasm, and engagement, while strengthening their faith that everyone matters.

The pedagogical practices that created the problem posing exploratory curriculum of the Young People's Project, flip mathematics on its head, enabling students to

reconceptualize mathematics as a cultural / social activity that can be used as a tool for social transformation.

Using an inquiry-based, problem-solving curriculum, students were forced to think outside of the box as they reconceptualized not only mathematics as a subject but the very act of using mathematics and what it means to be mathematically literate.

Working as a Math Literacy Worker nurtured a sense of leadership within the community, at home and in the classroom. For the high school students, their newly found identity as a leader carried over into all aspects of their lives outside of YPP.

For the Math Literacy Workers, leadership carried with it a sense of generating a social activism and math literacy with a belief that it would eventually result in a resolution of the present problems of poor math literacy and social injustice that have plagued our communities. Being a math literacy worker provided the youth participants at Horton Charter School with opportunities to take ownership over the learning of their community, raise confidence, strengthen voice, and lift personal awareness through a self-reflexive analysis of one's experiences, choices and the outcomes related to one's choices.

CHAPTER 5: DISCUSSIONS AND IMPLICATIONS

Restatement of the Purpose of the Study

The purpose of this study was to explore of the social factors that contribute to and influence the teaching and learning of mathematics. This research viewed learning of mathematics as a civil right and explored this view within the context of the launching of the Young People's Project at Horton Charter School in Los Angeles. Paying close attention to the peer-to-peer pedagogical model and specific strategies used by the Young People's Project (YPP), this study aimed to document the manner in which YPP transforms the learning of math into a community-wide effort that encourages social justice. Framed by a critical perspective, this study aimed to illustrate that math education can be reconceptualized to become a cultural / social activity that promotes *criticalmathliteracy*, nurtures agency, and stimulates critical consciousness in parallel with creating opportunities for students to authentically engage in their communities as leaders of a national grassroots literacy campaign.

Research Questions

Inspired by the math research of Boaler (2002, 2008a & 2008b), Brown et al., (1989), De Freitas (2008), Gutstein (2003,2007) and Krishner (1997), this study examined the cultural / social learning practice of the Young People's Project after-school math literacy program at Horton Charter School. The following are the research questions this study investigated.

1. How does the Young People's Project motivate students to participate in the math literacy campaign of the Algebra Project?

2. What are the teaching and learning practices of the Young People's Project that assist youth in developing *criticalmathliteracy*?
3. How does the Young People's Project cultivate young leaders and organizers as part of its Math literacy campaign?

Significance of the Findings

Personally as a math teacher, in my eight years of high school classroom experience I have had students fail my classes, yet I have never had a single student who wanted to be a failure. The experiences of my failing students appear to be filled with a mixture of apathy towards learning, a sense of learned helplessness towards mathematics, a sense of entitlement toward their dreams, a disbelief in the academic process, and an inability on my part to reach them. As a teacher I struggle to find ways to create meaningful opportunities for my students to become intrigued with learning, curious about knowledge, and disciplined in their work. When I think of the practice of math education as a civil right, it brings to mind the need not only for mathematics to be made available for all students, but more importantly for it to be accessible to all students. As a result of this research I believe I have found an alternative approach that focuses not solely on the content being learned, but reinvents the culture within which a student learns. Below is the significance of the findings of this research study of the newly launched Young People's Project in Los Angeles.

As a result of a rigorous inductive analysis, five key findings related to the theoretical framework of the study emerged that helped to generate answers to the research questions. From these findings 12 domains surfaced that characterized the

nature of the conclusions of this study. From these 12 domains I identified Five Themes of a Socially Constructed Critical Math Pedagogy. These themes were noteworthy in that they offered evidence of the social factors that contributed to the reconceptualization of mathematics as a critical practice for the 16 YPP participants at Horton Charter School. They also provide a platform for recommendations for future practices and research. These findings are significant in their relationship to YPP in Los Angeles, YPP nationally, math literacy after-school programming, and in general to math education.

The themes are:

1. The program invites participation.
2. Math literacy becomes a cultural / social activity.
3. The program promotes agency.
4. The program creates an opening for critical consciousness.
5. The program uses after-school spaces outside of the classroom to stimulate leadership inside the classroom.

The evidence gathered from this research study supports the intended goals of the Young People's Project and reflects the recommended skills framework developed by the "Partnership for the 21st Century" (Kay, 2002). This is significant in that the model for learning used by YPP fosters growth in the key domains of communication, problem solving, self-determination and global awareness that are stated as essential for learners of the 21st century as they participate in today's world. Beyond the parallels drawn between YPP and the Partnership for the 21st century, these findings are significant in that they draw links between YPP, situated social learning theory, and critical pedagogy.

The pedagogical emphasis YPP placed on relationship building, experiential learning, dialogue, reflection, leadership, empowerment, student voice, self-actualization, political action, community organizing, and praxis, are all tenants of situated learning theory and critical pedagogy. The findings highlight that with YPP's use of a peer-to-peer learning model YPP capitalizes on the role of the more capable other in their efforts to scaffold the student learning of marginalized and disenfranchised math students.

Theme 1: The program invites participation.

In summary, the domains of inviting participation for participants of YPP at Horton Charter School revolved around the following elements:

1. Knowing that everyone matters was characterized by the fact that as a Math Literacy Worker, students were in a position of leadership to directly impact a peer's learning and make positive change in their community. YPP participants took direct action in organizing and facilitating math literacy workshops. All participants were responsible for the workshops.
2. "It belongs to us" was characterized by the practice of all high school participants being facilitators of the literacy workshops, which was supported by opportunities that existed for organizing and travel to interact with other Algebra Project and Young People's Project participants around the nation.
3. Enthusiasm and engagement is characterized by the flagway curriculum, which is designed as an exploratory program that allows all students to investigate mathematical concepts through the vehicle of playing math games.

The significance of these domains was that they facilitated documenting the achievements of the Young People's Project in its efforts to bring the national literacy campaign of the Algebra Project to Los Angeles. The data demonstrated a clear commitment from participants at Horton Charter School to follow and implement the principles of YPP and to take action to help others beyond the math content. The Math Literacy Workers at Horton Charter School felt proud of being affiliated with a grassroots campaign for math literacy and social justice. Participants were empowered through their involvement with YPP, which had a positive impact on self-image and a sense of belonging. The domains related to the manner in which YPP invited participation illustrated that the program was able to move beyond the focus on making math education available and developed a pedagogical model that made math education accessible to students who previously felt shut out. This accessibility is an essential element of math as a civil right.

In relationship to math literacy after-school programs and math education in general, these findings provided a platform for schools to consider the social significance of using math literacy as a vehicle to engage students with their community, bringing a level of meaning and purpose to their education that for many students had been missing. Rather than focusing specifically on remediation and skills preparations, these findings highlight the positive impact that a social building curriculum could have on students' academic performance, social identity, academic identity, and sense of leadership.

Theme 2: Math literacy as a cultural / social activity.

In summary, the domains of math literacy as a cultural / social activity for participants of YPP at Horton Charter School revolved around the following elements:

1. The cultural formatting power of mathematics was characterized by an understanding by the participants that mathematics is a building block for culture and that it can be used to form and build social culture.
2. Math as a social activity was characterized by the interactive nature of the flagway games curriculum and the use of math literacy as a means of organizing grassroots movement that cultivates ‘math literacy + social change.’
3. Building pathways to math literacy was characterized by the focus of the Math Literacy Workers on working with younger, struggling math students in an effort to address mathematical gaps as early as possible, and to create excitement and enthusiasm with potentially disinterested and traditionally dis-enfranchised students. This was supported by the open-ended nature of an exploratory curriculum that stimulated self-direction and the use of a peer-to-peer education model that capitalized on the role of the more capable other as a means to work within students’ zone of proximal development. This process built confidence within the high school students and offered the struggling younger students with numerous opportunities to connect and receive personalized support, guidance, and instruction.
4. Reconceptualizing the teaching and learning of mathematics was characterized by the exploratory learning model, the use of games to learn and play mathematics, and the shifting of the culture of teaching and learning mathematics. This was achieved by

making the high school students, supported by college students, facilitators of another's learning and community organizers for math literacy.

The significance of these domains in relationship to YPP was that they distilled the achievements of the LA chapter in creating structured opportunities for students to cultivate intellectual flexibility as they developed genuine intent to understand each other's learning. These opportunities for students created the openings for YPP to use the more capable other as a means of assisting performance within each individual student's zone of proximal development.

These findings also provided evidence of the need for some areas of growth, particularly as they related to the flagway curriculum and the required support necessary for high school mathematics.

In regard to after-school math literacy programs and math education in general, the use of an exploratory curriculum highlighted the beneficial impact on students' confidence and the development of cognitive abilities including problem solving. The data provided evidence that supports a recommendation for general math educators to shift from a focus on short-term goals and short-term performance achievement to an expanded focus on the achievement of long-term cognitive development and academic gains. The National Mathematics Advisory Panel (2008) focused on three areas of concern, "The nature of what is learned, how learning occurs, and the transfer of learning" (Lobato, 2008, p. 595) The exploratory curriculum of the Young People's Project highlighted the beneficial impact a socially constructed learning environment has on all three of these factors. One area of criticism of the NMAP (2008) report is that it

provided little guidance on accomplishing their call for a redesign of the delivery system. In the context of this report, the Young People's Project brought to light the role that other forums, outside of the classroom may be able to play in redesigning the entire delivery system of mathematics.

These findings highlighted the positive impact of a socially constructed pedagogy designed around the principles of community organizing and social activism on student efficacy, problem solving, academic performance, and overall discipline. An underlying current to the theme of math as a social activity was the manner in which YPP Los Angeles worked to organize the families and community to participate in the math literacy campaign.

Understanding the difficulties and learning gaps parents of traditionally marginalized youth may have with mathematics, YPP LA organized numerous workshops for the parents of Algebra Project students in an effort to educate parents on the alternative learning model of the 'transition curriculum' that is used by the Algebra Project. These workshops, facilitated by the High School Math Literacy Workers, were an opportunity for parents to participate in the curriculum as they saw first hand what math in action may really look like. These parent workshops were an opportunity for the parents to participate in the literacy campaign by simply sharing their experiences with other parents.

This exponential growth of one parents telling two and then those two telling four and those four telling eight, and so on is the spreading of a grassroots movement that empowers parents to take direct action related to their child's education. These parent

workshops cultivate a parent voice, and parent voice is what helps to sway the tides of educational politics towards social justice.

Theme 3: Nurturing social agency.

The domain of nurturing agency for participants of YPP at Horton Charter School revolves around the following element: Generating critical mass was characterized by the work of Math Literacy Workers being facilitators of another's learning in an effort to engender social change. This happened because the Math Literacy Workers organized themselves and others at the grassroots level to facilitate and train other students in their local, state and national community as part of the Algebra Project.

The significance of this domain was that it showed YPP Los Angeles's ability to instill in the participants at Horton Charter School a commitment to life-long learning, faith in themselves and others' to achieve their goals, and a raised critical consciousness. When math is understood to be a civil right, math literacy becomes something that is essential for everyone's well being. The pedagogical model of YPP fostered within its' youth participants a world view that brings the significance of math literacy to the foreground of their efforts. When math is treated as a civil right, it takes on an importance larger than personal gain, and that was just what happened with the Math Literacy Workers at YPP Los Angeles. For the participants of YPP Los Angeles, math literacy was not focused on personal gain, but was inclusive of social transformation.

These findings are significant to math literacy after-school programs and math education in general because they provide evidence of an effective strategy that raises students' engagement with their own education. With growing concerns for culturally

irrelevant curriculum and student apathy, educators can look at YPP as an effective strategy that builds community, raises achievement, and creates a tangible opportunity for students to take direct action as they develop an understanding of the significance of math literacy. As well, the model of YPP provides a tangible link and functional model that connects the experience of a general math education to civic imagination , civic duty, and civic participation.

Theme 4: Critical consciousness.

The domains of critical consciousness for participants of YPP at Horton Charter School revolved around the following elements:

1. Student voice was characterized by the responsibility and leadership associated with being a facilitator of another student's learning.
2. Reflexive knowing was a core aspect of the way Math Literacy Workers used their debriefing time to grow as facilitators, community organizers, students, and leader.
3. Transformation of social identity was characterized by the raised awareness of the Math Literacy Workers as they saw first-hand the impact of poor math literacy in the elementary students they assisted. They developed an understanding of why this issue exists as they worked as community organizers to transform the perception and identity of their peers.

These findings show how YPP Los Angeles encouraged participants to develop a self-reflective learning process that enabled them to be culturally sensitive to the diversity of their community and the needs of other learners.

The liberatory nature of YPP became clear as evidenced by the Math Literacy Workers' being able to begin questioning the injustices in their communities, and the way they saw their role as Math Literacy Workers as a socially responsible way to address those problems (Freire, 2004). A finding of the analysis was an absence of any direct applications of a *criticalmathliteracy* curriculum. An integration of *criticalmathliteracy* with the flagway curriculum would offer an opportunity to create what Watts and Guessous (2006) referred to as a way to "create greater synergy between sociopolitical development and academic achievement" (p. 22).

The growth of critical consciousness was an unintended consequence of the Young People's Project. The program was not intentionally designed as a critical math education. However, as the evidence showed, there was ample opportunity for students to reflect on an individual level, regarding present social inequalities and their role as Math Literacy Workers in alleviating them. However, limited to no opportunities for this growth to happen existed as part of a structured group learning activity or experience. A fundamental aspect for critical consciousness to grow is dialogue. The structure of YPP created an opening for critical discussions. However, these openings were not utilized purposefully to elicit critical awareness or praxis.

In the general classroom math educators have a difficult time creating a space for critical reflections due to the structured pacing plans and benchmark exams that dominate the current teaching environment. The Young People's Project offered a pedagogy that illustrated how the use of a community-organizing model could bring a new level of

critical meaning to mathematics. The pedagogy of YPP created an opening for an unintended critical discussion and awareness to emerge.

In regard to math literacy after-school programming and math education in general the evidence highlighted the emerging paradigm and effective strategy of having teachers and students co-construct their curriculum. The benefits of YPP were a socially constructed and culturally responsive curriculum in which the students were meaningfully engaged in creating the curriculum; this cultivated a deeper sense of purpose for students to achieve academically.

Theme 5: Using after school spaces outside of the classroom to stimulate leadership inside the classroom.

The domain of using after school spaces outside of the classroom to stimulate leadership inside the classroom for participants of YPP at Horton Charter School revolve around the following element;

Empathy was characterized by the new understanding that the high school participants gained as facilitators of students' learning. They developed an appreciation for their teachers as they experienced the responsibility of educating their peers.

This domain demonstrates the impact that YPP is having on the classroom and on the students' capacity to be concerned for the growth and respect of others beyond their involvement with YPP. The practice of being a Math Literacy Worker has a positive impact on classroom behavior. This study raises the need for additional research to be conducted to correlate the anecdotal links generated from the stories of high school participants at Horton Charter School.

In regards to math literacy after-school programs and math education in general, the evidence gathered in this research highlights the impact a socially constructed, service learning, after-school math literacy program may have on fostering positive relationships and student leadership in the classroom. This positive consequence of YPP Los Angeles is another example of these reenergized students' going back into their regular math classrooms and functioning as more capable others, not solely as having the stronger math skills, but as importantly modeling stronger work ethic, discipline, and intellectual flexibility.

Recommendations for YPP at Horton Charter School

Based on the analysis of the data and its relationship to the literature reviewed, this research study suggested three areas of improvement for YPP at Horton Charter School. They relate to (a) communication, (b) reflection, (c) curriculum and *criticalmathliteracy*. As expressed in January during an interview with Raymond, a College Math Literacy Worker, all of these recommendations and the sustainability of YPP in Los Angeles are largely influenced by “the great unknown of Sacramento educational policy making.”

Communication.

When talking with the College and High School Math Literacy Workers, consistent recommendations emerged related to communication issues. Issues regarding communication breakdowns surfaced regularly.

Since the beginning of this research, YPP Los Angeles has spread like wild fire. As this research study began YPP existed at one site, Horton Charter School. As this

research concluded four new sites in LA that have YPP after-school programs were being developed, with more schools interested in the program. One of these new sites is a high school that has scheduled a new elective class for students interested in becoming Math Literacy Workers.

The recommendation for communication relates to the need to the Los Angeles chapter of YPP to develop a structured communication network that allows for regular messages to be passed in an effective and reliable manner. This may include a YPP Los Angeles chapter website. Consistent evidence in interviews, journals, and observations was documented that showed the impact, confusion, and disappointment related to communication breakdowns. As the program continues to grow, reliable and trustworthy communication will be essential for additional newcomers and volunteers to sustain participation with the Los Angeles chapter of YPP.

Reflection.

Reflection and debriefing are fundamental elements of being a Math Literacy Worker. My analysis of the data identified parallels and contradictions when it came to the role of reflection as part of a critical education in the literature review. Nowhere in the literature (Management Consulting Services, 2008) does YPP proclaim itself to be a critical education program. However, as the analysis and findings demonstrated, numerous aspects of the Math Literacy Workers training program characterize it as a critical literacy program.

The core aspects of the contradictions of critical reflection reside in the absence of consistent and intentional dialogue that provided students with a platform to reexamine

the very nature of mathematics education. Absent from this critical reflection was a discussion of the cultural and political forces that have spawned the social inequalities and educational injustices that YPP stands to eradicate. There was no discussion of the role that mathematics plays in society, the application of mathematics to “read the word and the world,” or a self-analysis regarding personal involvement in sustaining or transforming social inequality (Freire, 1970, 1973, & 2004; Skovsmose, 1994, 2005, & 2007). The analysis of the data led me to conclude that the radical spirit of the *Freedom Riders* and the civil rights movement remained dormant within the Math Literacy Workers of YPP Los Angeles and had not been fully tapped into. These are difficult topics to explore and are especially difficult for teenagers who often frame their knowledge within the limited experiences of their families and peer groups. Using a Vygotskian model, the college students and program coordinator could function as the more capable others, assisting the high school students’ growth in their Zone of Proximal Development as it relates to conscientização.

The process of assisting performance has a cyclical nature within the organization model of YPP. The program coordinator facilitated the trainings of the College Math Literacy Workers, who then facilitated the trainings of the High School Math Literacy Workers, who then facilitated the learning of their peers. As described by Paul, a College Math Literacy Worker in January this process with YPP Los Angeles broke down at times; which resulted in an absence of the College Math Literacy Workers in the trainings as facilitations.

This breakdown, due in part to a lack of commitment from college students to sustain participation and due in part to the present communication and organizational structures in place with YPP Los Angeles. The ability of YPP Los Angeles to continue to capitalize on the use of the College Math Literacy Workers was an essential component for the successful empowerment of the High School Math Literacy Workers. The College Math Literacy Workers supported the High School Math Literacy Workers in developing their intellectual flexibility and curiosity by instigating a level of socially conscious and responsive dialogue typical on a college campus, but typically absent from a high school campus. The college students, who were often questioning their own identities and social responsibility, could encourage the High School Math Literacy Workers to engage in these types of conversations at an earlier age.

The analysis of the data demonstrated that the High School Math Literacy Workers had a limited understanding of the meaning of *math literacy + social change*. Providing a platform for understanding the trans-generational missions and the legacy of the Algebra Project in generating critical mass, would have allowed the participating high school students to have a deeper understanding of the significance of their work as Math Literacy Workers.

The recommendations are simple, YPP needs to create time and space – maybe at a bowling alley, a café, in a park, or in a classroom – to have more intimate reflections about some of these larger issues that are so very much at the heart of YPP’s program and its meaning for Math Literacy Workers. Within the boundaries of the already existing

exploratory curriculum, ample space may be allotted for these conversations to mature naturally and holistically over time.

Curriculum and critical math literacy.

As part of the YPP program, the Math Literacy Workers hosted whole school math carnivals at the schools where they conduct their workshops. The results from this study suggested that the enrolled students at these elementary and middle schools be invited to co-facilitate these carnivals for the other students in their schools, and eventually become facilitators of the icebreakers and math games. This co-facilitation could support the community organizing effort of YPP by providing the participating elementary and middle school students with a leadership opportunity.

This augmented participation could also serve as an invitation to become High School Math Literacy Workers as they enter high school. The additional level of participation would honor YPP's model for success as a program people do not *grow out of*, but *in to*.

The curriculum for YPP flagway is designed around basic numeracy and arithmetic for elementary age students. When interviewed, several of the High School Math Literacy Workers explained that they would like to be Math Literacy Workers on a high school campus to support and facilitate the learning of their struggling and disinterested peers. It is a recommendation of this researcher that YPP explore the development of new flagway curriculum that includes working with fractions. With the correlational links evident between a student's ability to reason with fractions and algebraic thinking, it become essential for YPP, as an algebra readiness curriculum, to

provide struggling students with an opportunity to develop mastery of fractional reasoning.

From a critical perspective it is possible to critique the program, that if fractions are not included as part of the curriculum, as an algebra readiness program YPP may actually be sustaining the social inequality of math illiteracy by not ensuring that their participants master this essential math and Algebra Readiness skill. The development of a fractions-based flagway curriculum may provide an opening for the literacy workers in LA to host workshops on a high school campus, where students find fractions to be a challenge. The development of flagway curriculum for fractions that is used on a high school campus could also serve as additional leverage to support high school math teachers as we work to reconceptualize the learning of mathematics on our classrooms.

In light of the growing body of literature that documents and supports the emerging paradigm and practice of *criticalmathliteracy*, it is a recommendation of this researcher that YPP consider the two following aspects of future curriculum development:

1. Develop, as part of the College and High School Math Literacy Workers training program, math projects that require participants to directly use mathematics that enables them to deconstruct social inequality. This act of using mathematics to deconstruct social problems, as suggested by Gutstein, (2003, 2007), Frankenstein (2008), and Skovsmose, (1994, 2005, & 2007), would allow students to capitalize on the opening that YPP creates for *criticalmathliteracy* and critical discussion.

This step would provide students with a holistic reconceptualization of not just the culture of learning mathematics but a reconceptualization of the purpose for which it is being learned as well as practical and critical applications of their math knowledge. The results could become further evidence to support grassroots effort to mobilize the community around math literacy.

2. Explore how these projects could then be used as part of the high school flagway curriculum, including integrating them into the high school math literacy workshops. A gap between YPP and the literature was the application of a *criticalmathliteracy* curriculum. The findings conveyed that YPP is a critical education program in which students may take direct action within the community. They not only reconceptualize mathematics, but also experience being a teenager and a community member in a just society.

It is a recommendation of this research that YPP consider the potential benefits of participants having the opportunity to contextually analyze the application of mathematics. This contextualization will deepen their understanding of social inequality, their appreciation of mathematics, and the mechanisms by which to generate a critical mass for social transformation.

To support the development of critical literacy it is recommended that YPP look into their debriefing process and explore the possibility of integrating the work of Skovsmose (1994) who outlined five possible guiding questions for the development of critical math literacy. It may benefit students' already growing consciousness to provide them with additional opportunities to consider: (a) What is modernity, (b) The manner in

which mathematics can be used to either sustain or transform social inequality, (c) To explore what *math in action* means, (d) To explore the forms of suppression that can be exercised through math education, and to consider (e) How mathematics can be empowering, allowing students to engage in the political reality of mathematics education.

Recommendations for Future Research

Additional research at Horton Charter School.

The recommendations for additional research with YPP at Horton Charter School pertain to the outcomes of the high school participants and the elementary or middle school age participants. In regards to the outcomes related to the high school participants, it would benefit the growth and reflexivity of the program if a mixed method study were conducted that focused in detail on the relationship and impact participation has for the High School Math Literacy Workers in their regular math classes and at home. A collection of math scores and grades, along with observations in the classrooms, interviews with teachers, and interviews with family members, may provide more evidence of the outcomes of being a Math Literacy Worker and could support the growth of YPP in Los Angeles. A study of this nature would help to draw clearer links between YPP participation and academic achievement, thereby providing a stronger platform for the reconceptualization of mathematics to include a program with the pedagogical model of YPP.

In regard to the elementary and middle school participants a qualitative study that gathers evidence of their experiences in the workshop could help to illuminate the

characteristics of the program that are working, while shedding light on any areas of the program that need to be strengthened, reworked and redefined.

Additional research of the Young People's Project.

For YPP nationally three specific recommendations for additional research are offered: One relates to the growth of YPP Los Angeles, the second relates to the national network of YPP, and the third relates to the use of a longitudinal study.

The recommendation for additional research regarding the growth of YPP in Los Angeles concerns formally documenting the manner in which YPP Los Angeles has and will continue to organize itself. In the past YPP and the Algebra Project settled into communities through relationships built with specific schools and districts. Los Angeles is the first time YPP and the Algebra Project have established a program through a network of community-based, non-profit organizations known as One/LA/AP. This is a new experiment for YPP and the Algebra Project. It would be of benefit to document the experiences and share the effectiveness of this organizing strategy in creating a grassroots effort to transform math education in Los Angeles. This strategy would make it possible to replicate the Los Angeles model in other cities that may have community organizations outside the school system that are interested in transforming the learning of students.

The recommendation for additional research regarding the national network of YPP entails collecting data from all the sites, allowing the YPP national organization to develop strategies of best practices related to the formation of YPP in local communities.

Documentation of trends and outcomes that occur from participation with YPP as the Math Literacy Workers share their stories and impact their communities could be included.

The recommendation for the use of a longitudinal study is made with the conviction that it would greatly benefit the growth of the Young People's Project by documenting the lasting impact that participation in the Young People's Project has on Math Literacy Workers. This recommendation is for the YPP national organization as opposed to YPP Los Angeles to allow for as large and diverse a sample pool as possible. A qualitative study would focus on personal accounts and experiences of participants as they grew with the program and continued into their adult lives. Developing an annual cycle of interviews for up to ten years would provide a new layer of empirical evidence for the educational community. The study results would illustrate the sustained transformative impact of being a Math Literacy Worker.

Recommendations for Math Teachers

In light of NCLB and the recent report of the NMAP (2008) at the close of this research study I have listed several key questions for math teachers that I offer for reflection in the context of my recommendations. These questions are related to motivation, social engagement, and teacher preparation.

1. How can we use games to stimulate motivation and engagement? The flagway curriculum is designed around games, and as attested by the participants in this study, the use of icebreakers to stimulate motivation and the math games to sustain engagement was a success. One request I often hear from my students is that they

want to have some fun in math class and for the teacher to be their friend. What I am proposing to my colleagues is that to have fun and to be a students' friend does not mean we have to give up respect, authority, or control. On the contrary these will grow in strength because the students will share responsibilities. It is not easy, but sharing responsibilities often helps to build personal relationships, a process that creates opportunities for lasting teachable moments.

In a regular classroom icebreakers can be like our warm-ups (beginning of periods), cool downs (end of period), or transitional intervals. Icebreakers, like warm-ups can last 10 minutes and could be a good way to build energy in the classroom, as well as to provide students with an opportunity to move around and interact socially as they settle into the routines for the day. Another important time during a class when these activities could be of benefit is either at the end of the period, if there is some extra time remaining, or when a lesson drags on and the energy in the room feels heavy. All of us have experienced these moments. Taking a 5-10 minute break during class may be just what the students need to refocus their attention.

As I stated earlier in this dissertation, I personally used three of the icebreakers observed in this study with my regular classes. One of them, steal the bacon, had to be played outside, but two others, the Katy Game, and Rumors were played in my classroom without having to move any furniture. These icebreaker games are a simple way to energize and refocus a classroom.

The challenge for us as classroom teachers is to create openings within a test-driven, standards-based curriculum to play and befriend our students as we facilitate their learning of mathematical thinking and problem solving.

2. Another question that this research leaves me asking is, “How can we use mathematics as a vehicle to stimulate social engagement?” Typically, students look for purpose in a math class, something that is often lacking in a procedurally based math classroom. As the literature and research illustrated, students appreciate feeling a part of something meaningful. As difficult as it is, it is possible for classroom teachers to create openings for the work students do in the classroom to connect to a larger purpose. This connection to a larger purpose is a democratic education at its finest. A general education is supposed to prepare students to participate in society, but if we isolate them throughout their entire education to classroom experiences focused on abstract principles, what is it that we are really preparing them for? Who are they practicing to participate with?
3. A final question this research brings to mind is, “How can we prepare teachers to create experiences for students to enjoy mathematical thinking and problem solving?” When I think about this question the following concepts come to mind: pedagogy, teacher efficacy, self-actualization, problem solving, exploratory learning, craftsmanship, patience and time. First, a philosophical assumption of this question relates to a practice of enjoying mathematical thinking.

This is not to say that teachers do not want their students to enjoy mathematical thinking; it is just that we have such ingrained traditions of what it looks like and who can enjoy mathematical thinking that many students simply feel left out.

Teachers need opportunities to dialogue on the meaning of being a math teacher in the 21st century. When teachers are provided with these opportunities we have to be willing to take risks, be creative, imaginative, and bold when it comes to the opportunity for us to reinvent the manner in which we engage in the practices of teaching and learning mathematics. This pedagogical reinvention cannot happen in isolation within the teaching community, but requires the larger context of educational policy to reinvent itself as well.

Recommendations for Educational Policy

The evidence gathered from this study provides a need for reflection from educational policy makers as they develop ways in which they can redesign our delivery system of mathematics education. A general education is a civil right; therefore all aspects of a general education are civil rights. With technology being as ingrained in today's world as it is, math literacy has become extremely important as a social equalizer. If education is to be used as a vehicle for social transformation, if education is to be used as a tool for social equality, if education is to be used as a mean to ensure an intelligent citizenry, and if education is to be a measure by which our democracy fails or flourishes, policy makers must be bold as they reflect on the past, participate for today, and prepare for our future.

With present pressures from the White House to develop and implement a set of national standards, it has become essential that these standards reflect the needs of today and that they are designed with flexibility that allows them to adapt to the changing tides of tomorrow. Policy makers are in the position to shift the focus from our test-based culture of mathematics reliant on memorization to an application-based culture of mathematics. The study of mathematics as isolated and abstract principles has its place. However a general education is about social participation and young students must understand the ways they can use mathematics to understand and participate in our world. Math for the sake of math becomes damaging, but math for sake of community and social transformation, as evidenced in this research, is meaningful, purposeful, long lasting, and, ultimately, life altering.

Recommendations for Teacher Education

The final recommendation I would like to offer as a result of this research relates to teacher education. Teacher education is the basic vehicle with which teacher are supposed to receive training that prepares them for the classroom. Now I understand that there is really no amount of training that can prepare one for the classroom, it is just something that you have to do and then learn as you go. With that said teacher education relates to the period of time prior to one enters the classroom and the period of time after one enters the classroom.

The time prior to entering the classroom should be a time for teachers to build ideals, observe many practitioners, talk with veterans, study theory, create mock classrooms, and student teach with a specific focus on the content area one is intending to

teach. Speaking for myself, I attended a prestigious college for my MA degree and teaching credential in Secondary Mathematics and yet experienced no classes related to math methods. I had only one class taught by a math educator, but it was educational statistics and had really nothing to do with the practice of teaching mathematics.

In regards to teacher preparation for the time prior to math instruction a number of topics need to be included: project based learning, individualized assessments, holistic grading, writing in mathematics, math philosophy, critical literacy, teaching math for social justice, the use of games to stimulate engagement and activity, all accompanied by extensive dialogue related to the role of mathematics in a modern democratic civilization, the role of the teacher in sustaining inequality, and the role of the teacher in being a model for social transformation. Teachers need to be prepared with a pedagogy that allows them to engage their students while inviting them to participate, apply methods that foster mathematical reasoning and intellectual flexibility, and instill a philosophy that allows students to adapt to the changing times without losing their footing as an agent of social change.

When a teacher is in the classroom and theory becomes blended with personal practice, the space is needed for teachers to self-actualize. This process does not happen in isolation, but through regular dialogue with colleges at one's locality and with colleges at other locations. The process is something that happens not over days, weeks or months, but years and decades. As a teacher develops personal experiences, sustained professional development can evolve to meet varying demands of today's classroom framed by the diversity of present learning needs. For math teachers key elements

necessary for sustained growth are focuses on: understanding how students are able to acquire the language of mathematics; ability to identify and target individual learning obstacles while providing effective strategies to maneuver around them; applications for teaching mathematics as a practice of social justice and civil rights; capitalization on peer-to-peer learning; creation of differentiated learning environments with the necessary and appropriate scaffolding to ensure all students have access to the math content; strategies for including parents in the learning; methods for developing games; and developing a pedagogy that invites students to not only participate but co-create the curriculum.

APPENDIX A

YPP’s Model of Excellence for Teachers and Trainers

How I see Myself and Others	1	<u>See Self as Learner</u> Genuinely enjoys learning, looks for opportunities to do so, Sees self as continually growing and developing.
	2	<u>Respect for Others</u> Shows willingness to share the role of facilitator with the audience, shares responsibility for group & learning.
	3	<u>Positive Expectations</u> Displays genuine faith that others can do well and are worthy of care, concern and effort. Shows anticipatory confidence in others.
Creating the “We”	1	<u>Commitment to the Young People’s Project</u> Believes in underlying principles & methods of YPP. Works to ensure they are maintained.
	2	<u>Responsiveness</u> Assesses where people are and take action to help beyond the math content.
	3	<u>Cultural adaptability & Community Consciousness</u> Appreciates & adapts to customs, climate, values, needs & norms of a group or community. Sees work in the context of the larger community.
Helping Others	1	<u>Self Awareness</u> Recognizes one’s emotions & manages the situation according to the goals set.
	2	<u>Concern for Other’s Growth</u> Genuine intent & ability to help other’s long term improvement & growth.
	3	<u>Concern for Safety</u> Creates an environment where children or adults can function effectively without fear. Addresses emotional and/or intellectual safety.
	4	<u>Efficiency and Effectiveness</u> Use resources effectively to have positive impact on others.
Communicating the Math	1	<u>Intellectual Flexibility</u> Make useful connections between disparate ideas and experiences. Includes math concepts, everyday life & other subject areas.
	2	<u>Math Structuring</u> Structures activities to create links for students between the experiences & key math concepts.
	3	<u>Math Facilitation</u> Displays genuine intent to understand students thought process, impressions, feeling about math concepts. Ensures that key math concepts are fully developed & discussed.

APPENDIX B

Semi-Structured Interview Questions

Four types of questions.

- (1) DESCRIPTIVE (to paint a picture of a day in the life of literacy workers)
- (2) STRUCTURAL (how are literacy training experiences structured)
- (3) CONTRAST (to highlight pedagogical practices and distinctions with other math programs)
- (4) ESSENTIAL (targeted questions related to research questions and typological themes)

THREE INTERVIEW PHASES (Schuman 1982; Seidman 1989)

- (1) ESTABLISHING CONTEXT (Descriptive and Structural questions will be asked)
 - (2) PARTICIPANTS RECONSTRUCT PERSONAL EXPERIENCES (Contrast questions will be asked)
 - (3) REFLECTIONS ON RECONSTRUCTIONS (Essential questions will be asked)
-

Phase one: establishing context.

- (1) How did you hear about the YPP training program?
- (2) What was your first experience with YPP like? What was happening?
- (3) What did you decide to become a literacy worker?
- (4) What do the after-school trainings look like? What do you experience?
- (5) What does it mean to be a Math Literacy Worker?

Phase two: reconstructing personal experiences.

- (1) How is the Math Literacy Worker training program similar and/or different from your regular math class?
- (2) How are the facilitators of the training program similar and/or different from your regular math teachers?
- (3) What does a Math Literacy Worker do?
- (4) How have you learned to teach mathematics as a literacy worker, and do you ever use these strategies in your regular math class? If so please explain.
- (5) What is the kind of math that you are learning in YPP?
- (6) What are the ways you are learning mathematics in YPP?
- (7) How are you learning to teach other mathematics with YPP?

Phase three: reflections on reconstruction.

- (1) How have you grown as a Math Literacy Worker, student and family member as a result of working with YPP?
- (2) Do you think about mathematics differently now that you are a Math Literacy Worker, and if so how?
- (1) What does it mean to be a community organizer?
- (2) Do you help the community working as a Math Literacy Worker? if so how.
- (3) How has your participation as a literacy worker affected you in your regular math class, at home and with your Community?
- (4) What does it mean to be a leader?

- (5) How does your work as a Math Literacy Worker allow you to be a community organizer and leader?
- (6) What is math literacy?
- (7) What is social change?
- (8) What is math literacy + social change?
- (9) How has being a literacy worker supported you in understanding Mathematics?
- (10) Do you think differently about mathematics now that you are a literacy worker?
- (11) What has your family said about you being a literacy worker?
- (12) What are civil rights? Does math have anything to do with civil rights?
- (13) Do you feel being a Math Literacy Worker is allowing you to participate in your community? If so how.

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