

ACHIEVING EQUITY IN MATHEMATICS EDUCATION:  
ANALYZING RACIALIZED STUDENTS' VOICES

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## ABSTRACT

### Achieving equity in mathematics education: Analyzing racialized students' voices

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Little thought is given to how equitable mathematics would better the lives of those marginalized, or how the increased inclusion of marginalized voices improves the practice of mathematics. The purpose of this narrative research is to explore students' voices and analyze aspects of math identity: the reported beliefs and practices of a group of elementary urban students who identify as Black/Brown. Understanding voice through counter-narrative is a methodology for the equitable practice of teaching/learning mathematics. CRRP describes participants engaged in the metacognitive task of writing untold stories as it relates to their beliefs, practices, and experiences in mathematics learning. The findings offer meaningful and appropriate insights to math educators about student competency, belongingness, and agency.

Keywords: Black and Brown, marginalized students, student engagement, math identity, mathematical competence, sense of belonging to mathematics, mathematical agency, gateway, gatekeeper, fixed mindset, growth mindset, STEM pipeline, counter narrative.

## **Preface**

*"Are You a racist? No is not a good enough answer... you being so assured you're not anti-Black or Anti-Muslim isn't going to stop racism! We need to be active. We need to hold people accountable. What hurts one of us hurts all of us" (Marlon James, 2016).*

It's a challenging time to be a teacher, let alone a math teacher. We focus so much on our approach to recognizing power and privilege and how it affects our profession. As we turn our attention to pedagogical and equitable practices we are forced (rightly so) to negotiate how to teach math in a culturally relevant and responsive manner. This thesis for professors, pre-service and practicing classroom teachers, Special Education Resource Teachers/Coaches, guidance counsellors and administrators aims to help educators meaningfully integrate and increase awareness of equity and social justice issues surrounding the study of mathematics and how it affects Black and Brown students' fulfilment, not just for the requirements for STEM (Science Technology Engineering Mathematics) careers, but also of establishing healthy mathematical personas and identities.

The vignettes and narratives included in this text are written from the perspective of marginalized Black and Brown students at differing points in their experiences learning math (Elementary and Secondary, Post Secondary) and can be referenced to assist in the integration and

awareness processes related to achieving equity, diversity and social justice. Special emphasis is placed on the stories of the low-income racialized experience in order to paint a different picture other than that of the stereotypical existence of the high achieving math student. Viewing this portrait requires one to *unlearn* the stories told about mathematicians, for example, 'math is for boys' or 'mathematicians are nerds.' Stereotypes associated with math and age, gender and race can begin as early as the second grade but may span for the entirety of one's mathematical academia. My familiarity with math stereotypes is derived from personal math experiences but more recently, from parenting a Black child who can recount multiple occasions, in elementary, middle and high school, where Anti Black assaults and microaggressions were made at various levels by educators and students about his abilities and potential in mathematics.

*Multiplication is for White People* by Lisa Delpit (2012), provides a similar depiction of my son's learning experiences in math when she describes "disidentification" (p.24), My son was told he was an outstanding athlete and did not *look like* a math person. He was encouraged to avoid higher-level math courses, as they were unnecessary for athletic scholarships. The conspiracy against the prospects for poor children of colour manifests in many different realms (Sleeter, 2012); however, mathematics as a conspirator has

been overlooked for decades due to the premise that math is neutral, sterile and free from the effects of racism (Battey, 2013).

Currently, the *race* to do a computation is more considerable than the *race* of the “human computer.”<sup>1</sup> And traditional math might say *and so it should be, only the most scholarly shall compete*. However, recent history reveals that there is an under-representation of Black and Brown math competitors. African Canadians/Americans seemingly lack a sense of belonging to the academic culture of science, math, and engineering. Perhaps untold stories of *hidden figures*<sup>2</sup> have the power to change this fallacy.

Imagine the competition of the 100-metre sprint without the inclusion of Jamaican sprinter, Usain Bolt in the race. If a fierce competitor such as Usain were denied access and application of reaching his full potential, we would all be deprived of what constitutes a legendary performance. Although, sprinting and sports is an overused analogy, the stereotypical identity issue addressed is relevant and common among many Black and Brown students. Many Black children are encouraged by parents and teachers to pursue athletics as though an unwritten rule of belonging exists. However, this

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<sup>1</sup> The human computer is a term coined in reference to NASA's team of African American women working behind the scenes. In the early space-race days depicted in the film *Hidden Figures*, a job ... the word “computer” meant a human who makes calculations (Melfi et. al., 2017).

<sup>2</sup> Here, the phrase, *hidden figures* is a paronomasia. It is a well-known cinematic production about the untold story of the Black women mathematicians who helped win the space race, however, in this paper it is used duplicitously to also represent the untold stories of Black students in my narrative inquiry.

acceptance is rarely transferable to the milieu of Mathematics. Speaking of *belonging* to a subject or to math may seem extraordinary; however, the writer and cultural critic, bell hooks (2009), has documented the concept of belongingness to places, to people, and to a movement, she ascertains that it is common for *others* to feel “no sense of place”(p. 1). Dr. J. S. Matthews (2018) dedicates his research to belonging to mathematics instruction.

Do I feel a sense of place or belonging in mathematics? A dear friend once asked me, *Why math?* It is a fair question. When I speak to most of my friends about the inequities and injustices observed in math education, I see a glaze-over in their eyes. My contemplation of issues in education and the quest for an understanding of what it means to be an equitable teacher and an academic leader came from my diverse experience in schools and more directly from being a Black mother. No parent wants to see their child struggle in an education system rigged against them. As a Black mother, I have observed my child hurdle racial barriers that do not exist for non-racialized students. As a Black educator, I have observed, racialized students who incidentally discover the crushing effects of *not belonging* in elementary school. How quickly marginalized and racialized students uncover the mythical hierarchy of stereotypes. Blacks become Athletes, Asians become Mathletes, and Whites become the Paracletes or “brokers of

truths.”<sup>3</sup> Before secondary education is complete, racialized students recognize Whites have power and control. In Canada, Black scholars rarely see a reflection of self as they advance in higher math education. While they may excel athletically or musically as my child did, he never identified or belonged to the jocks or entertainers. Blacks and Browns have notable reputations as orators, for example, Dr. Martin Luther King Jr. or Gandhi and writers such as James Baldwin and Toni Morrison. To date, a Black scientist has never won a Nobel Prize. Why are bright young black people avoiding math as a viable choice? Black people in Western countries are less likely to study math or science, less likely to achieve a top degree and less likely to progress into STEM careers (Washington, 2011). My research focuses on young voices of Black and Brown math students, similar to that of my child. Listening to specific voices may provide insight into enhancing their contemplation of belongingness to math as suggested by Dr. J. Sharif Matthews (2018). Exclusion from the math race brings to light how gatekeeping is perpetuated in the STEM community, especially in the Western world. That’s why math!

Finally, who should study math? Addressing the need for unfettered and fair access to progressive mathematics education might

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<sup>3</sup> Athletes, Mathletes and Paracletes are used for literary effect. The term Privileged has been replaced with Paraclete, borrowed from seminary study to describe the mentor who should share with the mentees their God-given resources. The Paracletes inherently control advocacy, assistance, and correction (Matacio, 2006).

eliminate systemic gatekeeping practices that advance only affluent students. However, an impactful administrator/educator does more than point out the unrecognized flaws in a Eurocentric system. *Math is for everyone* is such a cliché, however, the concept of maintaining strong self-efficacy in mathematics is a growing phenomenon. In my opinion, math is typically treated as a prize for the privileged, (similar to healthcare in the US) as a means to maintain the current social order. My research contributes to an inclusive framework for math education in Canada. I believe recognition of student identity and agency is critical to transformative change. Professional development and enlightenment of teachers will only occur after they acknowledge and take noticeable stances in math education that meet the diverse needs of all students.

Establishing the Minds on Math Charity in 2019 within a low-income area, with an executive board of individuals from various backgrounds, sharing the common vision that all students should have equitable access to mathematics learning, was my way of taking a notable stance. The initiative arose with the intention to provide an innovative, alternative learning solution to close gaps, open opportunities for the disenfranchised and create a sense of place and belonging for marginalized and racialized students with undiscovered potential in mathematics. This thesis is based in a low-income



community and builds upon my work, giving me the opportunity to recognize and document the stories of marginalized and racialized students of mathematics. To be a steward, educator, and researcher in a non-traditional math environment, a misunderstood community is a calling from a higher power, and a harmonious risk I believe I was destined to take.

### **Acknowledgements**

I am grateful to my family and my dearest friends for the support and to everyone in the studied community for their warm welcome and trust to achieve a sense of belonging.

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dialogues with Dr. Karleen Pendleton-Jimenez in France over questions surrounding culture, identity and the stories we hold as minorities in education, were existential exercises that strengthened my ideology and understanding. Thanks to Dr. Denise Handlarski, Professor and Rabbi, for introducing me to a love of literacy and a passion for social justice. But more importantly, the stories shared from Black men and women in my life, white-collared, blue-collared, and no collared, their perspectives, nostalgic narratives and reflections of their past math experiences influenced me to listen deeply to the voices of our future racialized leaders.

For this particular project, I would especially like to give thanks to Martin and Kalil, and all of my Minds on Math executives, students and families in the *Ah Fi Mi Community*.



*Figure 1.* Family Portrait. Copyright August 10, 2019 by Shelly John. Reprinted with permission.

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## **Overview of Chapters**

This study is organized in the following manner. The opening vignettes are short scenes that set the stage of uncomfortable moments in math learning. While they describe individual experiences, they represent well-established systemic issues occurring in present-day mathematics education. I created the vignettes by intently listening, visualizing, and interpreting the math experiences of two long-term racialized senior residents of the region where I conducted my research. Both residents spoke candidly about memorable moments in relation to math.

Chapter One outlines the purpose and rationale of the study and articulates the significance of the study by exploring the gaps in mathematics education and marginalized Black and Brown students. It discusses the impact of excluding racialized students from advanced-level math and instruction. The low numbers of Black and Brown students pursuing STEM careers makes the impact of this exclusion evident. This chapter highlights how Eurocentric perspectives have dominated math thinking and shares theories by R. Gutiérrez (2002), and D. Martin (2003). The further impact of excluding has also affected the practice of mathematical teaching. The chapter ends with two research questions concerning the impact of the students' voices through stories on learning and teaching.

Chapter Two further reviews the literature and discusses the impact of highlighting identity in math by looking closely at theoretical frameworks. Theories surrounding the acquisition of equitable math learning and Critical Race Theory (CRT) are employed to analyze the narratives of the study. The examination of theory guides my research practice. The recent literature on the importance of a racialized student's sense of identity is also discussed in this chapter. I unpack the validity of understanding student voice and narrative research.

Chapter Three explores the theoretical frameworks for narrative research and how it appropriately enhances the marginalized voices of Black and Brown learners. I take an in-depth look at how analyzing student voices and identities according to the literature on CRT, Identity Theory and the implementation of equity within math using Cultural Relevance and Responsive Pedagogy (CRRP), affect ways of understanding the experiences of Black and Brown students. Race and racism play a role in the failure to reduce math educational disparities in schools.

Chapter Four describes the methodological approach. This is qualitative research that utilizes narrative analysis to examine the voices of marginalized Black and Brown students.

Chapter Five analyzes the data that emerged in stages of the research.



Chapter Six presents an in-depth discussion of the findings about math identity and engagement.

Chapter Seven presents the significance and makes recommendations for future research.

<b>Black and Brown</b>	The terms non-white, non-dominant culture is used interchangeably to mean people of African, Caribbean, and Indo-Asian descent.
<b>Marginalized Students</b>	Racialized and or impoverished children within an elementary school capacity.
<b>Student Engagement</b>	The school's ability to actively include students in decisions supporting students' academic achievement and personal development.
<b>Math Identity</b>	Dispositions and deeply held beliefs that students develop about their ability to participate effectively in a mathematical context.
<b>Mathematical Competence</b>	The ability to develop behaviours such as representing, formulating, solving problems, reasoning and strategizing. The student demonstrates or shares behaviours that affirm or challenge math identity.
<b>Sense of Belonging to Mathematics</b>	Mindsets and practices that promote and celebrate positive recognition of a student's math to self-connections and/or math to student home, hobbies, hopes, and heritage.
<b>Mathematical Agency</b>	A student's ability to define themselves as a mathematical thinker and active participant who shares beliefs and strategies to develop self and community.

<b>Gateway</b>	A student acknowledging that math is an essential subject to grasp while pursuing studies in the STEM industry.
<b>Gatekeeper</b>	A person who grants access to opportunities to receive advanced instruction in mathematics. One that guards the mathematical gateway.
<b>Fixed Mindset</b>	The belief that people have no control of their success in math and accept the notion that their success level in math is predetermined and cannot be altered.
<b>Growth Mindset</b>	The belief that people have control of their success in math and they can improve their comprehension and understanding of math and increase their math proficiency.
<b>STEM Pipeline</b>	Refers to a strict and precise path a person needs to follow in pursuit of a career in STEM. The study of mathematics is critical to this pursuit along with other key courses.
<b>Counter Narrative</b>	Refers to stories told from a marginalized person's perspective that challenge the normative views of people in power, mainly Eurocentric white.

Table 1: Key Terms and Definitions



*Figure 2.* Male high school basketball team playing game in gymnasium. istockphoto.com Copyright June 21, 2016 by monkeybusinessimages.

### **Vignette 1. The Recollection of “That was Easy”**

A Black male secondary student decides to change from academic to applied stream. Danial is in grade 11 at I. C. Collegiate. He lives in a low income, high crime area of a Canadian city. Danial lives with his mom and sister in a rental unit with poor maintenance. Many racialized “Newcomers to Canada” live in this complex. Many families are coping with unemployment; however, Danial’s mother is a full-time employee at the local hospital. She is a single parent raising two children and working as a nursing assistant on the night shift. Danial has learned to be very independent. Danial’s father is not involved in their lives and he remains in their home country.

Danial exudes charm, humour and athletic prowess in high school. When asked, Danial tells teachers his best subjects are playing basketball and chasing girls. He loves being at

high school but hates attending classes, math in particular. His Math teacher, Mr. Dante, suspects that Danial has not put forth his full effort to succeed. Mr. Dante has described Danial to his colleagues as lazy, but amazing when it comes to athletics. "He is a personable student, very social; however, he is not focused or interested in meeting his academic potential."

Mrs. Right, his English teacher, agrees with Mr. Dante, "Danial orally shares his insightful thoughts when he is in my class but rarely hands in his assignments. I usually see Danial at lunch hour hanging by the lockers talking loudly in a little group of Black students."

Danial's mom ensured he enrolled in advanced classes although his close friends take applied level classes at I. C. Collegiate. Mr. Dante notes that Danial always complains the math homework is too much. "You know I am going to check it, Danial. Act responsibly and make sure it is done instead of hanging out with your buddies in the cafeteria."

One of the friends that Danial socializes with during lunch is a teammate on the basketball team who offers a solution to Danial's dilemma of too *much math work*. "Man, that's rough! You should come to my class! No one stresses like that in Mrs. Feltwe's class." His friend suggests matter-of-factly. Danial in his mischievous mood agrees not to go to Mr. Dante's class and decides to try to sit through an applied math class with Sean.

Mrs. Feltwe is a new teacher to I. C. Collegiate this year and is assigned to teach the applied math to grade 11 students. There are fewer students in this class but a higher number of racialized students. Mrs. Feltwe stands at the door and greets students as they enter; however, she does not notice that Danial has entered as well. She begins by presenting an equation to be solved by the class, "Solve:  $3x + 1 = 7$ ."

Danial looks around in observation at the students who sit quietly avoiding eye contact or doodling on their book covers. Mrs. Feltwe stands at the front of the room watching the class and repeats the question to the class. She has not yet matched the names to the faces of the students in all of her classes and most students won't wear the name tags she has provided. She encouraged, "You may draw pictures to answer the question if you need to." Mrs. Feltwe had recently made a transition from the elementary panel to high school. English and art are her teachables, but she was willing to teach anything, as she was happy to land a permanent job.

Danial is amazed by the lack of effort to respond to the question he feels is very simplistic. He says aloud, "The answer is two!" Mrs. Feltwe is delighted that someone has participated. Danial is happy to oblige with his charming self. Danial remarks to his friend on how easy the class is. Sean says, "I told you, man! You don't need math for the NBA!" Danial decides after trying the class that he is going to switch all of his courses to applied levels.



*Figure 3.* A high school student standing in the hall. istockphoto.com. Copyright June 21, 2016 by FatCamera.

## **Vignette 2. Recollection of “Consistently Below Average ”**

I was a student that always had difficulty sitting still. I was frequently labelled ‘Class Clown’ and often seemed to be the centre of negative attention. I was small in stature compared to the average student and was quite chatty. I always felt antagonized by my peers, being the only racialized student. My best friend named Steve, who was white, and I spent most of our time running away from older students who bullied us. We had a small circle of friends but often I said bold things that landed me into conflicts with other students and my teachers as well.

In the fourth grade, I decided I did not like math and consistently received low grades in all subjects on my report card. In the fifth grade I remember being able to understand math concepts at the beginning of the lesson, but then my mind would wander off into my imaginary world. To assist me with concentrating in math class, in

the sixth grade, my teacher placed large white 'privacy panels' around my desk to reduce distractions and to stop me from disturbing others. My seventh-grade teacher, Mr. Jordon noted this strategy was obviously helpful for other students to concentrate but it wasn't helping my learning, it provided a private place to create more elaborate stories and daydreams. Mr. Jordon felt annoyed with me at times and wrote on my report card, unfocused in class, lacks a filter and says whatever comes to mind.' But he also said I had a creative mind for story writing.

In the eighth grade the Special Education Teacher, Mrs. Tohm suggested to my parents that I should go for placement in an Opportunity Class. (The Opportunity Education provides a supportive environment with specialized curriculum, instruction, guidance and counselling, psychological services, and tutorial assistance to help students overcome barriers to learning). I called it the *Retard Class*. The Spec. Ed. teacher tested me using an involuntary eye movement test and a battery of intelligence tests (the Woodcock-Johnson Intelligent test) and suggested to my parents that my scores were too high to be placed in the Opportunity Class. My problems, according to the Spec. Ed teacher were more behavioural related.

"It's unlikely Ricardo will succeed in the regular mainstream classes at High School," reported Mrs. Tohm to my parents. As a result of my poor performance on report cards in Elementary School, my parents decided with the help of the guidance department to stream me to the Vocational School in the low-income community.

I started out nervously at the Vocational High School. I attended mandatory applied math classes and found that I enjoyed my elective, drafting, which surprised me because there were some mathematical aspects of the course. It was a combination of creativeness and numbers. My

favourite class was a writing class. A teacher, Mr. Wyben took me aside to discuss a free writing exercise in which I excelled. My spelling was below grade level, and my penmanship required improvement, but Mr. Wyben took the time to decipher my writing. Mr. Wyben told me, "You have a gift. You have a very creative mind. Keep writing your stories." For the first time, I had felt right about something at school. However, the feelings did not last. In the 11th grade, I began to use drugs and sell drugs at my high school. My possession charge resulted in my expulsion from high school preventing me from graduating.

The danger of not listening is exemplified in Ricardo's vignette, a story of an overlooked voice from the past; a minoritized 65-year-old individual, who continues to reside in the particular marginalized neighbourhood discussed in this study. His narrative is a result of a casual conversation in the local library, but it hallmarks the apparent long-lived systemic racism linked to mathematics.

Ricardo attended an elementary school and a local vocational high school in the same low-income region as the children in my research. His father was a trades person and his mother was a homemaker. He has two younger siblings. Ricardo's father was a deeply religious authoritarian type who believed in corporal punishment when Ricardo did not achieve success in school.



## CHAPTER 1

Why do Black and Brown students appear to become less engaged in mathematics as students advance in education? Do Canadian educators recognize that their current beliefs and instructional practices contribute to the inequities within math education?

### 1.1 Introduction

Over the course of my time as a racialized student, a parent, and an educator, I received advice from white guidance counsellors who demonstrated disregard and/or indifference to the importance of advanced level courses selection. It was hurtful and offensive to my parents that a school guidance counsellor wanted justification to enroll me in higher level classes and programs, creating a long-term distrust resulting directly from the action of course streaming. This systemic resistance experienced on my part points to just one example of how unconscious bias and barriers can impact the direction of marginalized students' lives. Facts from the Bureau of Labour indicate that STEM careers are 33% more lucrative than non-STEM jobs (Council of Canadian Academies, 2015). Journalist, Amy Harmon reports in the New York Times that, "Black Americans receive about 7 per cent of the doctoral degrees awarded each year across all disciplines, but they have received just 1 per cent of those granted over the last decade in mathematics" (Harmon, 2019, p. A1). "Mathematical success is

somewhat of an undocumented passport to gain entry into practices that enjoy a different status in the wider society” (De Abreu & Cline, 2007, p. 125).

Since the late nineties, mathematics education in Canada has been influenced by the standards-based changes proposed by the American National Council of Teachers of Mathematics (NCTM, 2000). Education reform has been a top priority in America, nationally, politically, and policy-wise, at least since the 2001 passing of the No Child Left Behind Act for marginalized children. Consequently, efforts to reform schools have included an intense focus on the promotion of STEM education, with the most emphasis placed on mathematics as an essential and highly valued subject in society (Executive Office of the President, 2010; NCTM, 2013).

It is important to note that there has been an absence of large-scale movement concerning reform on mathematical education relating to marginalized students within Canada.

### **1.2 Significance of the Study - Why is Math Important?**

The underlying belief that not all students can learn mathematics and “...therefore no amount of effort will compensate [students] who lack innate ability” is a concern worthy to be addressed (Gutiérrez, 2002, p. 146). There have also been discussions surrounding the excellence versus equity debate and the belief that we cannot improve

and encourage our highest achieving students while simultaneously improving the achievement levels of our lower-performing students. Gutiérrez (2002) determines the excellence versus equity debate is derived from dominant mathematical principles, propagated by a Eurocentric viewpoint. Educators with this view recognize the subject of mathematics as the development of knowledge that is deemed necessary for students to aspire to be successful in life (and especially in STEM-related fields). This perspective gives rise to the likes of standardized testing seen in America and Canada. Dr. Danny Martin refers to these procedures as the mathematical pipeline, where selective people (traditionally non-minorities) are permitted to pursue the study of mathematics. With this viewpoint, mathematics continues to serve as a gatekeeper course for secondary and post-secondary education (Martin, 2003) allowing only those who have so-called 'mathematical talent' to advance.

Some revisionist educationalists support the exploratory side of mathematics as advocates for inquiry-based learning and as a means to achieve success from all learners. D'Ambrosio (1999) supports the term "Matheracy" as a way to measure success through students' ability to "draw conclusions from data and their calculations, make inferences and propose hypotheses" (D'Ambrosio, 1999). Nonetheless, this exploratory mathematics, on its own, can still perpetuate the

dominant mathematics standpoint outlined above. Although an inquiry-based mathematics education is a step in the direction of addressing equity issues, this method needs to be used in coexistence with the highlighting of issues of power and social justice.

Furthermore, there is a hesitation to view mathematics as a subject with room to improve and to believe in the idea that students' input can be beneficial to the study of mathematics. Gutiérrez supports this idea by stating that, "A more diverse student population in mathematics might expand the kinds of theories, discoveries, and applications of mathematics that have been developed to date" (Gutiérrez, 2002, p. 150). Notions of 'Matheracy' and exploratory math, I believe are critical to perspectives and should be carefully considered in the platform for equity in math. Educators of Black and Brown students must believe that these racialized students are capable of pursuing mathematics and all students can contribute to the subject of mathematics.

### **1.3 The Problem: Teacher Biases and Power Imbalances**

Even while it is often difficult to achieve, as educators in the field of shaping the minds of children, youth, and young adults we conceptualize the importance of creating a vibrant learning environment, welcoming and inclusive to all learners. It is vital that we also take concrete steps to realize the existence of an equitable

space by embracing equity, understanding diversity and unpacking the strategic measures that support social justice action in our classrooms, schools, and communities. Within the field of education, mathematics by itself reveals an underlying power relationship and demands an essential need to explore ways of addressing the imbalances.

Bourdieu's theory of 'reproduction' proposes one of the primary functions of schooling is to maintain the existing social order from one generation to the next, including inequitable power relations prevailing between different groups (Bourdieu and Passeron, 1990; as cited by Morgan, 2014). Power relations are hidden by the creation of academic categories such as giftedness, implying that those who succeed in math, do so because of their innate ability, rather than any systemic advantage they may be afforded.

For example, as an educator for several years, I have observed teachers; students and parents perceive mathematical ability as fixed and thereby practice the grouping of students according to similar ability. Those children commonly placed in lower groups who usually receive lower scores (often the Black and Brown students) are placed at a significant disadvantage. The difficulty here is recognizing the disengagement is less likely to do with ability and more likely to do with "remedial (and boring) curriculum" (Hodgen and Marks, 2009, p. 31), and grappling of educators' with unconscious bias, power and

privilege (Martin, 2019; Gutiérrez, 2017). Dr. Martin shared with me a salient vignette written by Cordell, an eighth-grader struggling with the intersectionality of his identities, as a mathematician and a Black male in a study completed by Dr. R. Berry III (2008) on narratives written by Black middle school students. Students need ways to be empowered rather than disempowered, in their experiences with math.



*Figure 4.* African American school boy, isolated on white background. istockphoto.com. Copyright September 23, 2013 by sam74100.

Cordell writes:

My name is Cordell, and I am an eight-grade student at Memorial Middle School. I am an only child, and I live with my mother. I know that my mother, being a single parent, has a tough job, so I have to take

on more responsibilities than other kids do, and I have learned to be independent. My grandmother and aunts help my mother by encouraging me to make good decisions and make sure that I stay the right track. My grandmother and mother talk to me about doing well in school if I plan on going to college.

Math is my favourite subject because it is my easiest subject. Math is interesting and fun because in math you have time to think and keep trying until you get it right. I was first drawn to math in the third grade when we started to learn how to multiply. I knew I was good because I learned to multiply earlier than the other kids in my class. I am glad that I was good at math at a young age, because that put me ahead of the other kids in my class. My third-grade teacher divided that class into groups; I was with the group that got the harder problems. This made me feel like I was smart.

When I was in fourth grade, I started getting into trouble because I was bored with school. My teacher was teaching me things I already knew, so I would start playing around in class. My mother thought I was not being challenged enough and that is why I got into trouble. After a few conferences with the teacher and the principal, my mother felt that I should be tested for the AG [academically gifted] program. The teacher and principal did not want me tested because they felt I was not gifted. My mother thinks the reason they did not want to test me was because I am Black. She stayed on the teachers and principals until I was tested. I did well enough to be placed in the AG program midway through my fourth-grade year (p. 473)

Teachers have a profound effect on student math identities (D. Martin, personal communication, February 23, 2019). Culturally responsive teaching practices for Black/Brown learners must include opportunities for empowerment and emulation of culturally significant instruction styles. For example, it is common knowledge that when First Nations elders teach traditional values to indigenous young people, they often use a circular formation, which allows for rich discussion and decision-making. Also, communication within these circles about restoring relationships with land, water, and communities serve as an initial step to understanding equity and mathematics learning. How wonderful it would be to explore an African American art form such as Spoken Word as a teaching/learning practice to engage students in mathematical expressions and dialogue? Through personal narratives in the form of Spoken Word, Dub Poetry and Hip Hop, young urban children's identities vividly come to life by utilizing children's situated learning activities (Love, 2015) paired with math strands such as Measurement and Number Sense.

Bourdieu uses the idea of 'Cultural Capital' to describe those social and cultural resources that are recognized and valued by schools (Jorgensen, Gates, and Roper, 2014). He argues that children from middle-class families arrive at school already endowed with greater levels of cultural capital, acquired through their upbringing, which



enables them to take advantage of the opportunities on offer (Noyes, 2007). Bourdieu argues that disadvantaged students become complicit in the erroneous and biased beliefs of their educators and are negatively impacted by these biases and often fail as a result of decreased self-confidence due to their internalization of their teacher's mindsets. This line of thinking influences decisions not to study mathematics beyond the compulsory stage (Morgan, 2014, p. 5).

Bourdieu's analysis provides a possible explanation as to why marginalized students' mathematical attainment and social class remain strongly correlated. It also supports the argument that the disengagement of children from disadvantaged backgrounds should be attributed to systemic causes rather than to "individual deficiencies on the part of particular pupils or parents" (Jorgensen, Gates, and Roper, 2014, p. 225). Social structures exist that privilege certain groups over others. From Bourdieu's Capital Cultural Theory, there appears to be a suggestion this math learning process is intentional, rather than inevitable as some educators believe.

[Black/Brown] social groups are aware that schooling is not neutral, that it presupposes familial power both material and discursive, and that such groups use this knowledge to improve their children's pedagogic progress (Bernstein, 2000, p. 23).

## 1.4 Declaration of Position

Having a Black child who excelled in mathematics from elementary through to postgraduate studies allowed me to be privy to further stories of discrimination (intentional and unintentional) and the existence of 'gatekeeping.' It has been challenging and enlightening watching my son navigate higher mathematics. I am ashamed to admit on more than one occasion I suggested that he should try another path because I incorrectly believed the false truths of who should pursue math. Admittedly, I did not have the appropriate support, guidance or early influences surrounding higher-level math to guide his next steps. However, what interested me was the confidence he had in listening to his own *voice and understanding* his own story that may have assisted him in overcoming barriers concerning math. He endured immense pressures and not-so-subliminal messages of, *an elite athlete not needing advanced math*. He ignored stereotypical labels placed on him by judgemental coaches and math professors who assumed he would score *no higher than a B in higher level math*. Understanding the construct of plotted points in his life helped him navigate pitfalls, define his path and stay true to his pursuit of brilliance.

I believe that school mathematics is a social barrier for certain marginalized groups that requires immediate attention. As educators,

we (knowingly or unknowingly) heighten barriers by assigning institutional identities, levels, and labels—a level one, two, three, or four. Measures of math proficiency assigned and shared with students to determine whether they can progress to the next grade should be accompanied with consideration of the complex ways in which students perceive themselves in the context of mathematics. This deeper consideration of student perception is critical to understanding how to increase the participation of groups of people underrepresented in mathematics and math-related fields. It is critical to create awareness of the link between social justice, systemic racism, and math education by implementing equitable practices (such as applied mathematics, spoken word poetry, etc.) for young Black/Brown learners so that they too, may use the “gateway” to possible careers in STEM and higher education. If we accept that mathematics is a gateway to higher education: our current educational system appoints mathematics as a gatekeeper to higher learning and success (Gholson, Leonard & Martin, 2010), and we acknowledge there are racial disparities created among those who proceed through the gate. This disproportionate outcome often results in an underrepresentation of Black/Brown male students in higher-level mathematics or STEM environments/careers (The Black Experience, 2016).

An investigation of an urbanized district similar to this study revealed a pattern of inequality in teaching eighth-grade algebra and identified algebra as a gatekeeper to high school, college, university and STEM careers (Morton and Reigle-Crumb, 2019). We can agree this adverse condition contributes to the continued inequities and injustices surrounding wealth and poverty in society. This premise led me to wonder how counter-narrative research could provide teachers, counsellors and teaching candidates critical insight and perspective before giving scholarly advice to marginalized young individuals.

Reflecting on the miseducation I received and the challenges my son experienced, prompted conversations with other marginalized adults, and we discussed similar stories of educational guidance and direction and/or lack thereof. These shared experiences prompted many inquiries about how the advice an educator, in a position of influence, such as a teacher, special education resource teacher or a high school guidance counsellor, influences the academic circumstances of young marginalized students.

Do guidance educators realize the magnitude of power and influence their position holds regarding marginalized students? Do guidance counsellors and teachers practice what John Dewey (1933) refers to as critical reflection, reflecting on their values, assumptions, and beliefs, before proposing solutions to marginalized students

(Hickman et al., 2009)? Do special educational resource teachers and guidance departments consider race before assigning streams and courses to racialized students? To direct and advise appropriately requires listening to the voices of the marginalized Black and Brown students. Identity research illuminates pathways into and away from heightened participation in math and fields for underrepresented minority students (Martin, 2012). Therefore, I revisit Dr. Martin's posit: what it is to be "Black or Brown while learning math, and learning math while Black or Brown" (D. Martin, personal communication, February 23, 2019). Understanding the influences of student engagement in mathematics, as students advance in education is an essential first step.

My inquiry is derived from the work and interconnection of the above-mentioned researchers, which led me to the following objectives:

- 1) To determine if stories told from the voices of Black/Brown students of low SES in the Ah Fi Mi Community at Guarded Gate Public School provide insight into students' math identity (competence, sense of belonging and agency) and their engagement, or disengagement with mathematics;

2) To determine how understanding the voices of personal narratives involving math helps to identify current systemic injustices for educators to shape and better address math learning for racialized math learners of low SES in the Ah Fi Mi Community at Guarded Gate Public School.

## **CHAPTER 2**

### **Literature Review**

#### **2.1 The Relevance of Researching Equity in Mathematics**

This research contributes to an emerging field of study conducted in Canada and the higher profiled research in the United States on social justice and systemic racism links to Mathematics (Lopez 2019; Leonard, 2018; Martin, 2017; Gutiérrez 2008; Anderson & Tate, 2008, Boaler, 1997). Mathematics is often viewed as free of inequalities, yet the evidence of imbalance is blatantly seen in the absence of Indigenous, Black and Brown people. The Humanities Research Council of Canada (2017) suggests that placing more considerable significance on equity, diversity, and inclusion in the sciences influences discovery and innovation while also promoting equity in the workforce (Social Sciences and Humanities Research Council of Canada, 2017).

Furthermore, ongoing incidents of inequity within school boards related to math continue to occur and require our immediate attention. For example, we continue to normalize white children's mathematical behaviours as the standard for all children (Martin, 2013). The reference to gaps in mathematics achievement and aim to help Black achievement mirror the level of White achievement contributes to Eurocentric normalization (Martin, 2013). Addressing

these concerns is relevant and should be of top priority. School Districts such as the Durham District School Board have implemented an Equity and Diversity Strategic Plan mandating that we “improve our responses, actions, programs and initiatives that are related to equitable practices and our ability to create inclusive and safe spaces in our diverse communities” (DDSB, 2017).

The purpose of my research is to provide educators with stories and analysis that support the development of programs (internal or external) to improve mental wellness and academic success for students, including recent immigrants, children from low-income families, boys and students with special education needs, among others who may be at risk of lower achievement, particularly in math learning.

This study contributes to and calls for further inquiry into research surrounding math and racialization that can empower students with assistive and informative feedback, as well as practical solutions required to achieve higher outcomes in mathematics.

## **2.2 Conceptualizing Equity and Math**

A preliminary step is first to develop a precise definition of equity with regard to student learning in mathematics. Investigating theoretical frameworks provides scaffolding for the challenging task of defining equity in mathematics. I thought it appropriate to consider the



acquisition of math through Individual Cognitivism vs Co-Constructivism, also the underpinnings of Critical Race Theory, and theories surrounding student voice and counter-narrative research. Collectively these frameworks aid in understanding and conceptualizing equitable mathematics pedagogies for Black and Brown students in schools.

Historically, mathematical equity has garnered various meanings to different people. Many terms, however, are often present in the discussion of equity, equal resources, opportunity to learn, comparable test scores, and quality teachers, to name a few. Scholars, teachers, parents and administrative workers define equitable education as an aspiration to remove injustices and some publications in math pedagogical theory and practice call for action to do so. The National Council for Teachers of Mathematics, for example, published Principles and Standards for School Mathematics, which includes an equity-specific principle: "Excellence in mathematics education requires equity-high expectations and strong support for all students" (NCTM, 2000).

The Equity Principle of the NCTM (2000) underscores the idea that all students should be exposed to appropriate and rich mathematical experiences and problem-based learning, regardless of their levels of procedural skill (Van de Walle & Folk, 2005). Many publications

(namely the NCTM) have been accused of merely outlining required goals in equity but failing to provide “a blueprint for achieving them” (Posner, 2008; Schoenfeld, 2002). Poverty and immigration, particularly for visible minorities, have increased in urban pockets (Ladson-Billings, 2006; Martin, 2003), where there is an acknowledged need to include a renewed design of the curriculum and programs. However, appropriate application and implementation should be addressed in the development of equitable educational processes, particularly for Black and Brown math learners and in concert with Black and Brown educators. “Nothing about us without us,” as voiced by South African disability activists Michael Masutha and William Rowland (Charlton, 1998). Young voices can promote educational processes, as well. Early student voice research and pedagogy focused predominantly on consulting students to elicit their perspectives on schooling and learning have been used to contribute to school improvement and reform initiatives and democratic pedagogies (Nelson, 2015). Students are positioned as ‘expert witnesses’ of schooling given their unique position as learners (Fielding; Flutter & Ruddock, 2004; Lincoln, 1995; Mitra, 2009b; Smyth, 2006b as cited in Nelson, 2015, p. 2).

By drawing on the above-conceptualized pieces, I would form a definition for equity in Mathematics as an inclusive practice of

mathematics that captures the voices of the students and encompasses clear, attainable goals for all levelled students. Equity in mathematics aspires to promote the participation of all students to achieve a variety of rich experiences, procedural skills, and culturally responsive and relevant problem-solving opportunities.

### **2.3 Conceptualizing Development of Identity in Math**

The truth of the matter is, the pedagogies of many math educators primarily focus on the growth of mathematical acquisition as a mechanism that is prescribed, fixed, secure and objective (Depaepe et al., 2014). The fixed perspective encourages teachers to stress skills that promote math as the ability to compute, memorize, and problem-solve (Depaepe et al., 2014). Alternatively, a viable approach to mathematical acquisition is also to understand one's relationship with math thinking (emotions and attitudes); that is to monitor one's progress by following personal beliefs about mathematics and identity as a mathematician (Op 't Eynde et al., 2006).

According to Op 't Eynde, a person's mathematical identity can be tied to social dimensions. Interactions with teachers, peers or places, influence student experiences (Op 't Eynde, 2004). Much research about beliefs, attitudes, and experiences surrounding math, has been acquired through narrative inquiry as the strength of this approach allows for the possibility to collect details relevant in the development

of the participants' relationships with math (Hannula, 2016).

Controversial issues invariably arise as we explore and understand identity from an epistemological or ontological context. Implementing equity in math would, therefore, require a thorough review of both the epistemological and ontological perspectives of math identity acquisition.

How one comes to know math is an arduous debate, and therefore it is appropriate to review historical theories behind learning acquisition and its connection to narrative research. Is learning math a performance epistemological in nature - stemming from a constructivist framework or is it a simple matter of being mathematically ontological - stemming from a sociocultural framework?

The constructivist framework that traces back to Piaget's comprehensive theory of cognitive development (Piaget, 1971) infers that a child's individual knowledge and experiences determine their learning outcomes. "Learning is therefore done by students' constructing knowledge out of their experiences," while Lev Vygotsky's social constructivism (Vygotsky, 1934) emphasizes the importance of sociocultural learning; how interactions with adults, more capable peers and cognitive tools are internalized by learners to form mental constructs. Prevailing dichotomies seem to result from these

competing paradigms: individual versus social, active versus passive, mental versus manual, thought versus action and instrumental versus relational (Sierpinska & Lerman, 1996). However, in my opinion, constructivism and socioculturalism are both relevant to math identity. It is John Dewey that reminds me that teaching is not just about building children's knowledge, but also about influencing the kind of problem-solver they will become (Dewey, 1933).

Math is a subject already riddled with numerous challenges for all learners, choosing a single framework complicates the practice of teaching and learning math. Socioculturalism characterizes the importance of practical activity and social context, while constructivism is based on metacognitive activity and personal experience. Both paradigms have in common the belief that individuals learn and develop through participation in social movements in the world.

## **CHAPTER 3**

### **Theoretical Frameworks**

Investigating equitable mathematics is dependent upon the foundational theoretical frameworks of Critical Race Theory (CRT), Identity Theory, and Culturally Relevant & Responsive Pedagogy (CRRP).

#### **3.1 Critical Race Theory**

CRT is an integral tool in this framework that describes the use of education as “an instrument of white supremacy” playing a role in “determining the very social and political structures of American life” (Curry, 2008, p. 35). Radical changes in instructional practices and progressive outcomes for marginalized students can be realized when math educators grasp the notion of “educational debt” composed of historical, economic, moral and socio-political factors affecting minority students (Ladson-Billings, 1998). CRT has been used to elicit racial and societal issues in education research, especially in mathematics (Jett, 2012) in an attempt to provide solutions to current inequities in education. Decades later, Ladson-Billings (2018) continues her research to examine the pedagogical practices of teachers who are successful with Black students. Concerns remain about the absence of deep intellectual interrogations of race and the work of race in teacher education programs. CRT promotes the idea that educators must feel

obligated to change the Eurocentric concept of democracy to one that is inclusionary of those who are not white, not male, not able-bodied and not straight. Ladson-Billings cautioned, "This vision can never be realized as long as its foremost enemy – that concept of race – serves [whiteness] so well" (Ladson-Billings, 2018, p. 103).

The theorist, Dr. Carl James, applies CRT in his research on *The Experiences of Black Youth in Toronto*. The focus of this research is on the social phenomenon of inequitable experiences for Black students. Dr. Carl James and Keren Braithwaite (1996) state that there is ample evidence to indicate that the experiences of African Canadians are consistent in most provinces of Canada such as Nova Scotia, Manitoba, Saskatchewan, Quebec and Ontario (p. 14). Dr. Carl James' work on the Black Experience focuses on the historical examination, interpretation, and narration of lived experiences of Black people including education (BEP Team, 2017). It suffices to argue that CRT provides a theoretical context for the examination of marginalized voices to overcome systemic discriminatory educational practices in math.

A narrative-based approach or counter-narrative methodology is a CRT tool that provides a platform for students to share personal and lived experiences. Delgado and Stefanic (2001) defined counter storytelling as stories by people whose experiences are often untold.

These stories serve to expose fallacies rumoured by non-racialized people of power and privilege, which are a part of the dominant discourse. Counter storytelling is more than a device for telling the experiences of marginalized individuals but challenges the dominant stories of those in power whose stories are regarded as normative (Solorzano and Yosso, 2002; Leonard and Martin, 2013). Martin suggests there continues to be an urgent need for other frameworks and different research that de centres long-standing accounts that have contributed to the construction of the children as "Mathematically illiterate and less than ideal learners, relative to other groups of students" (p. 49).

Hence, I believe that acknowledging the voices of young Black and Brown students and acting accordingly to the demands of equity heightens the future potential of Black and Brown mathematicians. Through CRT, educators may better navigate racialized students to succeed through the mathematical gateway.

### **3.2 Theory of Identity**

Erik Erikson developed the early heuristic framework of Identity Research and although his main focus is the link between creativity and identity, I believe that identity could also be grounded in other interests. Identity theorizing is relatively recent in mathematics education. The interpretation of identities is first mentioned in the



exchange between Sfard and Prusak (2005), Juzwik (2006), and Sfard (2006). The extrinsic and intrinsic elements that impact identities are worth considering as Sfard (2006) suggests, and those “identity-shaping factors” (p. 24) can affect but not necessarily define identity.

Sfard purported

Indeed, the fact that one cannot tell any story about a person, ignoring or contradicting this person’s inborn characteristics, does not translate into the claim that the identity-shaping factors (as opposed to stories about them) are an actual part of identity. Such a claim is as unlikely as would be the assertion that the person who modelled for Da Vinci’s “Mona Lisa” became, in flesh, a part of the famous picture (p. 24).

Research shows that strong math identities lead students to higher levels of performance and participation (Dweck, 2008; Martin, 2011). I also adopted the idea of socialization forces based on Martin’s (2000) multilevel framing. Martin suggests socio-historical factors contribute to “identity construction” (Larnell, 2016, p. 237). Martin addresses stereotypes and other external or situational impositions of identity, (referred to as contingency identity by Steele, 2010) which are not necessarily experienced but are transferred from one generation to the next. According to Martin, because mathematical learning is typically applied in the classroom, the idea of belonging to the mathematics classroom should have more substantial focus than that of self-conception as a learner of mathematics. “Without a sense

of belonging, possible categorical understandings for identities develop such as stereotypes, master narratives of identity contingencies” (Martin, 2000; Larnell, 2016, p. 241). Math education researcher, Jo Boaler points out, “theories of identity formation and practice give students an active role in the learning environment, as agents who negotiate, shape, and reflect upon their participation and non-participation” (Boaler, 2000, p. 381).

Applying these frameworks to my research might bring marginalized voices to the centre. These frameworks assign theoretical value to the stories young people tell about their experiences with mathematics.

### **3.3 Culturally Relevant and Responsive Pedagogy**

Within a context of mathematics and Black identity, Culturally Relevant and Responsive Pedagogy (CRRP) highlights the impact of race and draws on ways of knowing from families and their communities. It encourages educators to connect theory to practice by combining academic interventions and pedagogical innovations as progressive methods of “resistance to deficit approaches in education” (Sylvestre, 2018, p. 42), and to adopt the asset lens approach.

Culturally Relevant and Responsive Pedagogy highlights the following:

- a) All students can achieve success

- b) Students must be culturally competent
- c) Students must develop critical consciousness that allows them to challenge heteronormative, monocultural worldviews (Ladson-Billings, 1995)

Educators who advocate for CRRP approaches argue that people learn differently across cultures and contexts. Cross-cultural contexts can deepen learning including mathematics. It is reasonable to assume that if students maximize their educational outcomes when teachers gain knowledge of the cultures and experiences of their students, mathematics would be a component of this higher achievement. From my fieldwork experience, I have observed when culturally responsive approaches are embraced in learning environments, Black and Brown parents more readily see themselves as active participants, and feel their experiences and knowledge are valued. Action and dialogue are theorized by Freire as tools for engagement in the struggle of the oppressed for democracy and social justice (Freire, 1998). Culturally Relevant and Responsive Pedagogy supports theoretical and conceptual framework that connects theory to practice. Ontario government initiatives such as the Equity Education Action Plan (2017) that promised to address the disproportionate poorer outcomes of children of ethnic minorities are grounded in CRRP. As an educator and administrator, my role is to ensure teachers

employ instructional practices, as Ann Lopez suggested in her review of multicultural education, that reduce the achievement gap in all subject areas for racialized children and other students who have been traditionally marginalized in the school system (Lopez, 2015). Freire (1970) reminds us that victims of oppression should take matters in their own hands if they want to create change and challenge systems and structures that oppress them. Critical Race Theory, Identity Theory and CRRP intersect in a manner that creates space for Black and Brown students, their parents, caregivers, educators, and community stakeholders, to examine their voices and practices, and develop agency that challenges racism and all forms of oppression.

## **CHAPTER 4**

### **Methodology**

#### **4.1 Why Counter-Narrative Research: Rationalizing**

##### **Stories in Math**

My research is a qualitative narrative study whereby I attempt to highlight Black and Brown student voice within stories about their untold learning experience in mathematics. The idea of analyzing the voice of vignettes for central themes of identity and belonging in mathematics arose from Danny Martin's (2000) work of interpreting students' narratives. Martin believed that text is characteristic of "the social-turn moment of mathematics education research," in which his study is situated (Martin, 2012). The root of exploration of identity, belonging and agency of the student's voice is derived from theory and research such as Critical Race Theory (Ladson-Billings, 1998), Engaged Pedagogy (hooks, 1994), The Black Experience Project (BEP Team, 2017), Frameworks on Mathematical Identity (Martin, 2013; Sfard, 2008) and Theories of the Power of Voice (Nelson, 2011).

According to Bryman (2012), narrative research offers more in terms of flexible practices and breaking limited structures, it allows for greater ontological and epistemological understanding (Bryman, 2012), and it reveals equitable practices to improve the academic outcomes of marginalized Black/Brown students. Narrative researchers Clandinin

and Rosiek (2007) support the view of *experience* as a way of knowing and being. Highlighting experience is critical in education research as “relational experience” suggests there is an important reciprocal process in sharing, telling and listening that evokes greater understanding. Jean Clandinin and Shaun Murphy (2009) reflect on Dewey's (1981) findings on the theory of experience, naming three features of experience (relational, temporal and continuous) as providing ontological significance.

The epistemological consideration of exploring storytelling or writing is drawn from a sociocultural theoretical framework, which suggests the researcher and narrator(s) act as co-constructors of social interaction (such as teaching and learning math). According to Clandinin and Connolly (1990), there is equal significance in the intent and interpretations of the narration by both the researcher and the storyteller(s).

Again, I believe it is appropriate that both paradigms, constructivism and sociocultural, would be considered as underpinning for the methodology of Narrative Research. Both reject the idea of ‘value-neutral’ observations and universal laws, and both paradigms focus on understanding lived experience from the points of view of those who hold it (Creswell, 2014).

## 4.2 Conceptualizing Student Voice

Because the purpose of narrative inquiry is to underpin the work of the student's voice, it is appropriate to conceptualize voice through five main discourses (Nelson, 2015), which justify certain norms and practices in particular ways:

- 1) Student voice can be used as a standpoint that only students can produce, based on their direct experience of education as students;
- 2) Student voice can be used as a vehicle to increase learning and engagement, which is linked to constructivist theories of learning. Voice as a vehicle is supported by research revealing a connection between identity and belonging at school through active participation and engagement (Finn & Rock, 1997; Smyth, 2007);
- 3) Student voice should be relevant to school improvement plans (Beattie, 2012) given students' positioning as primary stakeholders of schooling;
- 4) Student voice can be a vehicle for equitable action and agency in democratic pedagogy (Smyth, 2006a) and as addressing children's rights afforded by the United Nations Convention on the Rights of the Child (1989);
- 5) Student voice can be linked to "neo-political ideals" representing a child's right to choice and representation as a user entitled to educational services (Brennan & Ritters, 2004)

Student voice in elementary school pedagogy has been promoted as a way to construct and design curriculum using enquiry and democratic methods (Nelson, 2015). Emily Nelson also cites recent work linked to student voice in middle school (grades seven through nine) as a way to inform teachers' professional development for intermediate and senior practitioners by researchers (Downes, Nagle, & Bishop, 2010 and Downes & Toolin, 2009). Justifying what counts as an agentic student voice provides discursive possibilities for students and teachers to gain clarity and understanding of each other's positions on a subject matter. Student voice is an integral notion within the "middle schooling concept" (National Middle Schooling Association, 2010). In the middle years, students are identified as ready to "play a major role in their education" with intermediate pedagogy "purposefully empowering young adolescents to assume this role, one that includes self-advocacy" (National Middle Schooling Association, p. 16 as cited in Nelson, 2015).

Student voice was used to promote a sense of belonging and identity (Matthew, 2018; Nelson, 2015) and address student disengagement in the middle years by initiating reform (Smyth, 2006b, 2007; Smyth & Hattam, 2001). Cook-Sather and Shultz's writing in an adolescent education context set up student voice as a way for teachers to listen to students so that when their concerns change, pedagogy and



schooling adapt to the changing interests of the students (Cook-Sather & Shultz, 2001).

Dr. Karleen Pendleton Jiménez (2016) understands the need to draw out the voices of young people while researching gender diversity and social justice in education. In the book, *Tomboys and Other Gender Heroes*, she reveals and releases the students' voices around traditional gender stereotypes in school activities, math, sports and class discussions on determinants of societal structures like occupations and salaries. In recounting her own childhood, she states,

I thoroughly enjoyed competing with boys in math competitions and serving as a captain of a grade eight boys baseball team. The boys were my good friends, and to the best of my knowledge, many of them appreciated my shared love of rivalry on the courts and in the classroom. If someone taunted me about my gender, I thought of it as an issue of fairness: why should boys get to do boyish things and not me? (p. 3)

This concept of normalizing gender to certain behaviours ties superciliously to racializing students for specific subjects like math. Children often have a strong sense that these actions are unfair and unjust (Jiménez Pendleton, 2016). However, it is my opinion that continuous faulty perceptions of structures in society influence Black and Brown students into conforming or complying with the dominant narrative, indicating *who should* study math.

It is by drawing out student voice that educators have the opportunity to uncover and interrogate which perceptions may be stifling them.

### **4.3 Conceptualizing Narrative Research**

Clandinin is a leading researcher in narrative study and discusses narrative as both a form of co-constructed inquiry and a phenomenon, especially to its use in a scholarly investigation (Clandinin & Murphy, 2009, p. 600). Jean Clandinin & Michael Connelly, attest that narrative knowledge can create reform in problematic situations concerning education. Torill Moen suggests using stories as thinking tools for our research colleagues, as new inquiry questions might arise from the narratives. Narratives, understood as cultural scaffolds, develop in practice” (Carter, 1993; Gudmundsdottir, 1997 as cited by Moen, 2005). Many studies regarding narrative research conducted on childhood experiences were dialogues or scripts of adults sharing their stories as a reflection and recollection from the past, or sometimes an interviewer speaks with a participant's significant other, for example, the child's parent (Caine, Estefan and Clandinin, 2013). However, Pauline Davis (2007) reassures that teachers can collect research data from elementary children about school subjects through storytelling. A narrative inquiry would potentially inform teaching practice and research, and provide

insight directing the next steps necessary to address “gap gazing” in elementary education for marginalized students. The written word also affects the audience from the author’s lens, the researcher’s lens or both. Is it possible to gain deep meaning and experience the life of the participants through stories? Chamberlain (1990) poses the same question in his book, *Narrative Perspective in Fiction*, and adds that it is essential to have the context of familiar and cultural differences. Coulter and Smith also attest that narratives rely on cultural expectations of readers about what constitutes a story. Having a voice narrate the story might be stronger than passively observing the experience. Smith (2009) and Iannacci (2007) also agree that the point of view can be nuanced using literary elements such as narrator reliability, tone, and authorial distance. However, the issue of third-person narrative versus the first-person narrative can often lead to possible misinterpretation and misrepresentation of the participants’ lives (Smith, 2009). Smith believes that narrative researchers should provide the reader access to enough data enabling readers to arrive at multiple perspectives and understand how he formulated his point of view, especially if there is a lack of understanding of societal or cultural norms, personal bias’ and beliefs. Clandinin and Murphy (2009) raised the concerns that focusing exclusively on issues of representation may lead readers to misunderstandings about narrative research.

Narration in mathematics is evident in the written works of Diane Miller (1992) and Rebecca Kasperek (1996). Sarah Van Ingen, G. MacDonald and D. Thompson (2012) claim that Common Core standards “require, implicitly, fluency with the language of mathematics” (p. 402). The researchers mentioned above note that interpreting writing assignments enable teachers to identify students’ strengths and weaknesses in math. For the student, writing in mathematics also works as a means of self-regulation and self-assessment and is associated with improved motivation and engagement (Munn and Woodward, 2006).

On the other hand, Kaasila (2007) argues that narrative writing in its traditional form does not necessarily provide the required breadth and depth of data for analytical research (p. 207). However, it has also been suggested that the application of guiding questions from the researchers can lend support to narratives and effectively reveals the power that identities, bodies, and stories have in educational research (Pendleton Jiménez, 2016). In my conversation with Dr. Danny Martin (D. B. Martin, personal communication, February 23, 2019), I asked about the effectiveness of narrative inquiry that he has used. He asserted that narrative study (counter-narratives) is a validated method of research for analyzing student learning and reflections. The methodology behind narrative inquiry can also be viewed as an

effective research approach to improve teachers' interpretive practices, especially when instructing Black and Brown students in mathematics. Dr. Martin suggested that students using narratives could demonstrate performance and competence as knowers and doers of math; it reveals complex ways of knowing and being. New educators can find reflective moments by reviewing narratives as a professional tool that can provide high-level commentary, enabling teachers to determine their students' path for learning math. Teachers must allow students to reveal their agentic voice and through story share who they are, who they can become and discover their potential math identity and agency (D. B. Martin, personal communication February 23, 2019).

In understanding the methodologies above, I can confidently pursue a narrative study as a validated method of research that can also be viewed as an effective approach to improve reflection and teaching practices when instructing Black and Brown students in mathematics.

#### **4.4 Research Questions and Hypothesis**

- 1) Do stories told from the voice of Black/Brown students of low SES in the Ah Fi Mi Community at Guarded Gate Public School provide insight into students' math identity (competence, sense of belonging and agency) and their engagement, or disengagement with mathematics?

- 2) Do the voices of personal narratives involving math help to identify current systemic inefficiencies for educators to shape and better address math learning for racialized math learners of low SES in the Ah Fi Mi Community at Guarded Gate Public School?

My interest lies in the beliefs and influences that shape a student's experience when learning math. I am curious about the impact student voice has on student identities as math learners.

Narrative stories of Black and Brown students may shape the academic direction and influence their abilities as mathematicians. These stories may provide a learning platform for math educators who may or may not be aware of unconscious bias and beliefs held regarding Black and Brown student's math learning interests. My aspirations for the future impact of this research are:

- 1) The narrative process of students sharing a personal math story will be an entry point of engagement for mathematics for Black and Brown Primary and Intermediate students, and
- 2) The engagement of educators with the narrative process in mathematics has the potential to provide further teacher knowledge about systemic inequities for Black and Brown students. Analysis of student's voices and thinking through

narratives may assist teachers with culturally responsive and relevant instruction and direction.

#### **4.5 Setting and Location**

This particular study was located at the elementary school Guarded Gate P. S., which is one of the schools that have been designated as needing intensive support based on academic needs.

Order	Neighbourhood	Percentage of Vulnerable Children	Number of Vulnerable Children	Number of SK Children Assessed	Compared with Durham Region (Lower is Better)	Quintile
1	Manning (W4)	21.1%	28	133	LOWER	1
2	Pickering North (P7)	21.1%	15	71	LOWER	1
3	Dryden-Anderson (W7)	21.2%	25	118	LOWER	1
4	Rural Uxbridge (U2)	21.8%	12	55	LOWER	1
5	Brooklin East (W9)	22.6%	56	248	LOWER	1
6	West Rouge (P2)	23.0%	23	100	LOWER	1
7	Brooklin West (W10)	23.6%	65	276	LOWER	1
8	Ajax Northeast (A9)	23.6%	87	369	LOWER	1
9	Urban Uxbridge (U1)	23.9%	27	113	LOWER	1
10	Oshawa Northeast (O12)	24.1%	75	311	LOWER	1
11	Dryden East (W8)	24.4%	32	131	LOWER	2
12	Bowmanville North (C5)	24.4%	54	221	LOWER	2
13	Riverside-Hermitage (A5)	24.5%	25	102	LOWER	2
14	Brock Ridge Pickering (P6)	24.8%	37	149	LOWER	2
15	Brock (B1)	26.1%	31	119	similar	2
16	Williamsburg (W5)	26.5%	40	151	similar	2
17	Grandview North (O9)	27.3%	42	154	similar	2
18	Darlington (C6)	27.4%	23	84	similar	2
19	Cochrane South (W3)	28.4%	27	95	similar	2
20	Frenchman's Bay (P1)	28.5%	37	130	similar	2
21	Whitby South (W1)	28.7%	54	188	similar	2
22	Carruthers (A3)	28.8%	61	212	similar	3
23	Amberlee (P3)	28.9%	26	90	similar	3
24	Dunbarton (P4)	29.0%	40	138	similar	3
25	Beatrice South (O8)	29.2%	26	89	similar	3
26	Courtice North (C2)	29.3%	29	99	similar	3
27	Pickering City Centre (P5)	29.6%	37	125	similar	3
28	Port Perry (S1)	29.7%	19	64	similar	3
29	Clarke (C7)	30.7%	51	166	similar	3
30	Whitby Brock North (W6)	31.1%	41	132	similar	3
31	Downtown Ajax (A2)	31.1%	32	103	similar	3
32	Ajax Waterfront (A1)	31.6%	25	79	similar	3
33	Downtown Whitby (W2)	32.0%	41	128	similar	3
34	Ajax Northwest (A8)	33.3%	69	207	HIGHER	4
35	Oshawa Northwest (O11)	33.3%	47	141	HIGHER	4
36	Central Ajax (A4)	33.7%	34	101	similar	4
37	Rural Scugog (S2)	33.7%	31	92	similar	4
38	Grandview South (O5)	34.0%	33	97	HIGHER	4
39	Stevenson North (O6)	34.1%	43	126	HIGHER	4
40	Downtown Oshawa (O3)	34.8%	31	89	HIGHER	4
41	Bowmanville South (C3)	35.2%	62	176	HIGHER	4
42	Central Park (O4)	35.3%	30	85	HIGHER	4
43	Hillsdale (O7)	36.5%	35	96	HIGHER	4
44	Bowmanville Central (C4)	37.9%	39	103	HIGHER	5
45	Beatrice North (O10)	38.1%	43	113	HIGHER	5
46	Lakeview (O1)	40.8%	78	191	HIGHER	5
47	Applecroft (A7)	40.9%	54	132	HIGHER	5
48	Courtice South (C1)	41.3%	76	184	HIGHER	5
49	Westney Heights (A6)	48.2%	40	83	HIGHER	5
50	Gibb West (O2)	51.0%	53	104	HIGHER	5

Table 2: EDI-Senior kindergartens vulnerable in one or more domains. (Durham Region Health Neighbourhood, 2015)

The need for educational assistance has been constant in this area due to the nature of the low-income apartments in this community. Based on demographic statistics from the last few decades, young, low-income families continue to reside here (Table 2). Children



continue to follow similarly challenged academic patterns. It is known that poverty is an empirically validated risk factor for academic strife and that Black and Brown students at-risk tend to have a higher population in these communities.

As noted, deep educational inequalities persist for students from low-income families and nondominant racial backgrounds. The outcome disparities that result are examples of the cultural reproduction of structural inequalities and opportunity gaps found in a racially and economically stratified society (Ladson-Billings, 2006).

#### Immigration in Durham

Immigration	Ajax	Brock	Clarington	Oshawa	Pickering	Scugog	Uxbridge	Whitby	Durham
Immigrants	46,335	990	11,045	26,975	31,155	2,155	2,660	29,555	150,885
Before 1981	11,240	630	5,940	11,925	11,455	1,570	1,540	11,175	55,475
1981 to 1990	7,520	115	1,645	3,765	4,850	210	330	4,285	22,725
1991 to 2000	12,255	90	1,550	4,290	6,775	130	375	5,615	31,090
2001 to 2010	11,735	105	1,460	5,035	6,155	150	305	6,340	31,275
2011 to 2016	3,585	45	455	1,950	1,930	100	115	2,140	10,315
Americas	30.4%	14.1%	21.7%	23.2%	28.8%	11.8%	16.9%	25.4%	26.6%
Europe	14.8%	65.7%	57.9%	45.3%	24.6%	75.2%	62.2%	34.8%	31.4%
Africa	5.9%	2.0%	3.8%	4.8%	5.5%	1.2%	3.0%	5.9%	5.3%
Asia	48.5%	18.2%	16.0%	26.3%	40.7%	10.7%	17.3%	33.5%	36.3%
Oceania	0.3%	0.0%	0.6%	0.3%	0.4%	0.7%	0.9%	0.4%	0.4%

Table 3: 2018-INFO-53-2016-Census-of-Population (Durham Region, Commissioner of Planning & Economic Development, 2018)

#### **4.6 Participants and Stages of Participation**

Before the research began, I worked with two classes as a Primary core teacher (20 seven to eight-year-old students) and an Intermediate history teacher (15 eleven to twelve-year-old students) for the school months September through April. Considering that the focus of this study was related to math, which is a core subject for all learners, the context of having all my students participate in the Math Story Project, which held two requirements: 1. a math story entitled *My Life in Math* and 2. *Math-to-Self Connections* can be viewed as purposeful in this investigation.

Stage 1: The Principal of the school:

- Distributed and collected the attached consent forms (See Appendices B & C).
- Made contact with the selected students and their parents/guardians to distribute information sheets and consent forms.
- Collected signed consent forms from participant students and their parents/guardians prior to the commencement of the study.
- Completed routine 'check-ins' with students at the school, sent reminder notes home in agendas and provided a reminder phone call to students to retrieve forms.

Consent would be obtained from both parents/guardians and students themselves. A student assent form would be provided (see Table. 2) to manage student's approval. The student comfort level of sharing data was ascertained by asking the student to place an X indicating a willingness to participate and share math stories and experiences with the researcher. None of the information was analyzed in the consent form until after the conclusion of the school year 2019.

Stage 2: Both Primary and Intermediate students in both classes completed the first part of the Math Story Project as a regular classroom practice. The *My Life in Math* took place over 3 to 4 non-consecutive days on a five-day schedule. All students in the class created a story based on personal math experiences at independent computer stations. All students were given a prompt page on paper (See Appendix A). Sentence starters were provided (See Appendix F) along with oral instruction (See Appendix A) as per usual class instruction. Using a constructivist perspective that narratives are co-constructed from a social interaction I developed semi-structured 'sentence starters' aligning the process with the concept that

participants intentions and interpretations are as important as the researchers (Clandinin & Connelly, 2000).

The students spoke their answers into a personal microphone at their independent computer stations. The voice was not recorded, but instead, it simultaneously transformed into text on their separate computer screens. Using speech-to-text technology (with typing/editing capability) as described above was a common practice in our classroom and students are comfortable and proficient in its use. On each day students worked on their math story for approximately 30 minutes, for a total of 90-120 minutes, including editing, revision and collating.

Stage 3: The second part, *Math-to-Self Connections*, took approximately 15-30 minutes during one class period as a regular classroom practice at independent computer stations. *Math-to-Self Connections* was an activity comprised of questions about the students' relationship with Math (See Appendix E). The questions appeared on their computer screens and through oral instruction as per usual class instruction. The students spoke their answers into a personal microphone at their independent computer

stations. The voice was not recorded, but rather it is simultaneously transformed into text on their separate computer screens.

Stage 4: The Narratives were saved to a shared Google Classroom Teacher Drive. The *Math-to-Self Connection* was also answered and submitted to Google using digital technology for both primary and intermediate groups. Students blended two data sets (story and connections) into one narrative called *My Life in Math*, or the title of their choosing.

Stage 5: The stories that emerged from the data were member-checked. Member checking allowed for participants to affirm that the narratives that were collected reflected the students' thinking (Creswell, 2014). Member checking improved the integrity of participants' writing by allowing them to verify the plausibility, modify or provide feedback. After publishing, students listened to their submission. Participants affirmed that the narratives that were collected reflected the students' own thinking (Creswell, 2014).

Stage 6: After the school year had concluded, and grades had been submitted, I retrieved consent forms from the

principal who provided them to me in a sealed envelope, then identified participants and commenced the analysis portion of the study. None of the information was analyzed in the consent form until after the conclusion of the school year 2019.

In all, ten narratives were selected. Each chosen narrative was based on the anonymized student's self-identification as a Black or Brown student and resided at the location known as Ah Fi Mi. Each story was uploaded to MAXQDA2018 and analyzed for word frequency and themes through word and phrase usage in student narratives (see Appendix H). The research data initially involved 6 to 12 participants who self-identified as Black or Brown; however, Black and Brown students living outside the Whitby community, referred to as Ah Fi Mi, who attended Guarded Gate Public School, also submitted qualitative data, which I found useful to highlight for comparison.

In blue, I highlighted phrases where students suggest they are math doers or knowers. A Doer acts when completing a particular mathematical task within strands of math, i.e. geometry, measurement, number sense, data management or patterning. As knowers, students demonstrate math competency through conceptual understanding and awareness that may be revealed in their conversations and expressions regarding self-confidence as it relates to

math. Yellow highlights indicate where belongingness in math is relevant to the student. J. S. Matthews (2018) encourages a more in-depth look at the 4H's (home, hobbies, hope, and heritage) to assist in isolating the elements of belonging within the narrative. Magenta highlights indicate the student's sense of agency. Is the student an advocate of his/her/others/ community learning? Does the student submit or omit evidence of traditional math learning?

Searching for this qualitative data collection in the Black/Brown student narratives is essential to identifying critical elements useful to educators to act as allies as opposed to gatekeepers, in support of future Black/Brown mathematicians.

#### **4.7 Observations**

These tasks were separated by division, Primary and Intermediate. Intermediate students required little direction in terms of narrative writing. Students chose their station, sat quietly, and did not share their work. Intermediate students used the prompt page for ideas and opted to type the narrative in prose even though speech to text was available. Intermediate and Primary students chose code names that had personal meaning to them. In terms of equipment, Primary students required minor assistance with microphone clarity and formatting narrative. All primary students demonstrated excitement to use the computers and opted to use speech to text for

both their math story and *Math-to-Self connections*. The Principal remained in the lab for each session and floated to students who required direct assistance with the technology (for example, Google often misinterprets the accents of English language learners). The Primary students appeared to be motivated to tell a story using digital technology and thrilled to illustrate the story as well (see Appendix I). The Principal's presence in the writing lab was to fulfill any needed clarification for students and assist with everyday writing tasks. Implementing their chosen code name preserved students' anonymity in all records.

#### **4.8 Ethical Considerations and Limitations**

The students may or may not have experienced any benefit as a result of participating in this study. Students may or may not have increased knowledge of themselves as math learners. Still, math educators may have experienced a broader benefit by understanding how children learn and express their understanding of math identities.

As the researcher, I was responsible for compliance with all applicable legal and regulatory requirements concerning the protection of privacy, consent for the collection, use or disclosure of information about participants. There are legal limits on information researchers can promise to keep confidential. A student's statements could have been reported to police in the highly unlikely event that he/she



disclosed abuse or expresses that he/she may want to harm themselves or others. Although there was minimal risk to participants in this study, participating, declining to participate or withdrawing participation partway through the process, was acceptable and it was communicated that no implications would appear on any academic records.

As a Black teacher in the education system, I was in a unique Insider/ Outsider position. My intersectional role as a Black adult female teacher created an element of what assumed to garner automatic trust from students who identify racially with me. There was a perceived sense of shared culture and experience. My outsider position was created as a researcher and an authority figure in the school. At all times, I was mindful of the existing power imbalances and protected the students participating by implementing measures to ensure no undue pressure was exerted. This was achieved by ensuring consent forms were signed and adding a statement indicating that students could participate, decline to participate or withdraw their participation partway through the process.

Other critical steps I included:

There was no implication of the student's academic record. Redacting and coding names would also protect identities and records of the students. An encryption code was used when storing digital

information. After the study is complete, digital files and student information will be deleted.

Limitations included language barriers for Black and Brown newcomers to Canada and difficulty completing and retrieving the consent form. In reference to the language barrier regarding the parent's English fluency, all of the students spoke English; however, one of two parents in a household may have struggled with the *Queen's English*. I managed this by asking the Principal to ensure that the stronger English speaking parent signed the form as well as assured the parent with lesser knowledge of English was aware that translated versions of documents were available upon request through the Principal. Through regular practice of teacher-parent school interviews, the Principal was aware of which parents spoke Creole. The Principal also spoke Creole and helped guide the parents orally through the consent forms.

## Chapter 5

### Analysis of Data

#### 5.1 Data Analysis Plan

Stage 1: The information was not analyzed in the consent form until after the conclusion of the school year. The Math Story Project generated two digital datasets: Stories and Math-to-Self Connections (short answer activity). The purpose of the activity, Math-to-Self Connections, was to trigger memories or oversights that could be included in the narrative.

The narratives were member-checked, edited and collated by the student as one story *My Life in Math*.

Stage 2: *My Life in Math* stories and *Math-to-Self Connections* were consolidated and then analyzed using narrative discourse analysis. The objective was to determine the impact narrative writing had on the development of math identities, which involved the analysis of students' voices as qualitative data. The texts in the narratives had undergone a narrative analysis, word frequency and an open thematic coding process using coding tool MAXQDA2018, which allowed me to generate categories,

themes, and concepts. MAXQDA2018 allowed me to conduct simple frequency word searches and create a coding system to categorize themes and phrases defining math identity. Themes include sense of competency, sense of belongingness and sense of agency, as well as subcodes. I grouped codes not necessarily because they are exactly alike, but because there was a commonality of a specific topic. When selecting themes, I considered identity-shaping factors based on the research traits outlined by Sfard, 2006; Martin, 2013; Nelson's, 2015; and Matthews (2018) (Saldaña, 2013).

Stage 3: The data was analyzed in the form of field notes and interpretations written by myself, the researcher.

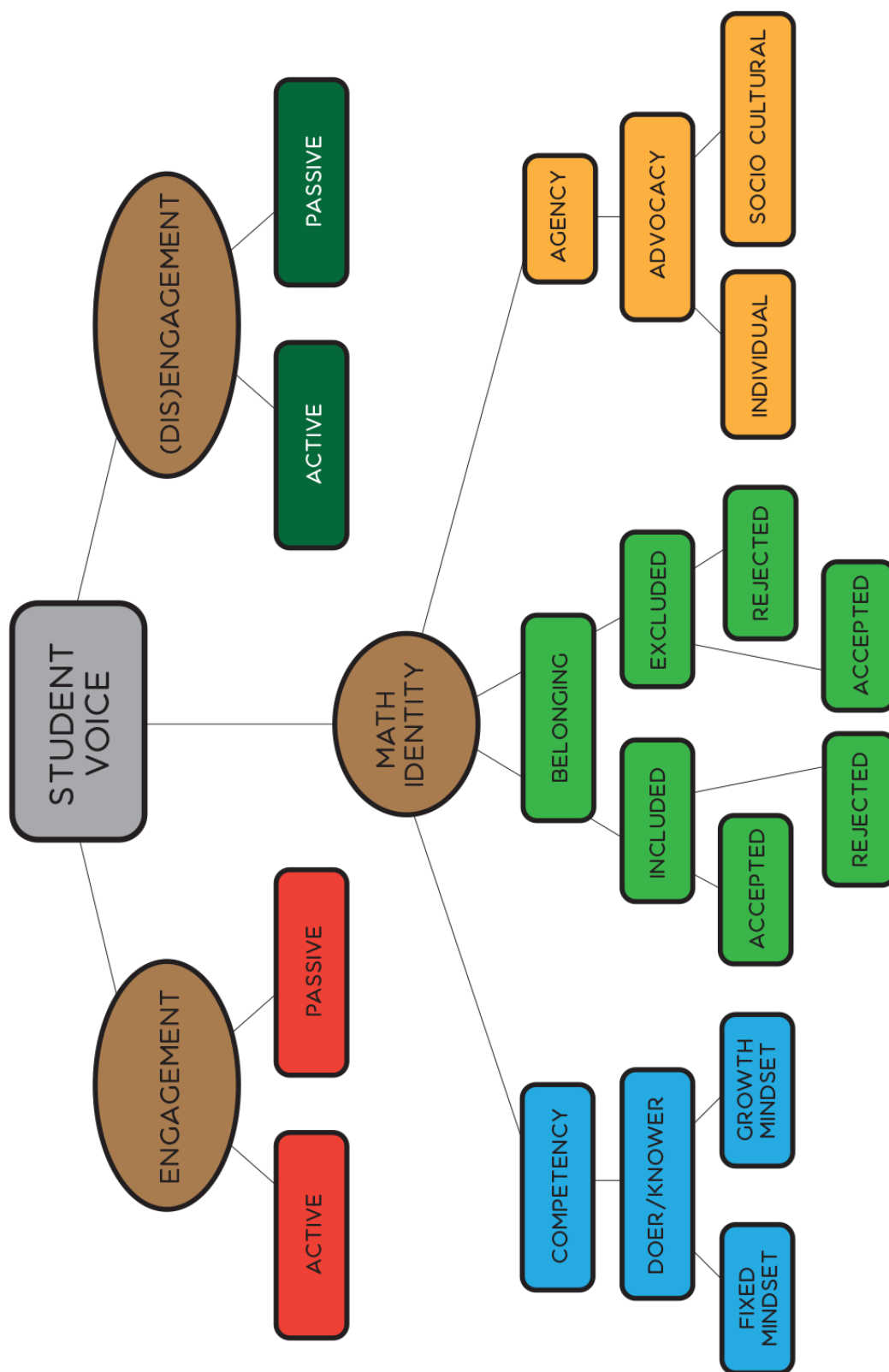


Figure 5: Model diagram of core categories of the narrative analysis

## 5.2 Data Collection after school had concluded June 2018.

Participants	Distributed	Completed Responses	Self ID Racialized	Chosen	Female	Male
Grade 2	20	19	12	5	2	3
Grade 7-8	15	11	11	5	1	4
Total	35	30	23	10	3	7
Chosen Narratives						
Age	Code name	Member Checked	Gender	Division	Resides in AFM	
7	Death Cure	✓	male	Primary	no	
7	Currie	✓	male	Primary	Yes	
7	Warrior	✓	male	Primary	Yes	
7	Bendy	✓	male	Primary	Yes	
7	Kaity	✓	female	Primary	Yes	
7	Butterfly	✓	female	Primary	Yes	
12	Triangle	✓	male	Intermediate	Yes	
12	Ria	✓	female	Intermediate	Yes	
12	Hot Fresh Oxtail	✓	male	Intermediate	Yes	
12	Tyrone	✓	male	Intermediate	Yes	
12	Black Bob	✓	male	Intermediate	Yes	

Table 4: Math Story Project Participant Profiles

### 5.3 Observations

Towards the end of the school year, I conducted the narrative writing exercises, *My Life in Math* and *Math-to-Self Connections*. These tasks were separated by division, Primary and Intermediate.

Intermediate students required little direction in terms of narrative writing. Students chose their own station, sat quietly, and did not share their writing. Intermediate students used the prompt page for ideas and opted to type the narrative in prose even though speech to text was available. Intermediate and Primary students chose code names that had personal meaning to them. In terms of equipment, Primary students required minor assistance with microphone clarity and formatting narrative. All primary students demonstrated excitement to use the computers and opted to use speech to text for both their math story and *Math-to-Self connections*. I remained in the lab for each session and floated to students who required direct assistance with the technology (for example, Google often misinterprets the accents of English language learners). The Primary students appeared to be motivated to tell a story using digital technology and thrilled to illustrate the story as well (see Appendix I). My presence in the writing lab was to fulfill any needed clarification for students and assist with routine writing tasks.

## Chapter 6

### Findings and Discussion

#### 6.1 Findings

An elaboration of the findings was organized for each of the participants. Word Frequency, Narrative and Thematic coding methods were used for analyzing. Several excerpts from narratives that are presented in my research, voiced by self-identified racialized students, such as Bendy (7), Hot Fresh Oxtail (12), Death Cure (7), Triangle (12), and Cordell(12) (from Robert Berry's narrative study), prompted the inquiry:

- 1) How do untold stories told from the voices of Black/Brown students of low SES in the Ah Fi Mi Community at Guarded Gate Public School provide insight into students' math identity as defined by their sense of competence, belonging, agency and their engagement, or disengagement with mathematics?
- 2) How does understanding the voice of personal narratives involving math lives help to identify current systemic inequities for math educators to shape and better address math learning for



racialized math learners of low SES in the Ah Fi Mi  
Community at Guarded Gate Public School?

In the first chapter, I chose to highlight a narrative that was written a decade ago by Cordell, who participated in a narrative study of African American Boys in Middle School who were successful in math, by Dr. Robert Berry III (2008). His story serves as an exemplar, along with my excerpts of 2 other vignettes. Here, I have included Dr. Martin's analysis of Cordell's narrative before proceeding into the analysis of my students.

Dr. Martin's (2016) analysis of Cordell:

Cordell's narrative reveals that students negotiate a number of complex identities that emerge as important to them. We see a number of identities that are important to him here: his sense of self as a math student. He says he is a middle school student, an only child, an independent good son, a self-acknowledged smart student, and a black boy. He acknowledges some school officials think he is not gifted in mathematics. As Cordell's narrative helps to demonstrate, both parents and teachers can have profound influences on their children's mathematics identities in response to the messages that they send about their competencies and abilities. These messages can emerge in the stories that children tell about their mathematical experiences (p. 150).

There were differences in my qualitative analysis approach; for example, MAXQDA was used to analyze the participants' stories. I also used the code-naming feature in MAXQDA to determine student

engagement. To illustrate the visual component of MAXQDA, I included one example that highlights selected codes and themes, such as word choice and math word frequency. For instance, I recorded the number of times a participant used a word or phrase relating to math (including numbers and words representing any strand of math). Bendy uses math terms in 42 percent of his story (see figure 6). The frequency usage tool on MAXQDA2018 helped me visualize student engagement and interest in the math story writing exercise. A colour coding function allowed for visual analysis of the text (green: math terms, blue: the sense of competency, yellow: the sense of belonging, magenta: the sense of agency, red: positive/ negative feelings). It is evident that Bendy actively engages in math dialogue throughout his story, which supports bell hook's research (2003), where she discussed students engaging in the "insurrection of subjugated knowledge" (p. 2) the subjugated knowledge in this instance is mathematics.

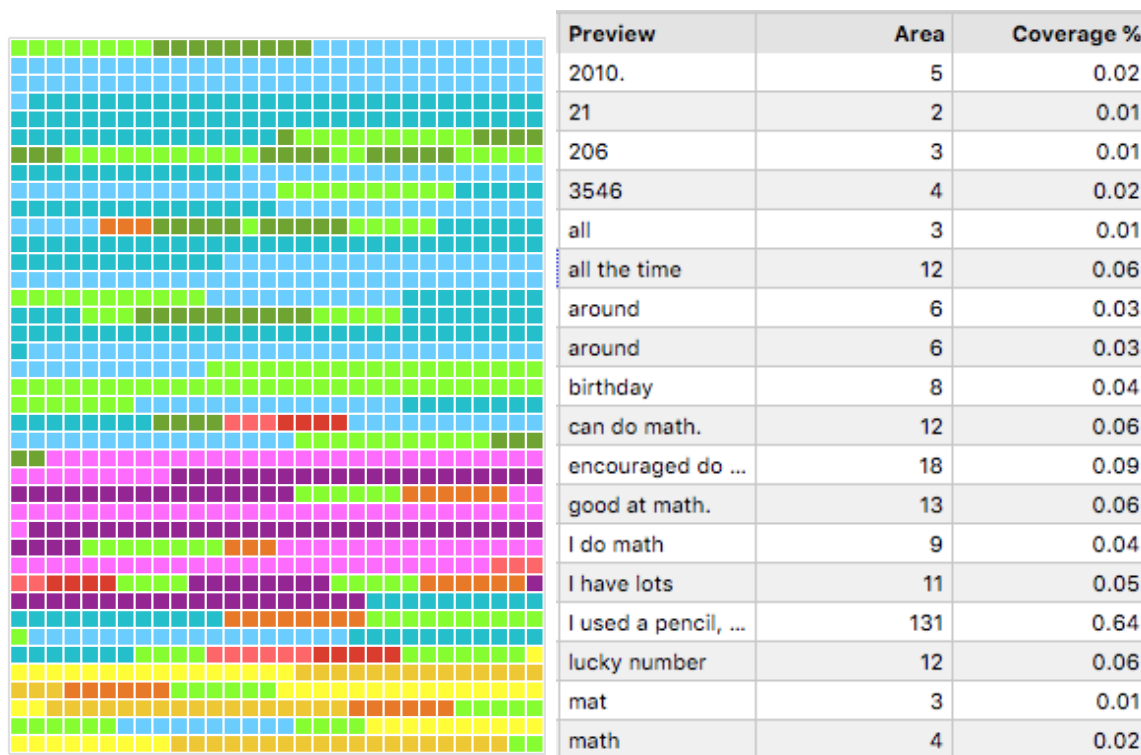


Figure 6: Document Profile of Bendy's Story. MAXQDA 2018 (VERBI Software, 2019) for data analysis.

Further analysis of colours shows his feelings about the math terms. Bendy shares positive statements (orange) and negative statements (red). 12 per cent of his narrative represented Bendy's feelings related to math.

These elements support the student's engagement to the Math Story Project.

### **Narrative Analysis: What's in a name?**

In addition to the messaging in student stories, during the narrative analysis I focused on the intriguing code names selected by students to represent their character (see table 5). In Dr. Berry's study, Cordell is a pseudonym selected by the researcher. The Math

Story Project allowed students to select their code name and narrate personalized math identity stories. In the *My Life in Math* writing exercise, all the students, including those who were self-identified as Black and Brown, understood the purpose of the code name. In primary and intermediate grades, students have prior knowledge and understanding of the significance of the main character in a story.

Ethnic representation of the main characters in children's stories is a fairly new phenomenon as a result of the rise of Anti-Bias Early Childhood Programming (<https://www.teachingforchange.org/anti-bias-education>). However, Gloria Ladson-Billings (2009) has long since identified racialized presence in literacy as one of the key aspects of pedagogy, curriculum, and inclusivity as it relates to cultural differences in the classroom (Ladson-Billings, 2009).

Coming from a racialized parent's perspective, I had difficulty finding stories and books with minoritized children as the hero(ine) and as an educator, I witnessed racialized students creating narratives that place a non-racialized child as the centre of their story. I found that both groups of students, primary and intermediate, enjoyed the opportunity to choose a code name for their math story. In my opinion, the code names provided culturally significant information such as pride in their national dishes and provided a fun entry point of active engagement for the students in this study.

## **Narrative Analysis of Bendy's Life in Math**

Bendy writes:

My name is Bendy. Numbers that are important to me include 2010. I am seven years old. My birthday is September 28, 2010. My jersey number is 29. My classroom is 206. My lucky number is 21. My phone number is 123-456-7891.

I know math is all around me. I see Math around me when I go to No Frills. I can do math when I am at school. I do math when I am at home.

When I'm doing math, my body is singing. I hear math when I am with my teacher. I do my best but not when I am doing times.

Once I solved the problem in math I used a pencil, paper, my brain, my ruler, my glasses, my computer, my hands and my feet.

Sometimes I make mistakes doing times. I try but I'm singing all the time in my tummy when I am doing math. The math learning advice I would give my friend is ...do a lot of homework. To improve my own math learning I will do more work like practicing times.

I do not like math but I feel that I am good at math. I know somebody likes math if they play math games. I have had experience with math games.

I don't know if my parents like math. I have never felt sad as a Math Learner. I do feel encouraged as a math student. My neighbourhood has parks. My door number is 3546. Nobody in my neighbourhood talks about math.

## **Codename Analysis**

The code name *Bendy* revealed to me the significance of the video gaming culture to the student story writer. Bendy is taken from a video game called *Bendy and the Ink Machine*. The Bendy character is a demon-like imp who is entirely coloured in black with the exception of his white face. Interestingly, the participant chose a character for his math story that was untrustworthy, mischievous and opted to make calculated inappropriate decisions at critical times in a game of survival. Bendy, from the video game, is similar to an evil Mickey Mouse, who uses its wits to create difficulties for Henry, the white protagonist in the game. I am curious as to why he chose the name of an evil antagonist to represent himself in his math story. From my studies in Children's Literature and decades of experience with Primary literature, the villain typically manifests behaviours in an attempt to gain control and have power over situations around them. Perhaps the participant codenamed *Bendy* wanted to be more active in his math-life, especially when learning his multiplication tables.

## **Mathematics Competency**

Bendy regards himself throughout the narrative to be what Dr. Martin would call a *Doer of Math*. Bendy demonstrates basic competencies and identities that are important to Bendy, for example, his sense of self and how he allows numbers to define him: age and

birthday. He acknowledges his efforts and identifies a weakness that he feels is caused by an intrinsic factor. Bendy confidently applies number sense by demonstrating ordinal and cardinal numbering and indicates an understanding of the measurement of time utilizing various units of minutes, days, months and years. Bendy writes:

My name is Bendy. Numbers are important to me including 2010. I am seven years old. My birthday was on the 28th of September in 2010. My jersey is number 29. My classroom is 206. 21 is my lucky number.

When I read this part of the data that Bendy shared in the narrative about the importance of numbers to him, I recognized immediately, and I had implemented a traditional teaching style. The self-focused description of math appears in all of the primary narratives. From my many years of experience in teaching primary math out of Canadian Nelson workbooks, I realized that building mathematical concepts around personalized data is encouraged. Nelson prides itself on providing opportunities for students to “engage in meaningful mathematical discourse” in “classrooms with rich tasks embedded in the real-life experiences” and students “learn to think and speak like mathematicians” (quotes taken from [www.nelson.com](http://www.nelson.com), 2019). I began to wonder, *real-life experiences, according to whom?* In my opinion, Nelson Math has trained math educators over the years to default to dominant, Eurocentric math on all accounts. If

we revisit Bendy's beautiful introduction to describe what numbers are important to him, it is obvious the ideas come directly from the prompt page, and Bendy ventures no further than prompts given. Maybe it was unclear to Bendy how significant his unique contributions to math could be. It may seem as though Math educators in the Western hemisphere cater to Eurocentric culture and practices. Birthdays, for instance, from non-Westerners' perspective, may be seen as European and paganistic celebrations of measurement. Some cultures do not place such strong emphasis on birthdays, which I learned from parents of my students who were of Islamic or Jehovah's Witness faiths. Many cultures place greater focus on religious celebrations or perhaps use alternatives measuring tools of time such as Islamic or Tamil calendars along with the Gregorian calendar to integrate concepts of probability, shape and time.

### **Math Belonging**

At first glance it would seem that Bendy values achievement and I sense he uses it as an indicator of belonging. Bendy suggests that he is a strong-achieving math student in individual strands and reveals insecurities in other tasks of math (times tables). Nevertheless, Bendy does not seem to question his sense of belonging at school directly. However, with contradicting words and evidence of one who both *likes* and *dislikes* math, Bendy doesn't readily identify any family, friends or



neighbours who have an affinity towards math. The realization of no familial connections to math led me to conclude that perhaps he does not have a strong sense of belonging to math. Bendy shares that math is associated only with school and that he has no knowledge about his parents' affinities toward mathematics.

Reviewing his visual story profile, Bendy's theme of belonging registered only 3 percent (magenta) on his document profile (figure 6), reinforcing my conclusion of his low sense of belonging in relation to math. Bendy writes:

I don't know if my parents like math. Nobody in my neighbourhood talks about math.

At this point in the story, I empathize with Bendy's "no sense of place" (hooks, 2009). In searching for Bendy's 4H's as defined by Matthews (2018), home, hobbies, hopes and heritage, Bendy reveals very little about home life or heritage and reveals some interest in game playing. There is a slight sense of confidence that he will demonstrate growth in math when he advocates for himself in the following section.

### **Math Agency**

Bendy suggests work and practice improves his math. Bendy identifies concrete places and uses for math in the environment and advocates for greater involvement (homework and games) in order to be successful. Bendy's narrative suggests success is evident by being a

*Doer* of math but does not mention assessment as a way of knowing he is an *effective doer* of math. Bendy does not reveal any experienced trauma or episodic threats in his learning or home space affecting his math knowledge. Then again, as mentioned earlier, Bendy is not forthcoming about many details in the physical environment at home, only to say that no one talks about math. I appreciate that Bendy advocates for himself through his story. This reinforces the bell hooks concept of student engaging in dialogue as it relates to a subject.

Bendy makes agentic statements such as:

When I'm doing math, my body is singing.  
I hear math when I am with my teacher.  
I have never felt sad as a Math Learner.  
I do feel encouraged as a math student.

It is my opinion that the singing is happy and joyful. I am pleased it is associated with math; however, Bendy also attributes the singing in his tummy to cause disengagement with math. He feels the distraction hinders his learning of his timetables.

I try but I'm singing all the time in my  
tummy when I am doing math.

As a qualified teacher of the Canadian Conservatory of Music, my knowledge of music theory and repertoire helps me explain the crossover of music and teaching mathematics. Music is intrinsically

linked to identity and could be used to help Bendy further understand fractional concepts and measurement in mathematics.

Upon further analysis of Bendy's story I am left with lingering questions:

What if Bendy was asked to report if Math liked him? How would he have responded? What about Bendy's omissions? What has been left unsaid about Bendy's math learning experience? What is excluded explicitly or by omission?

Within the subject of math, it is clear Bendy demonstrates acceptable Eurocentric traditional ways of talking, acting and being in Primary math. Does Bendy's voice in the narrative challenge or extend the discursive moves for math teaching and learning? It is my opinion that the challenges to express and omissions made by Bendy are as a result of systemic inefficiencies to move beyond the dominant culture in math learning.

In Bendy's narrative, he creates an image of mathematics as a product of the school environment. The math identity assumed in terms of competency, belonging and agency are as a result of school interactions and practices. Bendy would benefit from emphasizing the contributions of non-Western indigenous cultures to the development of science and mathematics (Leonard and Martin, 2013).

Bendy unknowingly reveals pedagogical traditions of mathematics that include viewing math as only computational and localizing math to the classroom, which in itself marginalizes a student's math identity. Bendy does not discuss math educational debates, design or decision-making in the narrative; however, a primary student would rarely engage in such activities.

The focus of my thesis is on the Black and Brown students who resided in a low SES in the Ah Fi Mi Community and attended Guarded Gate Public School. Black and Brown students, in particular, are typically positioned at the lowest level of learning and succeeding in mathematics (Aud, Hussar, Planty, Snyder, Bianco, Fox, Frohlich, Kemp, & Drake, 2010; Secada, 1992; Strutchens & Silver, 2000; Tate, 1997; Vanneman, Hamilton, Baldwin Anderson, & Rahman, 2009 as cited by Martin, 2003). However, it intrigued me to complete a comparison of Bendy's story to a narrative written by another racialized Primary student who attended the same school and was in the same class as Bendy. Still, he was the only Black student who lived outside the community in a middle-class neighbourhood. This primary student completed the exercise with the entire grade two class. His code name was Death Cure, and he wrote the following narrative:

I like math and I am good at math! I know someone's good at math because they study math. I learn more by doing equations and answering them. I get better by doing more math games. I

am very confident in math I even think I can do fourth grade math. I never feel nervous when I do math. I think I started to like math at age four. I like math because I play lots of math games. I played games at school, at home, day care. My mom likes math because she likes to solve math problems. I think my good friend likes Math. He loves to solve math problems. Yes, I have felt sad as a math learner and yes; I have felt happy as a math learner too. I feel encouraged by my teacher and my mom and both of my dads. My neighbourhood has houses, library, school, a pizza place, and friends. It's important sometimes to me to talk about math. Sometimes people talk about math in my neighbourhood.

When I compare the analysis of Death Cure's narrative to that of Bendy's and Cordell's, I determine that each participant has a great sense of competency. Bendy, Death Cure and Cordell dialogue well; however, Death Cure's math language and word selection seem more advanced than Bendy's. Like Bendy, Death Cure also seems influenced by media communications but takes a more positive problem-solver perspective. Bendy appears to share more anxious feelings surrounding math. At the same time, Death Cure and Cordell demonstrate a stronger sense of belonging as they confidently refer to his home connections (friends, moms, dads, aunts, and grandmother), his habits (studying and gaming in math) and a high degree of agency (or self-advocacy - *I can do fourth-grade math!*) as pertained to mathematics learning.

## **Narrative Analysis of Hot Fresh Oxtail's Life in Math**

Oxtail writes:

Hello my name is Hot Fresh Oxtail. Today I wish to talk about my math life. Did you know that I can do math at home, at school, at the library and in stores? Did you also know that math is all around me. Everywhere I go! And even when I get home. When you're playing with toys, when you play on your electronics. You know, when I do math my body is thinking, relaxing, sitting, writing and reading. I hear math every day even if I'm not at school from my parents, friends and family. Most importantly I do my best math when there is no noise. No interruptions. And when I have all my supplies. One way I solve a problem is to use my brain and math utensils like pencils. I am constantly making mistakes in math and I rush my work. Especially when I did not read it over. Some advice I would give my friend would be don't rush your work and read it over carefully. I can improve my math learning from my mistakes and focusing on my work and by studying hard.

I don't really like math but I'm good at math. How would somebody know they are good in math? They would know they're good enough if they trust themselves. I learned that by studying, taking the lines from teachers and friends and by asking questions about things I do not understand. I get better at math by studying hard and asking questions. I'm confident about my math because for the most part on my tests I have gotten one or two questions incorrect. I don't feel nervous when using my math skills. I only become nervous when I'm around people I don't know and if I don't know the material well. I started disliking math in grade 7 because we kept doing the same work from grade six. I can tell my parents love math because my mom was a teacher. My mom was a teacher in Jamaica. My friends always complain they don't like math. I've never felt sad as a math learner but I never felt

happiness as a learner either. I have felt encouraged in math by my teacher and my mother. I would describe my community as the ghetto. Math is not very important in my community. Nobody talks about math in my community.

When I analyze Hot Fresh Oxtail's math identity, I find that he has a great sense of competency and a high degree of agency as it pertains to mathematics learning.

### **What's in a name?**

Hot Fresh Oxtail is a Jamaican cuisine. I love that this intermediate participant chose a code name that was very distinctive of Jamaican culture. Oxtail wants me to know that he is proud of his heritage and chose to reveal it in his math story project.

### **Math Competency**

Oxtail is a doer of math. He identifies social forces (friends and family) and personal elements (nerves) that support or hinder competency levels.

Did you also know that math is all around me, everywhere I go, even when I get home, when I'm playing with toys, and when I'm playing on the electronics? You know, when I do math my body is thinking, relaxing, sitting, writing and reading...I do my best math when there is no noise, no interruptions, and when I have all my supplies. One way I solve a problem is to use my brain and math utensils like pencils. I don't feel nervous when using my math skills.

## **Math Belonging**

Oxtail can readily identify many environments and sources of encouragement that could enhance his sense of belonging. He indicates that by believing in self, there is the potential to improve, which is evidence of a growth mindset (Boaler, 2000; Dweck, 2008). Oxtail also affirms his family members belong to math education, as his mother was an educator in their home country, and they discussed math in their home as he explains in the excerpt below about finding lessons remedial in mathematics.

His narrative indicates he does not like math, possibly because participating in such a particular academic setting that was not advancing conflicted with the math identity that he held for himself—an identity as a high-achieving academic student. The statement is a counter-narrative of stereotypical ideology about the confidence Black and Brown students have of their math identity.

I hear math every day even if I'm not at school from my parents, friends, and family... I don't really like math but I'm good at math. How would somebody know they are good at math? They would know they're good enough if they trust themselves. I only become nervous when I'm around people I don't know and if I don't know the material well. I started disliking math in grade 7 because we kept doing the same work from grade 6. I can tell my parents love math because my mom was a teacher. My mom was a teacher in Jamaica.



Oxtail attests that he held feelings of insecurity when the material was unfamiliar. He equates this feeling to being among unfamiliar people. He also shares his view of the community and its lack of effort to embrace mathematics.

I would describe my community as the ghetto. Math is not very important in my community.

### **Math Agency**

Fresh Oxtail continues to advocate for himself and uses an agentic voice by sharing his mistakes for others to learn from:

Some advice I would give my friends would be don't rush your work and read it over carefully. I am constantly making mistakes in math and I rush my work. Especially when I did not read it over.

I can improve my math learning from my mistakes and focussing on my work and by studying hard. I get better at math by studying hard and asking questions.

Oxtail identifies as a *confident* math student but applies traditional pedagogy to validate and justify knowledge of competence:

I'm confident about my math because for the most part on my tests I have gotten one or two questions incorrect.

Oxtail's voice in the narrative reinforces discursive moves for math teaching and learning. Unlike the primary students Bendy and Death Cure, Oxtail knowingly reveals pedagogical traditions of mathematics that include analysis of standardized tests and report cards. Cordell,

who is also an intermediate student, mentions testing, which is a reliable indicator he is aware this is a standard pedagogical practice of assessment by math teachers. Oxtail can articulate with maturity, math dialogue and discuss with peers and adults if necessary. However, as an Intermediate teacher of math, I find that intermediate students do not often seek out active dialogue in math. I find that he and the other intermediate students actively and intentionally disengage if given the opportunity, even more so because of the secure integration of technology in the classroom. For example, my intermediate math students are each equipped with Chrome books, Internet and have multiple links to math sites such as Knowledge hook, IXL.com and Khan Academy. However, Oxtail does not delve into the technology or influence of media culture in his math story. Cordell does not discuss technology perhaps because the technology was not as prevalent in the math class 10 years ago; however, he talks about his boredom and the repetitiveness in math class as well, which is similar to Oxtail.

The beauty of Oxtail's story, which is similar to Cordell, is he focuses on the relationships and inquiry in his math life: his friends, teachers, and mother.

I learned by studying, taking the lines from teachers and friends and asking questions about things I do not understand. My friends at school always complain they don't like math. I've never felt sad as

a math learner but I never felt happiness as a learner either...I have felt encouraged in math by my teacher and my mother.

It is a poignant and powerful moment when Oxtail reveals his feelings towards math: he is indifferent. Although he demonstrates passive engagement, he makes minimal effort to seek out ways to improve his experience with math. Like Cordell, he complains about repetitive work, but he does not choose to seek more challenges or ask a parent to advocate for him. Perhaps he does not feel empowered to do so. Why is Oxtail unaware of his ability to become actively engaged? He receives his affirmation via traditional methods of marks and scores to determine his overall success in math. He also mentions the women who teach him... his teacher and his mother, but unlike Cordell, Oxtail doesn't turn to his network to challenge the status quo.

I compared Hot Fresh Oxtail's story to that of Triangle, who is another racialized Intermediate student, who resided in Ah Fi Mi, attended the same school and was in the same class as Oxtail and I discovered remarkable contrasts. This intermediate student whose code name was Triangle wrote the following narrative:

My code name is Triangle. I'm staring into space. The room around me is quiet because that's when I do my best math. I hear about math when I'm with my teacher, my family and my friends. When I get problems in math I use a calculator, my computer, my hands, an eraser, a pencil and paper.

Sometimes I make mistakes when I misread numbers or do not check my work.

The math learning advice I would give my friend is talk and do lots of math to see how it works. Then you'll understand how it works. For example, I learned how to add and multiply. This helped me learn fractions which help me with my problems etc. To improve my own math learning I'll talk about now and I'll do more homework.

To tell the truth, I like math and I'm good at math. I know people are good at math because teachers will give the harder questions. To learn math, the teacher has to challenge you with harder questions. To get better at math, the student has to study and find harder questions. I am a very confident math student, I get 90%. I am not a nervous math student. I started to like Math in grade 7. I suddenly realized it is easy. My math experiences are usually in school. I know my parents don't like math, they say it's hard. And my friends don't like math either. They say it's boring and hard.

Math has never made me sad, I'm usually happy doing math and I am encouraged by my teacher. My neighbourhood is calm. Math is not that important in my neighbourhood. No one usually talks about math besides me.

Triangle resides in Ah Fi Mi Community as well. He is of African and Jamaican descent and very proud of his culture, although he does not reveal it in his story. Perhaps it is because he is unsure of how his culture is relevant in mathematics? He does not share it in his story, but I am aware he is the last of 8 children and was raised by a single

parent. Triangle's code name is unique in that he chose a geometrical name to represent the character in his story. I find Triangle's story descriptions intriguing. At the beginning of his story, he focuses on his space and the quietness of his environment. At a later point in his story, he returns to describing the calmness of his space. I am highly familiar with the constant trauma and turmoil that occurs daily in A Fi Mi Community. Then again, I am familiar with teaching Triangle; he is considered a quirky individual. Triangle may appear oblivious to the plights of his community and often exists comfortably in his world.

He is similar to Oxtail and Cordell. Triangle, Oxtail and Cordell infer or clearly state that intermediate math is uninspiring. The boys find measures of success in reports, test scores and final grades. However, they also find affirmation in a teacher's effort to provide challenging work. All three participants agree that harder questions make stronger mathematicians.

**Cordell:** I was with the group that got the harder problems.

**Oxtail:** I get better at math by studying hard and asking questions.

**Triangle:** I know people are good at math because teachers will give the harder questions.

However, there are other striking differences between Cordell, Oxtail and Triangle's perspectives. At times Oxtail relinquishes his

active role and places ownership on teachers to enhance his math learning. Cordell's battle to gain access to the Gifted Programming suggests he and his family believe gatekeepers are preventing Cordell's promotion to higher-level education. Triangle realizes the importance of math dialogue and actively seeks his challenges. Triangle demonstrates a powerful agency even though he admits that his friends and family are not math people. The differences, in my opinion, amount to the same point that each intermediate student is missing an element of belongingness.

Because of the lengthy process and repetitiveness in the narratives, I provide only the entire excerpts of Bendy, Death Cure, Hot Fresh Oxtail and Triangle and the analyses for each participant for this thesis. The stories may be useful for my Doctoral research in the future. However, to honour the efforts of each participant, I chose to share some remarkable excerpts from the other Primary and Intermediate participants.

**Kaity:** I know math is all around me when I am at home, at the library, at the park, school, in games and No Frills, the doctor too. I can do math when I am at school, home, at the doctor's office, sometimes at the park and outside.

My neighbourhood has a park, not much grass, lots of cars, vans, jeeps, a lot of pavement. These are all near my apartment building in the court. It is important to feel safe in your neighbourhood.

Sometimes people talk about math in my neighbourhood.

**Warrior:** Once I solved the problem in math using plus, minus and times. Sometimes I make mistakes I don't understand. Sometimes I write something down that I'm not supposed to. I need to do a math problem and wasn't paying attention. So I just wrote a picture instead. If I want to fix a problem I would just go ask a teacher, "How does it go?" This works great for me! The math learning advice I would tell my friend is when he gets stuck I would help him get the answer and he might help me when I'm stuck. I will help him but I will not tell him the answer. To improve my own math learning I will go home and I will work and I work until I become very smart so my teacher will be proud of me.

**Curry:** I can do math when I'm at basketball and soccer, at the mall, at any grocery store, at school at home and at the library too.

When I'm doing math, my body is relaxed. I also feel relaxed when I'm reading and writing and my body feels good and calm. I hear about math when I am with my teacher and my mom. Sometimes I hear about math with my friends and maybe my grandparents. I do my best math when I'm with my teacher and my mom. I also need to stay calm and not be mad or angry or nervous.

**Black Bob:** When I'm with my mother who was a teacher in Jamaica and my dad who was an engineer, I hear about math. I do my best math when I'm confident and I know what to do and if I get what I'm supposed to be doing. The advice I would give my friend is to keep trying and never give up. This could be your job in front of you! Stay

focussed on what you're given and do not get to talking to your peers!

**Goat:** I would imagine learning math is from school. I improve by studying and taking an interest in it. I'm confident in math. I get A's and B's. I am not nervous at all to use my math skills. I learned I liked math in grade 3 and I got better at it. I'm learning algebra math right now. I don't think my parents like math because they don't talk about it. I don't know if my friends like math.

**Ria:** When I'm at school, home, at the stores, doing sports, watching television, playing outside, and in myself, I can see math! I see math everywhere.

**Tyrone:** Sometimes I make mistakes in math and it isn't really a natural mistake. I make the same mistake again and again. Careless mistakes. To improve my math I wouldn't do anything other than listen to the teacher and take more notes. The learning advice I would give my friend is...well I wouldn't give advice if I didn't have to but if I had to... I would tell them to just listen to the teacher and take notes. I don't think my friends like math. They're all dumb anyway. My neighbourhood is filled with a lot of different genders but there are a lot of slow and dumb kids. No one in my neighbourhood really cares about this stuff. No one talks about math, we talk about Fortnite.

**Butterfly:** At the park I see some math. I go with my ruler and I measure the length and width. Numbers that are important to me are my age number and my friend's number. I am eight years old. I can do math when I am at (friend-1) and (friend-2)'s house.



When I am doing math, my body is seeking because I don't know the answer. I hear about math when I am with my mom and dad and my best friend. I do my best math when I am not with my dad and mother. Once I solved a problem in math, I used a number chart and stacking. Sometimes I make mistakes in math when people are talking to me.

## **6.2 Discussion and Implications**

I believe all the Black and Brown students' from this research provided useful insight into their math identities. Black and Brown student engagement and/or disengagement from mathematics in school systems arise when the practices of teachers and others effectively serve as barriers to inclusion and ultimately create an unequal leaky alternative to learning. Deficits in teacher thinking and the inability to recognize bias belittles the voice of the racialized child and therefore challenges children's sense of identity: competency, belonging, and self-advocacy (Ladson-Billings, 2009). CRRP scholars insist, "that students' academic performance improves when a student's voice, as well as their culture, language, and ethnicities, are implemented by math educators, especially within urbanized communities" (Brayboy & Castagno, 2009 as cited by D. Sylvestre, 2018, p. 34). A counter-narrative or story telling approach may be, indeed, an invitation to opening uncomfortable conversations with math educators about understanding identities of a more diverse student population who are academically at risk as evidenced by the

[math] educational disparities in the schools in the Toronto District School Board, reported by James and Turner (2017) and those unannounced, who have yet to disaggregate race-based data in boards such as the Durham District School Board. In response to increasingly diverse communities in Ontario, advocates of equitable math education have called for math teachers to employ culturally diverse, culturally responsive curriculum and practices.

Ontario must take steps to have equitable assessment opportunities and organizational structures that challenge institutional and systemic processes to improve the academic achievement of all students (Ontario Equity Education Action Plan, 2017). The narrative approach connects to culturally relevant and responsive approaches that connect theory to school practices. I believe using Identity Research, and Narrative methodology are complementary practices of CRRP. As they challenge forms of oppression, it offers practical strategies that practitioners can use in schools and highlights the impact of race and racism in the lives of Black people (Ladson-Billings, 2009).

Non-racialized colleagues have often admitted to having a bias to Black students and making assumptions about racialized, immigrant students and their families. Often the result of what appears to be a student or parent disengagement is not because of disinterest or lack

of education. Many parents earned degrees and careers before immigrating to Canada.

Cordell says:

My mother says the reason they did not want to test me is because I am Black

Oxtail shares:

I can tell my parents love math because my mom was a teacher.

Black Bob writes:

*My mom was a teacher in Jamaica...my dad who was an engineer, I hear about math.*

In this regard, math educators need to be aware there are links between systemic racism and math education. I argue that a continued perspective of math as sterile and free of racial implications may encourage a journey of disengagement in mathematics for Black and Brown students. Efforts must be focused on preparing teachers to understand how race is mitigated in their instructional approach of math and how this affects marginalized math students. Lopez (2016) suggests that educators must learn from those who exist at the margins if we are to move forward in reconstructing the K -12 pipeline.

However, I also argue that while many believe equitable progress has a finish line and that somehow the process is relatively linear, travelling in only one direction that leads us to the post-racial math

pipeline, I would remind math educators that the application of Critical Race Theory is a result of racism becoming normalized and embedded into society. Gloria Ladson-Billings cited Richard Delgado stating CRT is experiential knowledge integrated with history and struggles to transform the deterioration under racial hegemony (Ladson-Billings, 2009, p. 175). Progress in STEM for Black and Brown students has the potential to be conflicted, contingent, and reversible. Dr. Edray Goins, an African-American mathematician, is a perfect example of reversible progress, Dr. Edray Goins (2018), at Purdue University, tells his story entitled, *A Dream Deferred: 50 Years of Blacks in Mathematics*, to the *New York Times*, detailing challenges experienced beyond his graduate studies in mathematics. He comments on the existing inequities and disparities that continue in the profession of higher-level mathematics. Dr. Goins has long been preoccupied with fixing what is known as the “leaky pipeline” (Harmon, 2019). The rigour of STEM challenges all students; however, the leakiness Dr. Goins attempts to address is the underrepresentation of successful racialized students and the institutional or disciplinary barriers implemented by design to maintain the status quo.

Culture and race, ethnicity, and gender is especially relevant in STEM fields, where racial and ethnic minorities and women are even more underrepresented than they are in most other fields (Anderson, 2006).

## CHAPTER 7

### CONCLUSION

#### 7.1 Significance - Practical, Theoretical, Limitations

Equity in mathematics has been a known need and pursued goal for decades. Math is also relevant to a wide variety of academic subjects, and a strong correlation exists between students who perform poorly in math and experience difficulty in their other subjects. The majority of top-down initiatives have been “derailed by teachers (because their ideologies differed significantly) or are too far removed from the [underprivileged] classroom to make an impact” (Gutiérrez, 2002). Ineffective approaches to improving education for Black and Brown children have prevented real change and remain to be an obstacle that requires serious attention.

Having the first-hand experience that stemmed from historical *othering* or having been *systemically overlooked*, it is my opinion that untold stories deliberately and intentionally focus on the voices of marginalized students often discounted in math education. The purpose of the Narrative methodology was to elicit stories about experiences that are important and meaningful to students’ identities in relation to mathematics.

The practice of listening to the voices of racialized students, scholars, mass media and the Black community at large allows for the

discernible discourse of Culturally Relevant and Responsive Pedagogy and its relevance to mathematics. I believe narratives in mathematics will emerge as an analytical tool used to understand the identities of Black/Brown youth and the broader community; also, counter stories challenge the Eurocentric assumptions about how we define mathematical learners.

## **7.2 Considerations**

I believe teachers can use math identity narratives to be agents of change in promoting equitable and radical approaches to mathematical learning. There are approaches that exist in the educative community which introduce some initiatives for teachers, such as fostering exploratory learning; narrative writing is a method of culturally relevant and responsive pedagogy and collaborative professional practice. Math educators claim considerable progress toward developing agendas for promoting equity; however, these resulting perspectives often aim to equalize all learners' within their mathematics classrooms (Larnell, 2016). Having said this, I argue that although initiatives with the best intentions to equalize and enhance student understanding of self as a mathematician, as well as to increase teacher instruction, are indeed a positive move in the direction of equity. More significant steps need to be taken to sus out student voice of Black and Brown students and dismantle the pervasive

systemic issues surrounding the mathematical pipeline for the privileged. Not only do inequities in mathematics education persist in teaching and learning at school, but they also adhere stubbornly to other aspects of mathematics socialization beyond schooling institutions. For example, a push through the pipeline does not guarantee gainful employment for minorities, including Black and Brown degree holders in STEM, as we see in Tyrone's narrative where he alludes to his parent's inability to find work in their fields (Council of Canadian Academies, 2015). Furthermore, it does not guarantee belongingness or inclusion, as noted in the recently published narratives shared by those few Black and Brown mathematicians as we see with Dr. E. Goins at Purdue, who was granted passage through the math pipeline and earned employment at the highest rankings (Harmon, 2019).

The extent of this research simply facilitates inquisitive learning in preparation for the never-ending journey toward equity in mathematics. Math educators at the Durham District School Board are encouraged to be conscientious about beliefs and attempt to understand every student's narrative, which may highlight capabilities and potential for contributions toward their success. Culturally relevant and responsive pedagogy begins with educators recognizing the political, social, and economic factors, effectively cultivating critical

consciousness regarding power relations” (Sleeter, 2012). Math teachers of the marginalized must begin to question: Am I a *Gatekeeper or an Ally for future mathematicians?* The educators are encouraged to pursue a continual practice of learning the intricacies of their students and collaborate with a diverse group of colleagues to effectively create more equitable environments. Mathematics should be perceived as a “living social construct, culturally bound, a process of inquiry, and a tool for posing and solving contextual and imaginary problems” (Ernest, 2007). The common belief of a through-line to achieve equity via professional development continues to perpetuate dominant hegemonic ideas about math. I am conscious of the ethos of my work environment; as a recent attendee at a PD for Math leads, accustomed to being the single racialized educator in the boardroom. Understandably, change is slow, and the equitable pipeline still seems somewhat of a pipedream. If equity does not seemingly exist among mathematics teachers, how will it among their students?

Black and Brown mathematicians should be viewed as members of math communities who are continuously contributing to and rewriting stories in mathematics. Dominant math personas must listen compassionately to the voices of Black and Brown students who are constructing stories about their mathematics identities and experiences in mathematics. Black and Brown voices need: to develop trusting



relationships, to take harmonious risks, to retell through personal lenses what math provides in their lives, and to avoid voluntary omissions and intentional silences. I believe the fear of the unknown drives the most ineffective behaviours. Blacks fear what the lack of exposure to advanced math learning may cost the community, while whites fear the loss of power and control. Experts in the non-white camps accuse the opposition of hidden agendas to maintain their whiteness (Di Angelo, 2011).

Most of the student narratives about positive or negative experiences mention formal and informal practices, such as Oxtail's revelation that he became bored from repetitive work in grades 6 and 7, or Goat's resignation to *just listen to the teacher and take notes*. There were many instances in which their identities involved institutional factors: grades and curriculum. Also, there are omissions of decision-making and school policies. Never inquiring from the students about their own perceptions on math identity in itself, suggests a system present with barriers to the math engagement of Black and Brown learners.

With regard to the second research question, clear systemic issues exist for learners, identifying as (often but certainly not always) Black and Brown students in the Eurocentric system. Oxtail and Tyrone testify of the richness of life they and their parents held before

immigrating to Canada, yet they now live in what Oxtail refers to as the “ghetto.” Oxtail describes his delight at seeing the multitude of beautiful ripe mangos picked at no cost on the sunny island and compared this to the depressing experience of paying for *tough* mango at the local grocer in Ah Fi Mi community. What inferences do students like Oxtail and Tyrone make about the worthiness of math identity and opportunity? It is crucial to note that the experience of being a racialized student at Guarded Gate P. S. was not always restricted to the classroom; their outside experience is also relevant for my research.

This study contributes to the research literature regarding student voice and how it can add to mathematics identity. Unique counter-narratives provided qualitative data. Gutiérrez also supports the notion that qualitative collection of data reveals “interests, achievement and participation” within a population of students and without significant clustering related to societal status. This deviation in societal status, however, does not indicate that *all* patterns and commonalities between students will be erased, as seen with Bendy (Black, low income) and Death Cure’s (Black, middle income) narratives. It also does not support the irrational hegemonic fear of a reversed pattern where students of low SES and students of colour begin to dominate the classroom academically. In an equitable class, a teacher should not

be able to correctly predict their students' achievement levels based on race or socioeconomic background (Gutiérrez, 2002).

As I consider sound arguments in the use of narrative writing to develop math identity and math engagement in Black and Brown students, Dr. Martin reminds me that Paulo Freire (1992) pointed out identities we wish to investigate may not always be clear or visible. When reading the narratives of my students, I considered some might have desired to keep certain factors that shape their math identity, private or some may have developed resiliency to contingency identities and societal shaping factors around them. I am reminded of an incident my child had in the third grade when his teacher became overjoyed and astonished he had achieved a degree with distinction in a theoretical exam. Clearly, there was a lack of awareness of his abilities, and the teacher inquired as to why he did not share it before, to which he simply responded... *you never asked me*.

Martin's (2000) framing of mathematics identity as a narrative-identity construct promotes the idea that math educators can play a significant role in advising Black and Brown students for achievement when armed with critical knowledge that was shared by the student. Math educators should seek multidimensional ways with which to capture identity work. This will potentially improve learning in a classroom and increase personal achievement levels. Consider the

words of a six-year-old, *My teacher thought I was smarter than I was – so I was.*

Furthermore, the adapted use of bell hooks (2009) *belongingness* and Sfard and Prusak's (2005) Identity framework—with a serious consideration of Emily Nelson's (2006) suggestion to focus on the agency of voice—adds to the interdisciplinary robustness required to attend to mathematics identities. Further research about academic and racialized identities may also be incorporated with these other identity elements.

The principle of CRT is storytelling. There is still much to discover about the experiences of learners in mathematics courses. We continue to find ways to refine and improve learners' experiences in math. There are both opportunities and challenges for analyzing narrative voice in the Canadian educational landscape. The opportunities to remove barriers to assist at-risk Black and Brown youth in STEM education have been given life through the newly established Culturally Relevant and Responsive Pedagogy. These are early days yet to assess the outcomes of Afri-Indo-centrism and First Nations education. In education, at this point, Euro-dominant mathematics education continues to prevail. And unfortunately, educators remain resistant to reforming Eurocentric directives and redefining their measures of success. Recentring the Eurocentric system around people of colour is

a tall ask and perceived as a risk to well-established power and privilege. We struggle to correct a systemic problem, to educate all members of society about the goals and initiatives, to address equity in many concerns in education.

Canadian society may need an urgent push to be more reflective of a multi-ethnic reality, and the acknowledgment that teaching math from a multiculturalist perspective (including that of First Nations and other marginalized cultures) is essential for all Canadian students.

### **7.3 Recommendations**

Equitable mathematics educators are those who view their students as members of communities that are continuously contributing to and remaking mathematics. The traditional discourse of mathematics contributes towards alienating a high proportion of learners and reproducing inequities within society. According to The National Council of Teachers of Mathematics (2014),

Equity-based mathematics teachers reflect on their own identity, positions, and beliefs in regards to racist and sorting-based mechanisms. It involves noticing students, learning about the worlds they live in, and building mathematics that comes from these worlds. And finally, it means engaging other educators in partnerships to build equity-oriented communities (Chao et. al., 2014).

Math Teachers need the opportunity to learn what equitable math practices look like in theory and carefully examine their own practice to identify sites for change.

Three suggestions come to my mind to break complicity and shift the mindset of math educators.

1. Genuinely caring for and getting to know the students and their backgrounds
2. Becoming culturally knowledgeable and aware of the experiences of marginalized urban students
3. Becoming critically conscious of how power and privilege affect teachers' lessons and student learning

I suggest the following recommendations:

- 1) **Embrace Equity.** To truly embrace equity, we must acknowledge that we live in a society that continues to bolster biases and pedestal privileges of the European white, affluent, heterosexual and able-bodied person. In Canada, acts of racism still exist, especially within our education system. These instances of microaggressions may be subtle, direct or manifest in certain biases. However, inaction creates the same level of hurt towards our students, families, and communities. Breaking down

systemic racism in our education system means to call out 'isms' hidden in our curriculum including mathematics.

- 2) **Deal with the Dilemmas of Diversity.** The meaning of unity and how the dynamics of *othering* affect Canadian society trickles down through our education system. Differences create the mosaic of our country that has the potential to help us learn and accept all members of society. However, over time, celebratory moments of diversity place more emphasis on the *intention* rather than *action* of equity. The exercise of anti-racism is an active movement in which educators must engage to achieve what George Dei (2006) calls "a new space."
- 3) **Secure Social Justice Aims.** As math educators, we all carry the responsibility of teaching math to develop character, ensure problem-solving ability and guide reflections as learners. The magnitude of the role makes it imperative that we recognize our perceived power, making our mandate greater than academia. To avoid gatekeeping, math educators have to be aware of personal privileged backgrounds, biases, and prejudices in our day to day interactions with our students. Mindful thinking is a conscientious and concerted effort, however, in doing so,

we hope to ensure all students' rights and that fairness takes precedence over fondness. We push for a world where the practice of gatekeeping no longer persists.

4) **Reflect Critically on the Social Need for Narratives.**

Narratives are compiled to provide comprehensive information and can be utilized as a resource that addresses personal perspectives regarding the development of students who want to share their experience in learning math. I believe that a student's potential to succeed in math must be measured on an individual basis. A measure of a child's success should be as distinctive as the child's DNA. Their social, emotional and physical developments are elements educators may or may not use to help map the way to achieving success. However, student voice in regards to the direction of math education should not be omitted or excluded. As a caregiver, a parent, teacher, and administrator, I have witnessed marginalized *late bloomers* who have had surprising atypical outcomes because an opportunity to be heard presented itself. If educators predict the role or outcome of students based solely on routinely traditional measurable elements (standardized,



performance testing and report cards) this egregious action would change (has changed) the trajectory of the future of many students, especially those who aren't of the dominant culture of persuasion. Historically, educators attempted to predict outcomes and looked for "normative traits" that privileged Europeans. In academics (especially in math), but an imperative objective as educators is to push beyond the acknowledgement of privileged and underprivileged students and act as allies, rather than gatekeepers for Black, Brown and Indigenous students in STEM. Educators, particularly in mathematics, can invite students to share their voice as mathematicians and identify attainable goals in math. Narratives provide teachable moments, more so from the marginalized voices, as they provide connections or reveal disconnects for math educators. By effectively using these stories it's possible to guide students to achieve their personal mathematical goals.

- 5) **Guidance for Teachers when teaching Marginalized Students Break down stereotypes.** Racial hierarchy in mathematics - math ability revealed by race. Often math educators assume notions unconsciously or consciously and

assign identities. A non-racialized educator may find it challenging to refute racial societal views i.e. Black boys have behavioural problems or Black boys only dream of being basketball stars.

- 6) **Foster Community Connection.** Non-racialized educators tend not to take ownership of unconscious bias, privilege or student choices. On many occasions ill advice or no advice is offered to marginalized families. All educators and administrators must recognize and address the needs of school dependent students from marginalized families (Delpit, 2012).
- 7) **Differentiated Instruction.** Teach to the students strengths does not mean “dumb down” or eliminate rich mathematics learning opportunities. Monitor and assess the implemented provisions for students accordingly, consider cultural responsiveness and relevant pedagogy. Recognize brilliance in Black/Brown students and teach critical thinking.
- 8) **Check Your Assumptions.** The degree of Black/Brown parent engagement and awareness of academic streams and options is not often understood.

**9) Systemic Changes**

- a) Offer one stream of math for all students entering secondary school
- b) Address the necessity of Equity, Diversity and Anti-Black Racism
- c) Anti-Racism training for all math educators

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**985120901**Oral Instructions for the *Math Story Project*

Please log on to your Google Classroom page and click on the assignment entitled *My Life in Math*. Please watch closely as I model how to use the template to complete your math story. Day One we will write the introduction part of your story. Day Two we will write about moments experienced in math. Day Three we will write about math fixes and hiccups. Day Four we will write the ending of our math stories.

Step 1) Click inside the Introduction box and introduce your 'Math Self', using your code name.

Step 2) Turn on your microphone and begin to tell about yourself. You will notice writing prompts have been provided to help you with your story, feel free to use them if they help.

Step 3) You may use the keyboard to make revisions if you want.

Step 4) You have the entire 30 minutes of class period to write this section. Have fun!

Writing Prompts for your story *My Life in Math*

If you get stuck when you are writing, you can use the math writing prompts below to help you remember moments in your math life, or to think of ideas for what memories you want to share.

Over the years you have spent many hours in different Math classes. You have had some positive experiences and some challenging ones. Please write about your life in Math using the following table to help in your writing:

# Writing Prompts For My Life in Math



## DAY ONE - INTRODUCTION

Numbers that are important to me include:	<ul style="list-style-type: none"> <li>▪ date</li> <li>▪ age</li> <li>▪ birthday</li> </ul>	<ul style="list-style-type: none"> <li>▪ jersey number</li> <li>▪ classroom</li> <li>▪ lucky number</li> </ul>	<ul style="list-style-type: none"> <li>▪ phone number</li> <li>▪ address</li> </ul>
I can see Math all around me when I'm at:	<ul style="list-style-type: none"> <li>▪ home</li> <li>▪ library</li> <li>▪ daycare</li> </ul>	<ul style="list-style-type: none"> <li>▪ No Frills</li> <li>▪ school</li> <li>▪ the park</li> </ul>	<ul style="list-style-type: none"> <li>▪ the mall</li> <li>▪ soccer</li> <li>▪ basketball</li> </ul>

## DAY TWO - MOMENTS IN MATH

When I am doing Math my body is:	<ul style="list-style-type: none"> <li>▪ sitting</li> <li>▪ standing</li> <li>▪ lying down</li> </ul>	<ul style="list-style-type: none"> <li>▪ playing</li> <li>▪ singing</li> <li>▪ talking</li> </ul>	<ul style="list-style-type: none"> <li>▪ writing</li> <li>▪ reading</li> </ul>
I hear about Math when I am with:	<ul style="list-style-type: none"> <li>▪ friends</li> <li>▪ parents</li> <li>▪ peers</li> </ul>	<ul style="list-style-type: none"> <li>▪ teachers</li> <li>▪ pets</li> <li>▪ grandparents</li> </ul>	<ul style="list-style-type: none"> <li>▪ baby sister</li> <li>▪ tutor</li> </ul>

## DAY THREE - MATH FIXES AND HICCUPS

Once I solved a problem in Math. I used:	<ul style="list-style-type: none"> <li>▪ pencil/paper</li> <li>▪ brain</li> <li>▪ eraser/ruler</li> </ul>	<ul style="list-style-type: none"> <li>▪ glasses</li> <li>▪ calculator</li> <li>▪ computer</li> </ul>	<ul style="list-style-type: none"> <li>▪ hands/feet</li> <li>▪ manipulatives</li> </ul>
Sometimes I make mistakes in Math by:	<ul style="list-style-type: none"> <li>▪ adding the wrong numbers</li> <li>▪ forgetting a number</li> <li>▪ writing a number backwards</li> </ul>	<ul style="list-style-type: none"> <li>▪ misreading numbers</li> <li>▪ not checking my work</li> </ul>	

## DAY FOUR - MY ENDING

To improve my math learning I would:	<ul style="list-style-type: none"> <li>▪ play lots of Math games</li> <li>▪ practice Math more often</li> <li>▪ complete puzzles</li> </ul>	<ul style="list-style-type: none"> <li>▪ do Math homework</li> <li>▪ review my work</li> <li>▪ talk about Math</li> </ul>
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*Achieving Equity in Math Education*  
LETTER OF REQUEST FOR YOUR  
CHILD TO PARTICIPATE IN RESEARCH

Dear \_\_\_\_\_,

I am a Master of Education student and a teacher at West Lynde Public School. I am writing to request your child's voluntary participation in the *Achieving Equity in Math Education* which is research examining stories of math learning told from students at West Lynde Public School. I am hoping to provide insight into student engagement and disengagement with Mathematics.

The intent of the project is to determine the most effective ways to support racialized students in Mathematics. The study will examine students' beliefs in their ability to succeed in Math at the elementary level through the writing of math stories from their lives. This study is important since the results may help the Durham District School Board in providing solutions that assist teachers, Special Education Resource Teachers, Guidance counsellors to discover best practices to guide all math learners, but especially those students who may experience ongoing racism and marginalization. This study may develop appropriate student support programming to help facilitate success in Math. The study will also allow students to reflect on their learning experience and share their voice for areas of desired support.

Students will be asked to write a math story over 3-4 non consecutive days in 30 minute intervals. Students will also respond to a 15-minute math-to- self connection. (May 2018). For both exercises students will be using a microphone and a computer. The microphone immediately changes your child's voice into writing on the computer. No recordings will be made of your child. Please note all students will complete the Math Project exercises regardless of the voluntary decision to participate or not to participate in the research.

I am responsible for compliance with all applicable legal and regulatory requirements with respect to protection of privacy, and consent for the collection, use or disclosure of information about participants. There are legal limits on information researchers can promise to keep confidential. Your child's statements could be reported to police in the highly unlikely event that your child discloses abuse or that your child expresses that he/she may harm themselves or others. There is minimal risk to participants in this study. Participating, declining to participate or withdrawing participation part way through the process, will have no implications on your child's academic record.

The data from this research will be stored using encryption software to ensure confidentiality. The results of the study will be used in a Master of Education Thesis, in academic presentations and publications, and a final report, where all students will remain anonymous. The final report may be shared with departments at the Durham District School Board's Accountability and Assessment Department within two months of the completion of the research. In all reports on the study, your child will be anonymous, be assigned a unique code name in order to protect his/her identity. All data will be destroyed five years after the completion of the study.

In respect of your child's right to choose to have their classroom math work included in my research, I have provided a letter here for your child. Please review this letter with your child, and let your child indicate whether or not they agree to have their math work included as part of my study. Please send this letter along with your own consent form back to the school in the return envelope provided addressed to the principal. It will be held by the Principal until the end of the school year, at which time I will receive them. I hope that you will agree to participate in this important study.

This study has been reviewed and approved by the Trent University Research Ethics Board. Please direct questions pertaining to this review to Karen Mauro, Certifications and Regulatory Compliance Officer, Trent University, Phone: 705-748-1011 ext 7896, Email: [kmauro@trentu.ca](mailto:kmauro@trentu.ca). Thank you in advance for your consideration of this request.

Sincerely,

Camille Prince  
Graduate Student, Masters of Educational Studies  
Trent University  
[camilleprince@trentu.ca](mailto:camilleprince@trentu.ca)



Questions about the project can be directed to Camille Prince at [camilleprince@trentu.ca](mailto:camilleprince@trentu.ca) or Dr. Cathy Bruce (study supervisor) at [cathybruce@trentu.ca](mailto:cathybruce@trentu.ca) or (705) 748-1011 x 7500.

*Achieving Equity in Math Education*  
LETTER OF CONSENT FOR YOUR  
CHILD TO PARTICIPATE IN RESEARCH

Camille Prince  
Trent University  
School of Education & Professional Learning  
1600 West Bank Drive  
Peterborough, ON, K9J 7B8

March 30, 2018

Dear \_\_\_\_\_

Re: Consent to participate in a study called *Achieving Equity in Math Education* that may provide insight into student engagement and disengagement with Mathematics.

Following our recent communication regarding your voluntary participation in the above-noted study, I am requesting that you acknowledge your consent to permit your child's participation by signing this form. Please note that your permission for your child's participation in this study is completely voluntary. I have provided an extra copy of this information letter, so that you can keep one for your own records.

The intent of the project is to determine the most effective ways to support racialized students in Mathematics. The study will examine students' beliefs in their ability to succeed in Math at the elementary level through the writing of math stories from their lives. This study is important since the results may help the Durham District School Board in providing solutions that assist teachers, Special Education Resource Teachers, Guidance counsellors to discover best practices to guide all math learners, but especially those students who may experience ongoing racism and marginalization. This study may develop appropriate student support programming to help facilitate success in Math. The study will also allow students to reflect on their learning experience and share their voice for areas of desired support.

The students may or may not experience any benefit as a result of participating in this study. Students may or may not increase knowledge of themselves as math learners, but educators may experience a broader benefit by understanding how children learn and express their understanding of math.

All students will be asked to write a math story over 3-4 non consecutive days in 30 minute intervals. Students will also respond to a 15-minute math-to- self connection. (May 2018). For both exercises students will be using a microphone and a computer. The microphone immediately changes your child's voice into writing on the computer. No recordings will be made of your child. Please note all students will complete the Math Project exercises regardless of the voluntary decision to participate or not to participate in the research.

I am responsible for compliance with all applicable legal and regulatory requirements with respect to protection of privacy, and consent for the collection, use or disclosure of information about participants. There are legal limits on information researchers can promise to keep confidential. Your child's statements could be reported to police in the highly unlikely event that your child discloses abuse or that your child expresses that he/she may harm himself or others. There is minimal risk to participants in this study. Participating, declining to participate or withdrawing participation part way through the process, will have no implications on your child's academic record. In addition, if there are questions during the interview that your child does not wish to answer, they can choose to skip them.

You may withdraw your consent to participate in this study at any time. If you decide that you would like to withdraw your participation, you may email the Principal Samuel-Brown at [paulettesamuelbrown@ddsb.ca](mailto:paulettesamuelbrown@ddsb.ca).

There is no potential for commercialization of the research findings. The Trent Research Ethics Board has approved this study. Confidentiality and anonymity are assured. Your child's name will not be revealed to anyone outside of the study. The data from the research will be used in a Master's Thesis, in academic presentations and publications, and in a final report for Durham District School Board Accountability and Assessment Department.

In all reports on the study, your child will be anonymous, assigned a unique code name in order to protect his/her identity. All files will be kept in encrypted, electronic storage and will be destroyed five years from the completion of the study. In respect of your child's right to choose to have their classroom math work included in my research, I have provided a letter here for your child. Please review this letter with your child, and let your child indicate whether or not they agree to have their math work included as part of my study. Please send this letter along with your own consent form back to the school in the return envelope provided addressed to the principal. It will be held by the Principal until the end of the school year, at which time I will receive them.

Thank you for agreeing to participate in this important study.

Sincerely,  
Camille Prince

Please complete the form, then sign and return.

I, \_\_\_\_\_, acknowledge that I am fully informed of the research project, that I have received a copy of the consent form for my records, and that I give consent for my child to participate in the study described above.

Signed: \_\_\_\_\_ Date: \_\_\_\_\_

Questions about the project can be directed to Camille Prince at [camilleprince@trentu.ca](mailto:camilleprince@trentu.ca) or Dr. Cathy Bruce (study supervisor) at [cathybruce@trentu.ca](mailto:cathybruce@trentu.ca) or (705)748-1011 x 7500.

Achieving Equity in Math Education  
LETTER OF ASSENT  
(ASKING YOUR PERMISSION)

Dear \_\_\_\_\_,

How are you? I am doing great!

I would like to share that I am doing some research on how students, like you, learn Math. You see, I am a student too, but I study at an adult school called Trent University. At this school, I get to look at things that may or may not affect your learning. I would like to include you in my study. Please know you do not have to participate in the study if you do not want to.

If you (and your parents) agree to participate, here is what we will do:

During the month of May, I will ask all the students in the class to write a short story about how you learn Math and do an activity called "Math-to-Self Connections". This will be a fun thinking and writing experience. I am interested in the ideas you will share about your math experiences so far. You will get a code name, and you own computer and microphone to tell your story. As you know, the microphone doesn't record you, it just turns what you say into writing. I will only share your story if you give me permission. No one will know your real name in my research and your story will not affect your report card.

The Principal is excited about the project too. She has given me permission to collect your math stories and math-to self-connections. When the study is complete, I will give you a summary of the things I discovered.

Please complete the form at the bottom of this letter and return it to class by April 30, 2018.

I really hope you will be in my study!

Thank you.

Sincerely,

Ms. Prince

My name is \_\_\_\_\_

Please read the statements below carefully and put an X in the box beside the statements you agree with:

I agree to participate in the research and share math stories.

I am Black.

I am Brown.

I am White.

Print Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Math-to-Self Connections

1. Do you like Math? Yes or No
2. Do you feel you are good at Math? Yes or No
3. How would somebody know if they are good at Math?
4. How do you learn Math?
5. How do you become better at Math?
6. How confident are you in your Math skills (what math grade level do you think you are)?
7. Do you feel nervous when you have to use your Math skills?
8. When did you discover (age, grade) that you liked/ disliked Math? What made you feel this way?
9. Can you tell me what experiences you have had as a math learner? (school, camp, home)
10. Do you know if your parents like Math? How do you know?
11. Do you know if your friends like Math? How do you know?
12. Have you ever felt sad as a math learner?
13. Have you ever felt happy as a math learner?
14. Do you feel you are encouraged as a student in mathematics?
15. How would you describe your neighbourhood?
16. How important is Math in your neighbourhood setting?
17. Do people talk about Math in your neighbourhood?

Visual sample of what the students will see in Google Classroom

Computer Template

# My Life in Math

## Day 1- Introduction

My name is... (code name)

I know math is all around me ...

I can do math when I am at...

## Day 2 - Moments in Math

When I am doing math my body is...

I hear about math when I am with...

I do my best math when...

## Day 3 - Math Fixes and Hiccups

Once I solved a problem in math. I used

Sometimes I make mistakes in math  
by...

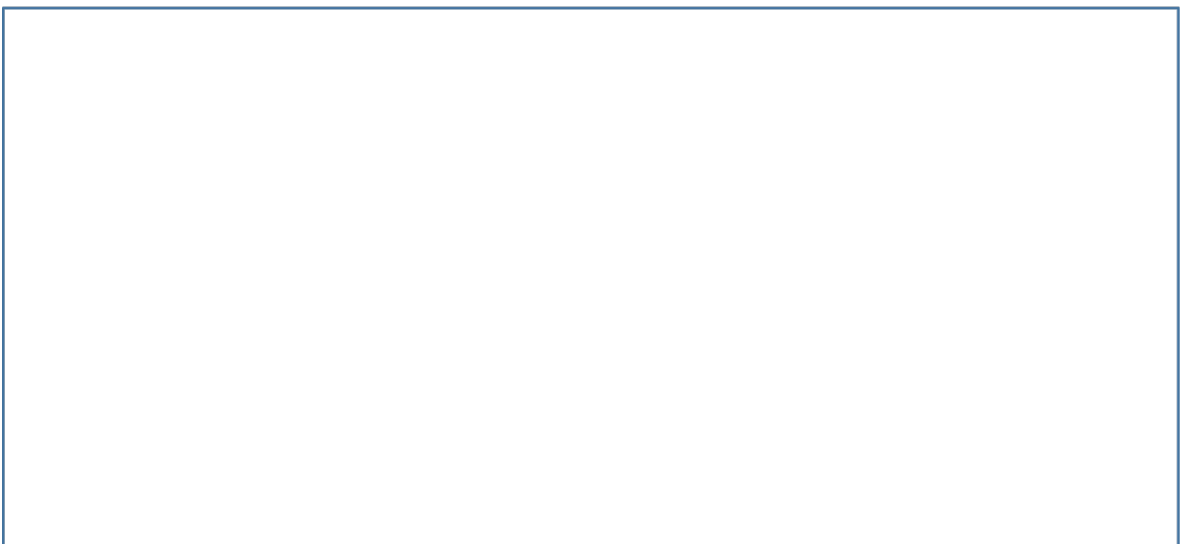


## Day 4- My Ending

The math learning advice I would give my friend is...

To improve my own math learning I will

Please draw a picture for your story.



### Research Assistant Confidentiality Agreement

This study, *Achieving Equity in Mathematics Education*, is designed to investigate the following research questions:

1. 1. To determine to what extent stories told from racialized students of low SES in the White Oaks Community at West Lynde Public School (as defined by lowered educational expectations in math, or lesser access to math assistance and/or resources) provide insight into student marginalization, engagement and disengagement with mathematics;
2. 2. To determine to what extent understanding personal narratives involving math learning helps to ascertain the gaps for educators to shape and better address math learning for racialized math learners of low SES in the White Oaks Community at West Lynde Public School?

***Research-related activities may include: classroom observations and related field notes; collecting student stories and short answers; secondary research related to the writing of the literature review; data analysis, project updates and summaries preparation; report writing, and publications.***

I, \_\_\_\_\_, agree to:

1. Keep all the research information shared with me confidential by not discussing or sharing the research information in any form or format (e.g. disks, tapes, transcripts) with anyone other than the Principal Investigator and the study supervisor Dr. Cathy Bruce (contact information below)
2. Keep all research information in any form or format secure while it is in my possession;
3. Return all research information (eg consent forms) in any form or format in a sealed envelope to the Principal Investigator when I have completed the research tasks;
4. After consulting with the Principal Investigator, erase or destroy all research information in any form or format regarding this research project that is not returnable to the Principal Investigator(s) (e.g. information sorted on computer hard drive).

**In accepting this agreement, you agree that the ownership of the research (as well as any equipment loaned to you) will be vested in Trent University.**

Research Assistant:

\_\_\_\_\_  
\_\_\_\_\_  
(print name) (signature) (date)\_\_\_

Principal Investigator:

\_\_\_\_\_  
\_\_\_\_\_  
(print name) (signature) (date)\_\_\_

If you have any questions or concerns about this study, please contact:

Dr. Catherine D Bruce  
Dean of Education  
Trent University,  
1600 West Bank Drive, OC214  
Peterborough ON  
705-748-1011 ext. 7376  
cathybruce@trentu.ca

*This study has been reviewed and approved by the Research Ethics Board at Trent University. For questions regarding participants rights and ethical conduct of research, contact the Trent University Research Office at (705) 748-1011 ext. 7050*

Coding Themes and Sample MAXQDA2018 Sample

The image shows two panels from the MAXQDA2018 software interface. The top panel is titled 'Document System' and displays a hierarchical tree of documents. The bottom panel is titled 'Code System' and displays a list of codes with their associated counts.

**Document System**

Document Name	Count
<b>Documents</b>	<b>95</b>
Triangle's Math Story	9
Black Bob's Math Story	5
Goat's Math Story	7
Ria's Math Story	9
Tyrone's Math Story	7
<b>Hot Fresh Oxtail's Math Story</b>	<b>25</b>
analyzing qualitative data	0
Intermediate Narratives	0
<b>Primary Narratives</b>	<b>33</b>
Death Cure's Math Story	0
Warrior's Math Story	4
Currie's Math Story	1
Butterfly's Math Story	9
Kaity's Math Story	0
Bendy's Math Story	19
<b>Sets</b>	<b>19</b>
Set 2	19

**Code System**

Code Name	Count
<b>Code System</b>	<b>95</b>
agency	10
RED	44
belonging: home, hobbies, hopes and heritage.	1
BLUE	38
competacy math doer	1
belonging: home, hobbies, hopes and heritage.	1
<b>Sets</b>	<b>0</b>

Document Browser: Hot Fresh Oxtail's Math Story

agency

calculate

1

2

Hot Fresh Ox Tail's Math Story

Hello my name is hot fresh ox tail. Today I wish to talk about my math life. Did you know that I can do math at home, at school, at the library and in stores? Did you also know that math is all around me. Everywhere I go! And even when I get home. When you're playing with toys, when you play on your electronics. You know, when I do math my body is thinking, relaxing, sitting, writing and reading. I hear math every day even if I'm not at school from my parents, friends and family. most importantly I do my best math when there is no noise. No interruptions. And when I have all my supplies. One way I solve a problem is to use my brain and math utensils like pencils. I am constantly making mistakes in math and I rush my work. Especially when I did not read it over. Some advice I would give my friend would be don't rush your work and read it over carefully. I can improve my math learning from my mistakes and focusing on my work and by studying hard.

3

I don't really like math but I'm good at math. How would somebody know they are good in math? They would know they're good enough if they trust themselves. I learned that by studying, taking the lines from teachers and friends and by asking questions about things I do not understand. I get better at math by studying hard and asking questions. I'm confident about my math because for the most part on my tests I have gotten one or two questions incorrect. I don't feel nervous when using my math skills. I only become nervous when I'm around people I don't know and if I don't know the material well. I started disliking math in grade 7 because we kept doing the same work from grade six. I can tell my parents love math because my mom was a teacher. My mom was a teacher in Jamaica. My friends always complain they don't like math. I've never felt sad as a math learner but I never felt happiness as a learner either. I have felt encouraged in math by my teacher and my mother. I would describe my community as the ghetto. Math is not very important in my community. Nobody talks about math in my community.

Please show a picture of your story.

