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**BELIEF IN AFRICAN AMERICANS AS LEARNERS:
CONNECTING MATHEMATICAL IDENTITIES AND
FOREGROUNDS**

Jamaal Adetoro Ince

INSTITUTO DE GEOCIÊNCIAS E CIÊNCIAS EXATAS

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UNIVERSIDADE ESTADUAL PAULISTA
"Júlio de Mesquita Filho"

Instituto de Geociências e Ciências Exatas
Campus de Rio Claro

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Tese de Doutorado apresentada ao Instituto de
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Claro, da Universidade Estadual Paulista “Júlio de
Mesquita Filho”, como parte dos requisitos para
obtenção do título de Doutor em Educação
Matemática

Orientador: Prof. Dr. Ole Skovsmose

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DEDICATION

I dedicate this dissertation to my family, friends, close colleagues who have helped support me throughout this life changing process, to the students I have encountered and have yet to meet. Here is to constant and consistent improvement and the acquisition of learning so that tomorrow can prove to be even slightly better than the day before.

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EPIGRAPH

Building dreams I wanted to see
Hearing about other worlds far away
Never understanding how they differed
Differed in experiences lived by others like me
I traveled now to the United States
A curious talkative turned into a quiet soul
Struggling to understand my experiences
With less recognition of my identity
Craving for a sense of belonging called home
The feeling of loss in connections
Tirelessly trying to build new ones
The confusion of the Black experience
Completely different from mine
The trauma of being told by Whiteness
My African identity made me elite
Seeking to bury it all in academics
It became very evident however
Statistics did not account for heritage
When generalizing Blackness as a monolith
Because the racist philosophies
Were deeply rooted in systems
Within the inequities I now navigate
Systems with White supremacy at core
Never a regard for how it tore down
My home through colonialism
Enslaving my brothers and sisters
A Black African in the diaspora
Is by its own accord my identity
One filled with richness and heritage
One filled with culture and beauty
One filled with oneness with others

(ATTIPOE-DORCOO, 2022)

RESUMO

Apesar do aumento da investigação em educação matemática para estudantes negros, continua a existir uma disparidade de desempenho entre eles e os estudantes de outras raças. Isto não se deve apenas às pontuações que os alunos podem obter nas avaliações, mas também às crenças associadas que podem ser atribuídas aos alunos negros e ao seu sucesso na educação matemática. Houve muita progressão na pesquisa, especialmente em relação à teoria das identidades matemáticas para estudantes negros. Este estudo contribui para a área, utilizando a perspectiva de alunos do ensino fundamental e de seus professores. Um componente particular desta pesquisa é a correlação entre as identidades matemáticas e os primeiros planos dos participantes. Este estudo qualitativo explora a ligação entre estas teorias e os seus efeitos nas percepções dos estudantes negros sobre as suas possibilidades futuras em relação à matemática. Esta pesquisa é realizada com alunos e professores de duas escolas de ensino médio no distrito de Escolas Públicas de Newark, com foco em suas experiências em matemática, pensamentos sobre sucesso, obstáculos, esperanças, sonhos, preocupações e preocupações.

As fontes de dados incluem entrevistas individuais semiestruturadas com 18 alunos e dois professores no Distrito Norte e Central de Newark, NJ. A análise de conteúdo temática é usada para destacar quatro temas distintos. As conclusões destacam as diferentes formas como os participantes se identificam com a matemática, incluindo a forma como veem, definem, compreendem e percebem a matemática no seu mundo e como possíveis partes do seu futuro.

Palavras-chave: identidades matemáticas, foregrounds, backgrounds, racismo, obsessão por velocidade

ABSTRACT

Despite the increase in research in mathematics education for Black students, there remains an achievement gap between them and students of other races. This is not only due to the scores that students may achieve on assessments, but also the associated beliefs that can be placed on Black students and their attainment of mathematics education. There has been much progression of the research particularly in relation to the theory of mathematical identities for Black students. This study contributes to the field, using the perspectives of middle-school students and their teachers. A particular component of this research is the correlation between the participants' mathematical identities and foregrounds. This qualitative study explores the connection between these theories and their effects on Black students' perceptions of their future possibilities in relation to mathematics. This research is conducted with students and teachers in two middle schools in Newark Public Schools district, focusing on their experiences in mathematics, thoughts about success, obstacles, hopes, dreams, worries and concerns.

Data sources include semi-structured individual interviews with 18 students and two teachers in the North and Central Ward of Newark, NJ. Thematic content analysis is used to draw out four distinctive themes. The findings highlight the different ways in which the participants identify with mathematics, including how they view, define, understand, and perceive mathematics in their world and as possible parts of their future.

Key words: mathematics identities, foregrounds, backgrounds, racism, speed obsession

RESUMEN

A pesar del aumento de la investigación sobre educación matemática para estudiantes negros, sigue existiendo una brecha de rendimiento entre ellos y los estudiantes de otras razas. Esto no se debe sólo a las puntuaciones que los estudiantes pueden obtener en las evaluaciones, sino también a las creencias asociadas que se pueden depositar sobre los estudiantes negros y su logro en educación matemática. Ha habido mucho avance en la investigación, particularmente en relación con la teoría de las identidades matemáticas para estudiantes negros. Este estudio contribuye al campo, utilizando las perspectivas de los estudiantes de secundaria y sus profesores. Un componente particular de esta investigación es la correlación entre las identidades matemáticas de los participantes y los primeros planos. Este estudio cualitativo explora la conexión entre estas teorías y sus efectos en las percepciones de los estudiantes negros sobre sus posibilidades futuras en relación con las matemáticas. Esta investigación se lleva a cabo con estudiantes y maestros de dos escuelas intermedias del distrito de Escuelas Públicas de Newark, enfocándose en sus experiencias en matemáticas, pensamientos sobre el éxito, obstáculos, esperanzas, sueños, preocupaciones e inquietudes.

Las fuentes de datos incluyen entrevistas individuales semiestructuradas con 18 estudiantes y dos maestros en los distritos norte y central de Newark, Nueva Jersey. El análisis de contenido temático se utiliza para extraer cuatro temas distintivos. Los hallazgos resaltan las diferentes formas en que los participantes se identifican con las matemáticas, incluyendo cómo ven, definen, comprenden y perciben las matemáticas en su mundo y como posibles partes de su futuro.

Palavras-chave: identidades matemáticas, foregrounds, backgrounds, racismo, obsessão por velocidade

LIST OF FIGURES

<i>Figure 1</i> : Created by the author; the data was referenced on Chalkbeat	14
<i>Figure 2</i> : Population of Newark, 1910-2017	24
<i>Figure 3</i> : The National Guard on Springfield Avenue in Newark on July 14, 1967.....	26
<i>Figure 4</i> : Backgrounds, Mathematical Identities, Foregrounds Cycle (BMF Cycle).....	80
<i>Figure 5</i> : Path Forward Through Inquiry.....	87
<i>Figure 6</i> : Research Participants	89
<i>Figure 7</i> : Themes through analysis.....	94

SUMMARY

Contents

1.	Introduction.....	1
1.1	The importance of the research.....	2
1.2	My relationship to the research.....	5
1.3	Why Foregrounds and Mathematical Identities?	9
1.4	Goals and research questions	10
2.	Mathematics Education in Newark.....	13
2.1	Mathematics educational history and context.....	16
2.2	Black students in Newark	24
2.3	Possibilities for mathematics classrooms.....	29
2.4	The power and option of choice.....	31
3.	Mathematical Identities.....	33
3.1	Exploring identities.....	34
3.2	Identifying with mathematics	40
3.3	Mathematical identities for Black students.....	47
3.4	Conjoining identities and future possibilities	49
4.	Racism and Racial Identity	50
4.1	Race and its complexities.....	51
4.2	Origins of racism.....	54
4.3	What is racism today?	56
4.4	What is racial identity?	60
4.5	Racism in mathematics education.....	63
4.6	Connecting identities and racism	65
5.	Black Identities, Backgrounds, and Foregrounds	66
5.1	Identities.....	69
5.2	Backgrounds	70
5.3	Foregrounds	73
5.4	Perceptions of mathematics	75
5.5	Mixing of mathematical identities, backgrounds and foregrounds.....	78
6.	Methodology	84
6.1	Research journey.....	86

6.2 Participants.....	88
6.3 How the data was produced	90
6.4 Analyzing the data.....	92
6.4 Ethical Considerations	95
7. Presentation of the Participants.....	96
7.1 Presentation of students	96
7.2 Presentation of teachers	103
8. Perceptions of Racial Experiences.....	110
8.1 Education and racism.....	112
8.2 Racial and mathematical identities	115
8.3 Observing other racial struggles and their effects.....	120
8.4 Acknowledgement and awareness	121
9. Mathematics and Speed Obsession.....	123
9.1 Speed obsession and connection to foregrounds	126
9.2 Prioritizing curriculum.....	126
9.2 Conversations with students and their focus on speed.....	131
9.3 Slow it down, look where you are going	134
10. Learning Environments: Where to Position Mathematics	137
10.1 Building knowledge everywhere	139
10.2 Environments to construct mathematics and learning	141
10.3 Depleted learning environments	148
10.4 Accumulation of learning about learning environments	150
11. Black Students' Foregrounds: Evolutions, (De)formations, and Connections in Mathematical Identities	153
11.1 Connecting backgrounds to the foregrounds	154
11.2 Foregrounds in Newark.....	156
11.3 Multitude of foregrounds and mathematical identities	161
11.4 My experiences and foregrounds	168
12. Reflections and Considerations.....	171
12.1 Starting point.....	171
12.2 A look at the theoretical (back)ground.....	172
12.3 Backgrounds growing into foregrounds.....	174
12.4 Foregrounding identities	176

13.	References	179
14.	Appendix	193
14.1	Interview Protocol	193

1. Introduction

“We are not educating ourselves as well as we should, and like most injustices, this especially harms the most vulnerable. Lack of access to mathematics and lack of welcome in mathematics have had devastating consequences for the poor and other disadvantaged groups. [] Not tapping everyone’s potential is a loss for all of us and will limit the ability of future generations to solve the problems they will face.” – (SU; JACKSON, 2020)

Mathematics education is a struggle for most of the United States, for both students and teachers. For decades, students from the United States have been measured against the success of students from other countries who have proven through assessments to be more advanced in mathematics¹. This is true interracially within the United States, as Blacks students² are reported to perform poorly in mathematics in comparison to other races.

Assessments do not tell the entire story of one’s ability to do and understand mathematics, nor one’s capacity to function as a contributing citizen in the world; however, assessments are an integral part of the current reality that measures an individual’s mathematics mastery, along with assessments, grades, and track records that follow students’ progress. Students’ attitudes and thoughts about mathematics are rarely considered or used to measure student potential in mathematics.

Black students in the United States are viewed as low performing in mathematics when it comes to various areas such as grades, assessment scores, and college enrollment (MILLER; WANG, 2019; OLSZEWSKI-KUBILIUS; LEE; NGOI; NGOI, 2004), as well as unmotivated

¹ For example, US students that participated in the Program for International Student Assessment (PISA) assessment in 2018 ranked 37th globally. PISA is an international assessment that measures 15-year-old students’ reading, mathematics, and science abilities every three years, coordinated by the Organization for Economic Cooperation and Development (OECD). <https://nces.ed.gov/surveys/pisa/>. The 2021 assessment was bypassed due to the pandemic.

² Throughout this thesis I will refer to students in theory, and students involved in the study, as Black and African American students. I will use the terms interchangeably throughout the text. The reason for this is that there are many Black students in the United States, some who may be African American, and some who may be from other countries and identify as other than African American. These Black students, regardless of where they are from, may be assumed to be African American because of generalized categorizations. In either case, the terms Black and African American speak to nothing more than how the students are socially categorized.

when it comes to learning math (WILLETT, 2021). According to NAEP³, in 2023 Black students across the nation averaged a score of 253, which falls short of the NAEP Basic score of 262. For a variety of reasons Black students receive low scores in mathematics, in standards set by academics.

But this deficit narrative and negative perspective of student ability does not tell the entire story of mathematics development and understanding for students (BATTEY; FRANKE, 2015; MARTIN, 2012). Students are complex individuals, as all people are. There are many students that love and appreciate mathematics, but unfortunately, they are not always able to identify with the mathematics that they are learning (MARTIN, 2000) there is not a clear connection for them between the mathematics curriculum and their own goals and interests (FORD; HARRIS; TYSON; TROTMAN, 2002). These goals and interests can be short term or long term, for many young students it is difficult to have an extensive outlook for their futures but can prove to be even more challenging if they are not well prepared.

In this chapter, I will explain the importance, value, and purpose of this research. I will give an overview of my history, experience, connection, and relationship to this study. There will be a brief explanation of the theories that I will use as a framework for my research, followed by the intended goals and research questions for this study.

1.1 The importance of the research

There has been much research on Black students' low performance and apparent lack of motivation in mathematics (MATTHEWS, 2010; WILLETT, 2021). This low performance level is determined by low assessment scores and low achievement in mathematics courses, possibly causing a disruption in the advancement of learning in students' futures and identities. Identities have been profoundly researched, which has involved analysis of the beliefs and thoughts of individuals (DEAN, 1997; ERICKSON, 1959; NICOLSON, 2016; POOLE, 2010) however, the concept of *mathematical* identities of students is new in the field of mathematics education (GONZALEZ; CHAPMAN; BATTLE, 2020; MARTIN, 2000; MATTHEWS; BANERJEE; LAUERMANN, 2014; MOORE; GROVES PRICE, 2015; ROBERTS, 2018; VARELAS;

³ NAEP - The National Assessment of Educational Progress - is a national assessment provider and often referred to as the nation's report card. See (NAEP, 2023)

MARTIN; KANE, 2012). Young students' (in grades before high school) mathematical identities are greatly under-researched, especially from the perspectives of the students receiving the education. To understand the influence of (mathematical) identity on mathematical performance, the theoretical chapter that follows will further define these theories, as well as their interests in and outside of school, is valuable in assessing and critiquing mathematics education.

In recent research, Anderson (2019) identifies the problem of African American males' struggles in mathematics being misunderstood because of life factors unaccounted for. These life conditions include one or more of: living in poverty, parents being unemployed, enduring poor living conditions, being exposed to domestic violence, and experiencing unstable of family life (ANDERSON, 2019).

Considering these living conditions, I agree with Anderson that the task of learning mathematics is extremely difficult and may not be a high priority. These living conditions can have effects on students' identities (MATTHEWS; BANERJEE; LAUERMANN, 2014) and interest in school (SKOVSMOSE, 1994) I also think that there is more to explore here, as Anderson alludes to the need for us to provide a better and more relatable mathematics education for students (SKOVSMOSE, 2022a), that prioritizes and includes students. Skovsmose (2022) argues the same, providing an amplified learning experience that attends to student interest and considers sociological issues.

In addition to discovering more about Black students' learning and living conditions, and being empathic about these conditions, there is a need to take the time to understand how one comes to see and understand mathematics, and to view oneself as a mathematician - in other words, one's mathematical identity (MARTIN, 2000; 2009a; ROBERTS, 2018). This can be affected by the conditions in which a student lives, how they perceive their realities, and how mathematics interconnects with their lives and realities.

So there exists a connection between students' lived experiences and how they come to see themselves as mathematicians' - they always do so, but in different ways (GONZALEZ; CHAPMAN; BATTLE, 2020). This has an effect on the way they might see their future, the options for their future, and the way they come to understand meaning (SKOVSMOSE, 2014b). What are my dreams, what do I want to do when I get older, where do I want to travel, who do I want to be? These are questions that students might ask themselves, or be asked, and the

responses can be good or bad depending on how one subjectifies them. Subjectivity inherently requires us to listen and observe the narratives of others to attempt to understand - and certainly to acknowledge their thoughts and views. In this way we can recognize the manners in which others contextualize their perspectives, experiences, and motivations in relation to mathematics (VALERO, 2015).

To discuss these embodiments of lived experiences and how one comes to see oneself, I draw from Skovsmose (2012, 2014) and refer to these occurrences as their foregrounds⁴. The foregrounds of students are intertwined with how they come to learn mathematics. The way students learn mathematics, have experiences with mathematics education, and participate in activities that involve mathematics influences their perception of their ability in math and their motivation to participate in related opportunities (GONZALEZ; CHAPMAN; BATTLE, 2020; MATTHEWS; BANERJEE; LAUERMANN, 2014; VALERO, 2015). These perceptions and interpretations that individuals have can represent dreams or nightmares, positive possibilities, and obstructions in their lives (SKOVSMOSE, 2014b).

A current dilemma within mathematics education is the disconnect or little-known connection between the formation of foregrounds and the growth and development of students' mathematical identities. There is a need to know and understand the experiences and interpretations students have in order to connect mathematics to them in a way that is valuable (SKOVSMOSE, 2012). This thesis seeks to determine possibilities of teaching and learning mathematics that relate to the entire student body, including their hopes and worries, realities, and speculations. I believe it is possible to build students' interest in the subject of mathematics, facilitating spaces for students to bring themselves into mathematics. In this sense, students can develop their mathematical abilities in various ways and determine its importance in their futures.

This research aims to contribute knowledge and literature to the under-researched area of the connection between mathematical identities and foregrounds of students. Under the theory of foregrounds, the goals and interests of students will be addressed, along with their fears, dreams, perspectives of self-ability, living and communal conditions, and future outlooks. This study

⁴ Foregrounds were constructed by Ole Skovsmose, and are discussed in further detail in Chapter 5.

involves students from 7th and 8th grade, and two teachers who were interviewed about their mathematics education experiences.

1.2 My relationship to the research

My motivation for carrying out this research relates to my community, my family, and the students I have taught and will teach in the future. Although I never actually dreamed or conceived the notion that I could become a Doctor of Mathematics Education, I now see that this path can help me further my life goal when I set out to become an educator. That goal was, and remains, to help Black and Brown students conquer their fears of mathematics and to do their best when learning math.

In my community, college and advanced academics were not popular choices, nor topics for concern. People would say that education was important, but being the best or having high expectations for academic performance was not. Instead, the priority was acquiring the greatest amount of money possible, whether legally or illegally, for material gain. Showing that you had money to purchase or do whatever you wanted, working and getting by to have whatever you needed, or living life with minimal responsibility were symbols of success.

Most students had the aspiration to be an athlete or a famous rapper. Others learned to hustle and earn money in “other ways”. These were the dreams of most children in neighborhoods like mine: earning a lot of money and having the ability to live in a nice house, or travel where you wanted. Expectations would be set high, upon the prospect of being an athlete or performer (MYRDAL, 2017). Expectations regarding academic education, on the other hand, would not be nearly as high for most families.

There were some families that had high aspirations for their children in school. My mother had high expectations for me. She was one of the few people that obtained their undergraduate degree in our community, and later acquired her Master’s degree as well. Prior to these accomplishments she had a very strong opinion about education, and to sum it up with a common phrase, it is to “learn every day”; this could be to learn something new or to learn how to do something better.

My academic education existed in ways outside of school too. My mom would often take me to the library or museums on weekends - different cultural events - and I was able to learn in different ways and develop my own appreciation for learning. Building an appreciation for learning fueled my motivation to excel and do well in school.

From a young age I performed well on tasks and tests in schools. From the 2nd grade on I was placed with students that also performed better on assessments and in school academically; by the 5th grade I was placed in the GNT (Gifted and Talented) class. Being placed on this track gave me access to honors classes in all four academic subjects - language arts, history, science, and mathematics - meaning that I would also be on track to take Algebra I in my 8th-grade year, which at the time was not offered to general education classes. Much of my love and self-confidence for math was influenced by my 7th and 8th grade teacher. She taught Pre-Algebra and Algebra I. The GNT track that I was on had much fewer Black students than the general or special education classes.

During my 7th-grade year I began to play American football as well as playing an instrument, and I was becoming more well-rounded.

Students in general education did not particularly like students who were in GNT and would consider them to be nerds; it was not considered to be cool to do well academically. Being part of this class was considered as being superior academically in the eyes of teachers. I noticed that these perspectives from peers and teachers continued through my academic career in high school.

I took honors classes at Hudson Catholic my freshman year, where I also began to build a greater interest in athletics. Hudson Catholic is a private high school, which at the time was an institution intended only for boys. In the honors classes, one thing was familiar, and that was the number of Black students enrolled in the honors program with me. There were a total of three (including me). However, if you looked at the athletic teams, especially for football and basketball, they were mostly comprised of Black students.

The influence of the under-representation of people who look like me in the field of mathematics or in the honors math classes that I took persuaded me that perhaps I should choose another path. During my years in middle and high school, those honors classes consisted almost

entirely of Asian and White students. Even though the school population (in public schools) consisted of mostly Black and Latinx students, these racial groups were not performing highly on the state tests, nor was there a great interest shown in mathematics. In New Jersey students take the New Jersey Student Learning Assessment (NJSLA)⁵. In my honors math classes in middle school, I was one of four Brown and Black children, and the only one who identified as African American⁶. This honors class was a gateway to better educational opportunities. The students that I graduated with all went to other schools than were offered by the zone school assignment⁷.

In Jersey City, your address determined the high school you would attend if you were unable to gain access into a school of your choice by means of academics or athletics. Most of my classmates selected McNair High School, a highly academic-achieving and nationally recognized public school in Jersey City where students have a great opportunity of being accepted by affluent universities. Even today, two of their largest demographic groups are Asian (42.6 %) and White students (17.8 %) (NEWS, 2022).

As far as I knew, I was above proficiency in mathematics, as measured by the results from the state test. I was a strong student when it came to procedural activities and completing my math homework. Because of the structure of education, most mathematics classes emphasized procedural skills and a clear set of steps to solve certain types of problems, which can also be framed as the paradigm of exercises⁸.

Since these were easy for me, I felt that mathematics was simple to understand and that I fully understood mathematics. I knew that I had to repeat the steps that I was taught and then regurgitate the information that was given. I do not remember always feeling comfortable sharing my thinking in class; I often had the feeling of shame and being mocked for not being as smart as the other students in class. This was not because students would say out loud that they thought I was stupid, but I would put pressure on myself. Being in an honors room and the only African

⁵ NJSLA is the state standardized test administered to students in grades 3-11 (students who are between the ages of 7-18).

⁶ The other students were from Guyana and Trinidad; they all identified as West Indian.

⁷ Zone-assigned schooling means that a public school is assigned an area of responsibility in the city. If you are a resident in that area then your child will enroll in that public school.

⁸ (SKOVSMOSE, 2022a)

American student, I felt that I always needed to be correct. So I would only speak when I knew for sure that I was correct with my solution or in my thinking.

I became a student that did my work silently and only shared when I had full mastery of the concept (which, in my mind, was the steps necessary to complete the problem). I was very fearful of making errors, let alone taking the risk of being wrong in front of my peers. However, we learn most when we are open to making mistakes (BOALER; ANDERSON, 2018). Growth occurs when we are willing to take risks and commit errors, which improves the learning process (BOALER; DWECK, 2016).

Being able to take intellectual risks - or not - reflects a student's academic confidence. My academic confidence was high when I performed well but dropped dramatically when I came to struggle. I felt like it was affected at home, in school, and in my neighborhood. From late elementary into high school, I desired to excel and be accepted in all these environments. It was difficult to establish a connection between two or more.

Over time, I started to feel as if I had found my place. However, as I grew comfortable socially, my standard of work became lower and lower, as did my care and concern for it, because there was no clear space or acceptance of it in my social life. My social life and academic life did not coincide.

As an adolescent African American and Latino male living in an economically depressed area, neither the societal narratives nor the environment where I lived encouraged me to lean toward the academic side. Fortunately for me, I had a caring and well-educated parent at home who encouraged me to do my best. Nevertheless, I admit that my best became whatever was good enough for me to get by, and school had become less important in my life. Hanging out with friends and playing sports became increasingly more important. This is where I saw others who looked like me thrive. School became something that I had to do, rather than somewhere I wanted to be to enhance my thinking and capabilities.

Race, mathematical identity, dream and goal manifestation, and self-confidence in mathematics are issues that I have confronted. This causes me to want to understand them deeply so that I can research how we, as educators in all forms and contexts, can positively influence mathematical identity, increase academic confidence, and help connect mathematics with future

possibilities for Black students in urban school districts such as Newark, NJ. In addition, I want to understand how we can come to learn more about students' foregrounds to understand the possible influences it has on their mathematical identity and vice versa.

1.3 Why Foregrounds and Mathematical Identities?

The objective of this research is to learn more about the development and growth of mathematical identities in connection with the foregrounds of Black students in Newark through the perspective of students and teachers.

During the span of a lifetime there are numerous decisions, occurrences, and external causes that can affect the trajectory of one's life, and this can be an ever-changing process. Skovsmose (2014) notes that foregrounds of individuals are a complete mixture of social and personal elements. Some factors may not have consequences until the very distant future and others may take place immediately. The quality, equity, and justice that can be provided for students in school is one aspect in life that can greatly influence their future, and needs to be considered with immense care, optimism, and respect.

Reading about the experiences of Danny Martin (2000) and his life-changing moment of being placed in the accelerated mathematics program reminded me of my own journey in my mathematics education when I was placed in the GNT program. He was also placed on an advanced mathematics course that helped to change his trajectory in life. He too was provided with an opportunity to gain access to more options in his future. In his book he reflects on this experience:

“As I look back on that experience, more than 20 years later, I realize that I had no way of fully recognizing the significance of what my teacher was saying. Nor did I know that I was being put on a path in life where I would encounter few other African-Americans and where trying to understand the difficult and complex issues associated with mathematics learning, achievement, and persistence among African-Americans [...]” - (MARTIN, 2000)

The ways in which race, schooling, environment, and educational opportunities interact shape a student's academic identity, mathematical identity, their personal identity, and future outlook. My mathematical identity as a child was not something that I considered or concerned myself with. Our different identities are shaped and contoured by our experiences, our self-

perception, and our opinions of how others view us. Varelas, Martin, and Kane (2012) state that identities are lenses through which we position ourselves and our actions, and through which others position us, meaning that we are influenced by the systems and people that evaluate us, who teach us, those we have interactions with, as well as our judgements of ourselves (based on our own perception and how we think others perceive us).

These systems that we interact with - whether socially, academically, or professionally - have an influence on whom individuals decide to become, and what their narratives will dictate. “One’s narrative of identity can be told as a path or trajectory through our available ‘figured world’” (BLACK; WILLIAMS; HERNANDEZ-MARTINEZ; DAVIS *et al.*, 2010). The world around us has an influence, and this world does not only concern academic spaces but the lived experiences in all contexts.

I draw from Skovsmose (2014) in his use of real-life worlds, which are structured socially and do not have any one straightforward way of being constructed. As foregrounds they exist temporarily and can come to change in perspective. Foregrounds can be considered as part of real-life worlds and can stretch beyond these worlds (SKOVSMOSE, 2014b). The real-life worlds of students should be acknowledged to address the whole student, the whole self, when they come into mathematics, as this is also a space where their foregrounds are formulated.

These influences reflect in one’s intentionalities, life-worlds, the ways in which they come to identify, and how they come to foreground themselves. Therefore, I believe that it is worthwhile to include differentiated experiences when learning mathematics, to appeal to all learners, including Black students. A possible way to address this is through the acknowledgement and interpretations of students’ foregrounds, relating this to their views of mathematics.

1.4 Goals and research questions

The goal of this research is to observe and engage in conversation with students and teachers to learn about their means of identifying with mathematics, processes of foregrounding, and the connection between the two phenomena. This may help to create ways of connecting their social lives, future goals, and aspirations with their mathematics learning, to spark their interests

and provide students with additional academic opportunities and enhance their professional careers as adults. My research is guided by the following questions:

- How do Black students experience their foregrounds?
- In particular, what is the relationship between the mathematical identities of Black students and the formation of their foregrounds?

PART I – THEORETICAL REFERENCES

Part I is composed of four theoretical chapters. To begin there is a chapter on the mathematics education circumstances in Newark, looking at the history of the public school system and social conditions. Following is a chapter on the theory of mathematics identities, how they are constructed and how they may influence or can be influenced by different learning experiences. Chapter 4 is about the theory of racism and how they may have an effect on how students come to develop their mathematical identities. Part I closes with a chapter about the connect between mathematical identities, backgrounds, and foregrounds.

2. Mathematics Education in Newark

Mathematics can be viewed as the subject which determines if you are intelligent or not. People often connect the idea of being good at math with the fact of being “very smart”. People realize the importance of mathematics and are aware that it can be involved in everyday life but do not realize how it can also dictate and control everyday life, and on a more basic level give access to so many opportunities in the STEM field⁹, which can translate into higher earnings in the future, especially as the world continues to become more technologically advanced (MCGEE, 2020). Who are those that gain access to these opportunities, and why is the gate to them so seemingly difficult to enter? What are the necessities to be considered at the gate? A possible answer to these questions, quite simply, is mathematical knowledge and proof of mathematical ability and coherence, and a way to accomplish this is through education in mathematics.

Concern for the education of Black students in the United States has been tremendous within the realm of mathematics education (CAMPBELL; PAYNE, 2023; DAVIS; MARTIN, 2018; FORD; HARRIS; TYSON; TROTMAN, 2002; OLSZEWSKI-KUBILIUS; LEE; NGOI; NGOI, 2004), and there have been efforts to attend to equitable learning, such as the introduction of culturally relevant teaching and learning. However, while there have been some successes, there are many instances where Black students have not been adequately supported in relating to and learning mathematics.

From another perspective, there are a large quantity of students who get left behind or blocked from taking opportunities because of their lack of education in - and understanding of - mathematics, and this does not dictate lack of ability or interest. In other words, students can be included or excluded (CAMPBELL; PAYNE, 2023; SKOVSMOSE, 2019; 2022a; SKOVSMOSE; SCANDIUZZI; VALERO; ALRØ, 2018) desirable or unwanted (CARRIJO, 2023).

Due to this lack of quality education, mathematics maintains the restrictions imposed upon marginalized students (FREIRE, 1972). There are missed and unavailable chances or options to

⁹ STEM is an acronym meaning Science, Technology, Engineering, and Mathematics. Some positions included in this field are software engineers, IT technicians, or cyberspace technician. Some of the other possible positions can be located here: <https://money.usnews.com/careers/best-jobs/rankings/best-stem-jobs>

advance in mathematics or benefit from future occupations that require deeper mathematical understanding, especially for marginalized groups of students (WEBER; RADU; MUELLER; POWELL et al., 2010). There is evidence of inequity in this area for Black students. Understanding how Black students create meaning, view, or relate to mathematics in their middle school years can help in understanding the phenomenon of Black students performing poorly in mathematics, and further combat the idea that Black students are not capable or proficient when it comes to learning mathematics.

In the city of Newark, New Jersey, mathematics education has been a difficult and continuous uphill battle. According to assessment scores¹⁰, the students' performance is well below the state average. The state average for math proficiency on NJSLA in 2023 was about 37%; the average for proficiency across the state in 4th grade was 44.3%, and in 8th grade it was 17.8%¹¹. Below, in Figure 1, is the data for the NJSLA mathematics proficiency in Newark Public School District (NPS) for the 2022 and 2023 school year.

Grade	2022 Proficiency	2023 Proficiency	Change
4	12.2%	17.3%	+5.1
5	11.4%	13.1%	+1.7
6	11.4%	13.2%	+1.8
7	14.6%	16.2%	+1.6
8	11.4%	10.9%	-0.5

Figure 1 : Created by the author; the data was referenced on Chalkbeat¹²

A positive aspect of this data is the fact that there is growth from grades 4 to 7 (though it must be noted that there is a slight decrease in grade 8). However, all data points are below the state average, especially comparing the 4th grade data of the district with the state. A noteworthy data point is that 40% of students in the district of Newark are African American.

¹⁰ The assessment used in New Jersey is the NJSLA, which is an acronym for the New Jersey Student Learning Assessment.

¹¹ Data referenced on <https://www.njspotlightnews.org/2023/12/analysis-student-test-scores-up-from-2022-but-nj-education-still-lags/>

¹² <https://www.chalkbeat.org/newark/2023/12/11/new-jersey-2023-state-test-results-reading-math/>

Standardized assessments are not equitable evaluations for Black students; these tests administered by the state fail to relate to the everyday realities of marginalized students (DAVIS; MARTIN, 2018), which consequently can diminish their perspectives of mathematics. Unfortunately, assessment data can be utilized to view Black students through a deficit lens in reference to mathematics learning (MARTIN, 2009a). However, the current reality for Black students is that they must take these assessments, and that these evaluations are necessary to their future success and opportunities. For this reason, it is important to acknowledge students' current status. This is an opportunity for growth, for the student as well as their teachers, rather than diminishing and degrading the potential of Black students.

Although there have been plenty of implementations of new learning and teaching approaches, including interventions from different programs and consultants, Newark continues to falter in the ability to adequately provide all students with quality mathematics education. This is not only evident through assessment data, but through day-to-day observations of students' interactions with teachers in my experiences as a mathematics coach for NPS; students' opportunities to participate in and learn mathematics are often shallow or narrow, and the ways in which students are communicating their knowledge of mathematics and being affirmed in their efforts to learn mathematics are inadequate.

This could be a result of teachers' discomfort with certain topics in mathematics, or insufficient knowledge of how to adequately implement and facilitate open or equitable mathematics learning opportunities (BATTEY; FRANKE, 2015) that foster critical thinking (FRYKHOLM, 2004) and elicit student dialogue (FRANKE; WEBB; CHAN; BATTEY et al., 2007). This could also be a result of schools not providing the time and space for teachers and students to participate in or create these possible realities, simultaneously putting more responsibilities on them.

There are numerous reasons as to why students may not perform well on mathematics assessments and lose interest in the classroom. Among these is the inattention to their interests and needs as learners, the impatience shown to them as learners, the overlapping of language from formal mathematics to students' communication of mathematics (LERMAN, 2001), and as a result the disqualification of learners in regard to their knowledge, skills, and abilities over time (FAUSTINO; SKOVSMOSE, 2020; SKOVSMOSE, 2022a). There is also the inequity of

assessments - in other words, the disconnection that exists between what they are tested on and what they experience in their culture and everyday life (MARTIN, 2009a; b). In addition, students in Newark, who are mostly Black or Latinx, are consistently told that their performance is low compared to other races such as White or Asian, and lower than the performance of other regions and cities in the state of New Jersey. This deficit narrative can have a negative effect on one's belief in their ability to do mathematics (MATTHEWS; BANERJEE; LAUERMANN, 2014; MOORE; GROVES PRICE, 2015; WILLETT, 2021).

Educators might assume that if the majority of Black students perform in this way, it must be the case that other students like them cannot understand mathematics at a proficient level (ROBERTS, 2018; SCHOENFELD, 1985; WEBER; RADU; MUELLER; POWELL et al., 2010). It depletes confidence because some Black students may put their best foot forward and continue to perform poorly because of the styles of learning, communication of knowledge, and lack of enriching learning environments (MARTIN, 2000; 2012). Over time, these trends of poor performance can become part of the expectations of both students and teachers, turning into a norm. Consequently, this can also contribute to the loss of student interest: who wants to continue to participate in something that they appear to fail in year after year?

In the sections below, I will discuss the different elements of the educational environments in Newark and the ways in which they may influence the educational outcomes in mathematics for Black students, as well as the concerns mentioned above. First, I will take a brief look at the history of education in Newark, then the context in which students learn mathematics currently, including the materials used, the ways in which they are instructed, and how this may be related to the early beginnings of education in the city. Next, I will look at the educational experiences for Black students in Newark. Finally, there will be a discussion of the different possibilities for mathematics classrooms and the power of choice that can come with the availability of richer mathematics education environments.

2.1 Mathematics educational history and context

There are many factors that affect education all over the globe. Aspects of education that can contribute to success or failure include origins of the education that students receive currently, materials to use and consider when teaching, environments students learn in, knowledge students

come to school with and how this knowledge is connected, expanded and challenged (SKOVSMOSE, 1994; 2016; 2022a; STINSON; BIDWELL; POWELL, 2012), formalized, molded, ignored, changed, altered, or manipulated. Additional influences may include the different interactions that happen in the school building during a typical day, behaviors modeled by students and educators (MATTHEWS, 2020), and the learning objectives, mission statements, and goals of a school. It is vital to think about what is important for the education of an individual, as well as the possible ways to present this information and knowledge to students.

The education situation in Newark is steeped in history, much of which is culturally, socially, and politically inequitable when referring to Black citizens, like many other urban cities in the United States. The public school system was founded in the year 1769, when records show an allotment of funding for the schools in the district (District History, 2010) its responsibility was to provide education for the poor, prioritizing non-Black poor immigrants. This implies that all Black and Native American children were secondary. Newark, before the 1800s, was mostly composed of private schools in which only people of wealth were able to attend; this excluded non-White children.

By the end of 1854, there were 16 public schools in the city of Newark: seven were for boys, seven were for girls, one primary school was for boys and girls, and one was for colored¹³ (as referenced in the literature) children, as recorded in the annual report of 1855, later printed in 1856 (NEWARK, 1855). The basement of an old church was offered to them for education, and it was the only option available to Black children, as opposed to the numerous schools available for White and European immigrant children. An interesting observation of this “Colored School” is that the total enrollment for the year was 108 students; however, on average only 56 students attended that year. This could signify the priorities of other areas of life, such as working for survival, or the distance to school being too great (as it was the only school they could access); there is no detailed reason in the report.

There was a clear difference in the education that was provided to the wealthy and to the poor, and a dehumanizing distinction between the educational environments for poor

¹³ A term commonly used during slavery, post-slavery, and in the Jim Crow era to describe Black folks.

immigrant students and Black students, limiting their resources and possibilities for learning (GUTIÉRREZ, 2018).

Besides the racist and exclusionary actions that students had to face (and continue to face) in the public school system, let's look at the development of math curriculum and where it is today by first understanding how the district framed arithmetic and mathematics. In a course of study for the public schools of Newark, it states:

“Arithmetic; is the science of numbers, not the art of “figuring.” This art is secondary and subsidiary. Through the study of mathematics, children should acquire a conception of number and dimension, which are the content of the study. Mathematics should introduce the child to an accurate knowledge of the physical world. It should always deal with real things rather than with the signs of things.” - (NEWARK, 1897)

From this excerpt I understand mathematics to be a way of communicating about the world through numerical representation, which can be done in a multitude of ways. It also mentions arithmetic, which is “the science of numbers” and not the art of “figuring”, and is what students are usually required to do through exercises and other non-contextual tasks in mathematics classrooms, rather than possible investigations (Skovsmose, 2022, p.7). In this text it also states the need to allow children to naturally recognize mathematics:

“Children naturally recognize the various relations expressed by addition, subtraction, multiplication, division and partition upon such numbers as they can readily handle and comprehend.” - (NEWARK, 1897)

Here, it is clear that there is recognition that students can come to understand under their own awareness. They have the ability to make connections based on their experiences, education they receive at home, and their daily experiences (GATTEGNO, 1970; POWELL, 2022; RAY, 2013). There were many great suggestions of how to instruct mathematically, but these suggestions were then followed by pages of drills and exercises, that of the exercise paradigm¹⁴, moving further away from the initial communicated idea of instruction.

¹⁴ Skovsmose (2022), in Chapter 1, *Entering Landscapes of Investigation*, discusses the exercise paradigm and possible strategies to move away from this ideology.

This text was created before the start of the 20th century, and many things have since changed within mathematics education, but there are still remnants of the past that exist, such as the preconceived ideas of the best ways in which students learn and what they are able to learn. The consequences that arise for Black students because of the lack of equity, diversity, and quality of their mathematics education include limited opportunities for dialogue and discussion about mathematical topics (FAUSTINO; SKOVSMOSE, 2020; FRANKE; WEBB; CHAN; BATTEY *et al.*, 2007; SKOVSMOSE, 2022b).

Over the following century, new school buildings were constructed, and a curriculum was organized and designed for all schools. Their education was a by-product of materials created for the White students that comprised the majority of the enrolled students in NPS at the time, but excluded Black students. Moving into the 20th century, there were new goals set and initiatives put into place, demanding a new curriculum. The two overall goals¹⁵ of the curriculum created in 1949 were:

1. *To help the learner acquire mathematical meanings and achieve computational skills based on understanding.*
2. *To build an awareness of the social significance of number in the affairs of daily life, and to develop the ability to use quantitative procedures effectively in such situations.*

These goals look great on paper, and very similar to the goals of the mathematics department and the curriculum that is in place now. However, the expectations and workload that are placed on teachers and students make these goals nearly impossible to achieve. Currently, there are still limited opportunities for Black students. The curriculum goes on to expand into 11 specific goals for mathematics learning:

1. *To help the child understand and appreciate the importance of our number system and its many uses in everyday experiences.*
2. *To develop meaningful concepts of quantity, of whole numbers, of common fractions, and of decimal fractions.*

¹⁵ These goals were found in *Arithmetic in Our Schools*, which served as a guide for the improvement of public schools in NPS. (NEWARK, 1949)

3. *To build an understanding of the fundamental processes and the ability to perform computational procedures with facility and accuracy; to develop the ability to estimate results and to check work accurately.*
4. *To build a useful vocabulary of arithmetical terms for expressing number ideas and relationships; to help the child understand the quantitative vocabulary used commonly in business and social activities.*
5. *To help the pupil acquire an understanding of various units of measure and the process of measurement; to develop skill in the use of measuring instruments.*
6. *To lead the child to an understanding of the important principles, relationships, and generalizations of arithmetic.*
7. *To develop an understanding of graphic representations of quantitative data and the ability to use and interpret them.*
8. *To develop the ability to think or reason soundly in problem solving.*
9. *To create an awareness of the ways in which arithmetic functions in the home, school, and community.*
10. *To aid the child in acquiring the knowledge and skills essential to intelligent buying, selling, spending, banking, and the like.*
11. *To develop good habits of work and desirable social characteristics.*

Many of these objectives for the curriculum are resemblant of current goals in the present-day mathematics curriculum. Many also continue to be a struggle for students and teachers. However, objectives 9 and 10 can be very crucial to students' mathematics development, and there is not much emphasis on these aspects of learning. In particular, these objectives relate to the mathematical identities and foregrounds of students. The awareness and knowledge highlighted in these goals are important to the development of their mathematical identities, outlook on learning and their futures, and their overall success in mathematics considers possibilities in their foregrounds. This ineffective attempt continues in present-day mathematics education.

More recently, in a report from National Council of Teachers of Mathematics (NCTM¹⁶), it is stated that there is much to celebrate about student achievement mathematically, but there are also many students that underperform in mathematics. One of the reasons as to why is: "Too much

¹⁶ National Council of Teachers of Mathematics, a professional organization for schoolteachers of mathematics in the United States.

focus is on learning procedures without any connection to meaning, understanding, or the applications that require these procedures” (MATHEMATICS, 2014).

This concern pertains to many mathematics classrooms in NPS. Let’s look at the mission statement for NPS’s mathematics department:

“...all students have access to high-quality, engaging mathematics instruction. There are ambitious expectations for all, with accommodation for those who need it. Knowledgeable teachers have adequate resources to support their work and are continually growing as professionals. The curriculum is mathematically rich, offering students opportunities to learn important mathematical concepts and procedures with understanding. Technology is an essential component of the environment. Students confidently engage in complex mathematical tasks chosen carefully by teachers. They draw on knowledge from a wide variety of mathematical topics, sometimes approaching the problem from different ways until they find methods that enable them to progress.[...]” - (NPS, 2023)

Once again, the notion of mathematics teaching and education is communicated well, however, this is not the reality that all students have in the city, although it may be true for a percentage of students, as I have not witnessed or observed all of the schools in the district. As stated in the objectives from the curriculum in 1949, there is no acknowledgment of the awareness of mathematical connections students can develop between their academic spaces and social spaces - a potentially essential element for many Black students.

Skovsmose (2022) argues that it is possible to move away from procedural forms of mathematics instruction and implement other strategies such as projects and activities that will invoke more dialogue, creativity, and cognitive thinking amongst students and with their teachers. One concern is that the curriculum used by the city of Newark is primarily focused on the exercise paradigm, a major reason being that this will prepare students for the NJSLA. It does not grant space for students to explore mathematics in multiple contexts or have the freedom to bring themselves and their choices into their learning (DOCKRELL; SMITH; TOMLINSON, 1997; QUINNELL, 2018; SKOVSMOSE, 2022b). A problem is that this way of learning is proving time and time again to be unproductive. Two reasons as to why it seems to be unproductive in Newark are the low test scores, which is counterproductive to the methodology of communicated

pedagogy, and the shallow understanding and awareness of mathematics that many students are left with, which can reduce future possibilities.

Teachers are often confined to this curriculum, in which they must also maintain pace to ensure all material is taught, not necessarily learned. This can be stressful for them, as there is pressure to teach effectively and expeditiously (FRYKHOLM, 2004), which again goes against the possibilities of the mathematics mission in NPS. Consequently, educators can be assessed poorly for their teaching abilities if observed to be behind pace, if there is no proof of following what is given in the curriculum guide or plan, or if they are conversely evaluated well because students display the ability to work even without deep understanding, because they outwardly appear to be following all of the teachers' directions. The role of educators seems to be to process students through quickly and efficiently. In this sense, speed and memory are prioritized over in-depth understanding. While these two aspects are important and valuable, they cannot be the two heavily relied upon elements of developing students.

In line with the objectives of the early curriculum in Newark, Pratt (1993) argues that the goal of education is to assist students in becoming productive citizens in society - what could also be known in this day and age as being part of the mass labor force. This process of becoming a productive citizen in society is also known as becoming "thorough and efficient", a term commonly used in the protocol and politics in the state of New Jersey to signify the basic skills that students need to have mastered in the public education system to prove that they are prepared to be contributing citizens and capable to be part of the labor work force (PRATT, 1993). This way of learning is not productive for the learners; it is only as beneficial to capitalists.

A goal of mathematics education is to assist students in becoming productive citizens in society. This can be achieved by promoting social justice (GORISS-HUNTER; BURKE; WEUFFEN; PLUNKETT et al., 2023; GUTSTEIN, 2012; SKOVSMOSE, 2019; STINSON; BIDWELL; POWELL, 2012) through the use of multiple epistemologies and perspectives. One could view multiple paths of society leading towards this goal, some guided by conscious citizens capable of critical thinking, others guided by systemic motivations to become part of mass labor forces.

Outside of the curriculum and materials used in schools are the practices and environments where students learn. Some schools have poor day-to-day procedures and structures for students,

where there is little order, and discipline can be too harsh. Many exclusionary tactics are used, and students receive less time and opportunity for their education (CAMPBELL; PAYNE, 2023).

Limited opportunities can lead to many misconceptions for students. Many students in elementary and middle school have the perception that mathematics only takes the form represented by the mathematics teachers that they encounter, therefore less time can leave some students doubtful and left behind. The lack of exposure to other mathematics occupations, opportunities for advanced mathematics, or open discussions of other sectors where mathematics exist can limit the creativity and imagination in mathematics for students.

Mathematics continues to be taught with old approaches, preparing lectures about different concepts and subjects, modelling the steps needed to succeed and then following the set of steps to achieve the correct answer. Lack of resources, the loss of quality teachers to growing charter school networks in Newark, and budget limitations or dispersions can have an effect on the students and teachers of Newark as well (FARRIE; JOHNSON, 2015).

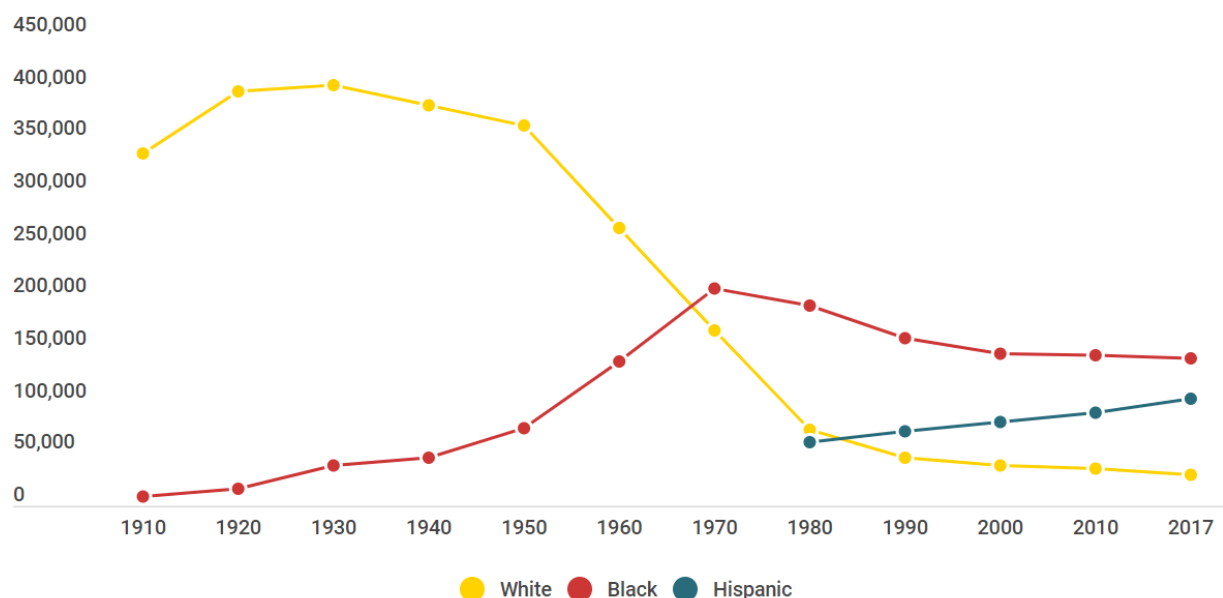
Building an understanding of the historical and present-day context of mathematics education in Newark allows for more awareness of struggles for Black students. In the following section I discuss the context for Black students in the city of Newark.

2.2 Black students in Newark

Population of Newark

Population by race and ethnicity from 1910 to the 2017, the most recent estimate.

Note that in 1980, the U.S. Census Bureau began separating out Hispanics (initially called "Spanish origin"), so white population estimates from then on are only for non-Hispanic whites.



Source: U.S. Census Bureau

Figure 2: Population of Newark, 1910-2017¹⁷

Newark in the early 1900s was a highly industrial city in the North that was less apparently racist than the segregated and Jim-Crow-enforced South. However, Black people, as well as non-White people, living in Newark faced unexpected conditions imposed by European immigrants, and were not treated fairly nor made welcome by White people. This truth was evident in educational spaces as well.

¹⁷ Data retrieved from: <https://www.njspotlightnews.org/2019/09/19-09-02-newark-before-the-comeback-a-city-marked-by-white-flight-and-poor-policy/>

From 1940 to 1970 there was a major migration of Black people. After the Newark Riots in 1967, approximately 100,000 White people migrated from Newark to other cities and suburban areas of New Jersey. The city of Newark had been destroyed by the riots and there was little care taken for businesses, institutions, and schools. The riots of 1967, which can also be referred to as the rebellion of 1967, was caused by the unjust arrest of an African American cab driver, John Smith. However, there had also been previous incidents in the city that had angered Black residents, displaced them from housing, and continuously dehumanized African American residents.

The mayor at the time of the riot, Hugh J. Addonizio, stated that “This is a difficult situation, but apparently it has no significance as far as relating to any other problem.” However, in a study conducted by Sean Patrick Dockray (1999) he found that mayor Addonizio had recently elected a White man over a more qualified Black man for the post of secretary, and decided to raze 50 acres of housing to construct the New Jersey College of Medicine and Dentistry. Events such as this, in addition to what occurred with John Smith flared anger and tension in the city of Newark, resulted in distrust among Black communities in the city’s structures and politics.

Subsequently, there was still an increase to the Black population, at a slightly lower than before the riot occurred. As seen in Figure 1, the steady increase of Black presence in the city was paired with a decrease of White population. This decrease of White people in response to Black migration commenced after the 1930s, with a sharp decline after the 1950s. Consequently, much of the leadership in business and enterprise fled for the suburbs as well.



Figure 3 : The National Guard on Springfield Avenue in Newark on July 14, 1967.¹⁸

Exodus and deindustrialization of the city was paired with racial discrimination; it had an effect on the economic and political infrastructure and maintenance of the city (CURVIN, 2014; DANLEY; RUBIN, 2020). Actions such as redlining¹⁹ and housing authority implementation created difficulties for African Americans in purchasing and owning homes, by reducing opportunities to build wealth and pushing them to rent in poverty-stricken and ill-maintained neighborhoods.

Black people were viewed as detrimental to property value; they were part of a list of undesirables in a “good” neighborhood, which included the likes of gangsters, bootleggers, and prostitutes. Therefore, multiple policies were put in place to segregate neighborhood housing, often placing African Americans in public housing or less desirable communities. The National Association of Real Estate Boards in 1943 stated the following as part of their discriminatory reasons to turn down requests: “a colored man of means who was giving his children a college education and thought they were entitled to live among whites.”

¹⁸ Photo Credit: Don Hogan Charles/The New York Times. Retrieved from <https://www.nytimes.com/2017/07/11/nyregion/newark-riots-50-years.html>

¹⁹ A tactic involving restrictive regulations used by the Federal Housing Administration (FHA) to prevent Black people from accessing bank loans or mortgages in particular areas of urban cities. These areas were usually indicated by red markings on city maps.

Movements organized by the FHA and other federal housing organizations contributed to segregation and poverty concentration (CURVIN, 2014; MASSEY; TANNEN, 2015; ROISMAN, 1995). African Americans were sorted into certain neighborhoods (South, Central, and West wards²⁰) and there are still large numbers of Black people that currently live there, in poverty. This poverty has thus become generational, and ever more difficult to break out of. Curvin (2014) states that African Americans are locked into the city.

Another result of poverty being focused within these particular neighborhoods is the quality of schools that service the children in these areas. The conjunction of segregation through schooling, housing, and concentrated poverty in Newark created a landscape of difficulty for African American students to overcome. Schools are part of the community. Just as the areas for the Black communities were ill maintained, so were the schools. In the wards that are heavily populated by African Americans, schools are struggling mightily in terms of assessment data and in meeting the goals set by the mathematics department of the district.

The issues that arise from generational poverty are numerous. Students that need to study in these neighborhoods may lack the resources that they need in schools and outside, such as bookstores or sufficient libraries. They might miss out on other meaningful educational experiences, leading to further lack of access (FORD; HARRIS; TYSON; TROTMAN, 2002; OLSZEWSKI-KUBILIUS; LEE; NGOI; NGOI, 2004; WINKLER, 2012). The absence of academic opportunity can illuminate the deficit and destructive habits of these neighborhoods such as violence, crime, and disinterest or disconnect from their education (LADSON-BILLINGS, 1997).

Societal structures and policies, persistent perceived occurrences of deficits, and disconnected forms of education lead to beliefs that African American students are incapable when it comes to mathematics (MARTIN, 2009b; 2012). Observing and challenging the deficits (MATTHEWS; BANERJEE; LAUERMAN, 2014; NASIR; MCKINNEY DE ROYSTON, 2013) is a possible way of improving the conditions for African American students in mathematics education. Foregrounding their futures with greater possibilities by attending to their identities within mathematics can stimulate the ideas around improving these conditions.

²⁰ The city of Newark is divided into five wards: North, South, Central, East, and West. The majority of the Black population live in the South, Central, and West wards.

Noticing the manners in which these aspects of students' development are ignored highlights the ways in which discrimination persists for students in society. They are told what they should learn, how they should learn, and then assessed in the way they should be able to respond to the knowledge imposed upon them. This method is prioritized over taking the time to consider how African American students understand and relate to mathematics (BLACK; WILLIAMS; HERNANDEZ-MARTINEZ; DAVIS et al., 2010; GHOLSON; WILKES, 2017; MARTIN, 2000).

Why does it seem to be innate for some teachers to doubt the ability of Black students when it comes to mathematics education? I have often heard, and continue to hear, phrases such as “they can’t do it”, “this is too much for them”, “they’re going to fail” when discussing lessons or plans in mathematics learning for Black students. A lot of these phrases were, unfortunately, uttered by White teachers. But this situation is not a simple White versus Black problem. It is a systematic problem that leads teachers of all ethnic and racial backgrounds to believe that Black students are incapable of doing mathematics (CAMPBELL; PAYNE, 2023; MARTIN, 2009c; WHITE; FRIDERES, 1977). Working as a mathematics teacher and coach, I noticed this in multiple different grades between kindergarten and eighth grade.

The deficit treatment of mathematical ability seems to influence the way that Black students approach, participate, and believe in themselves as doers in mathematics (BATTEY; FRANKE, 2015; DAVIS; MARTIN, 2018; GHOLSON; WILKES, 2017; MARSHALL; ROSADO; BATTEY; WILSON, 2022; MOORE; GROVES PRICE, 2015; NASIR; MCKINNEY DE ROYSTON, 2013; VALOYES-CHÁVEZ; MARTIN, 2016). A vicious cycle can form between the lack of belief from both the teacher and students. Teachers can begin to lose patience and place blame on students for being below grade level and unable to understand certain concepts or skills. They may not take on the responsibility of educating and helping students in their care as well as they could. Students begin to get frustrated or have negative beliefs in their ability to learn mathematics, which can translate into disinterest in mathematics, possibly leading to further struggles in mathematics later in their education.

The system of education in public schools is highly flawed. It places teachers and students in precarious positions, often leaving both in situations where it can be very difficult for either to find success.

Some schools prioritize discipline over actual education and improvement of knowledge, insisting that the students need order. While order is necessary for organization, it can often be communicated in demeaning ways or reflect behaviors similar to those displayed in prison. This is often a reason why students in communities where the majority are Black are not interested in school. Schools seek to control what and how they learn rather than empowering their thinking. This control goes beyond the classroom and extends into other social environments, such as lunch and recess, which should be more liberating.

In the following section, I raise possible conditions and perspectives for learning environments in mathematics education.

2.3 Possibilities for mathematics classrooms

Similar to other researchers, I argue that African American students should be provided with a mathematics pedagogy that is built on their cultural experiences (DAVIS; MARTIN, 2018; GUTIÉRREZ, 2018; LAVE, 2019; LERMAN, 2001; POWELL, 2022; WINKLER, 2012). Furthermore, I contend that this mathematics pedagogy should prepare African Americans and others to participate in our democracy, as well as a society that permits open and equitable thinking (SKOVSMOSE, 2014a; TATE, 1994).

“We contend that critical consciousness, a strong math identity, and opportunities to be seen and understood as knowledge producers is essential for students of color to navigate mathematics, and push mathematics to transform for greater justice.” - (MOORE; GROVES PRICE, 2015)

To move towards the idea stated by Moore and Groves Price above, we need to take time to understand the other, understand the language that best suits individuals initially, and what representations can best move all of us towards understanding.

The concepts of patience and understanding are lacking in mathematics classrooms. Every day in schools, relationships are being formed or transformed, undergoing evolution or destruction between staff and students, as well as peer to peer. There should be more attention given to these aspects, to what seems to be a simple addition to daily practice in schools - not only from teacher to student, but from human to human in a school building, as teachers, leaders, parents, and

students all deserve more patience and grace. To slow down does not mean to stop or dumb down, but to consider and include all.

As there have been greater efforts to involve social emotional learning (SEL) into classrooms, it is often separated from rather than incorporated into academic spaces. But there is value in addressing the entire individual while learning. Below, Baczko-Dombi refers to mathematics as more than just learning, but a combination of the self and the considerations we need to consider in mathematics education:

“Mathematics, as no other school subject, evokes conflicting emotions and contradictory attitudes – from “the gate to a career” and “the queen of science” to the widespread acceptance of mathematical ignorance in society. The process of studying mathematics requires systematic work and patience, as mathematical knowledge has a cumulative nature. In the case of mathematics education, some students abandon mathematics at quite early levels of education and begin to consider themselves “humanists”, which results in serious consequences for future educational and career choices.” - (BACZKO-DOMBI, 2018)

The learning of mathematics takes time, and the understanding of mathematics requires practice in various ways and in different contexts (BOALER, 2002). In classrooms, there need to be creative and concrete ways to practice what is learned. There should be more technology in classrooms for students to practice their mathematics on, as this is what they will encounter in their daily lives as adults.

Learning cannot be solely based on memory; there need to be solid opportunities to learn and build knowledge, and this requires time and patience (GATTEGNO, 1970). Many education models do not allow sufficient time to build knowledge. Mathematics classrooms are ruled by a curriculum which is a set guide on what to teach, based on the standards and goals of the district, determined by what it is most crucial for students to master on that year’s assessment (DOCKRELL; SMITH; TOMLINSON, 1997). The end goal of this is not one of value, such as finding joy in learning, nor does it communicate importance; rather, it communicates that it is most important that you remember this information right now to pass the test at the end of the year to move on to the next grade, and the same process will be repeated next year.

Most students come to forget what is taught in class and will be given a review which reinforces remembrance. There are not adequate opportunities for unique learning experiences

where students can build knowledge and understanding. Understanding cannot stand on memory alone, and nor can cognitive development.

The opportunities for learning need to stem from activities that stimulate thinking and evoke dialogue and critical thinking. This can be stimulated by including projects, real-world problems, and problems suggested by students from their imaginations (FRANKE; WEBB; CHAN; BATTEY et al., 2007; SKOVSMOSE, 2022b). This can empower students to create and think of the possibilities that may become opportune in their futures.

2.4 The power and option of choice

Mathematics is a mandatory subject for testing and assessments. To access further education and learning, one has to show their proficiency in mathematics. If one is unable to prove their knowledge or skill in mathematics, they can be shut out from other opportunities or choices. In the state of mathematics teaching and learning in Newark at this time, many students are not being awarded with access to certain programs due to the lackluster conceptual mathematics education that they are receiving.

The power of having the option to choose a mathematics-related subject or major in secondary education or at university is quite important, as this can give further access to high-paying jobs. Due to the limited educational opportunities, there are low percentages of African American people in occupations related to mathematics and sciences.

Mathematics has to be communicated in a way that associates what students understand or have an interest in with the ways in which mathematics will be valuable for them in their futures (NEWARK, 1949). This has been a goal since 1949, yet it is still a desired reality for many African American students. The proof that this has not been realized is the current state of mathematics education for Black students and the fight that rages on to address it (GUTIÉRREZ, 2018; MARTIN, 2009b; c) - not only for the sake of understanding mathematics but for the increased autonomy in society (VALOYES-CHÁVEZ; MARTIN, 2016).

Some education systems can be inconsiderate in the ways that they expect children to learn, meaning that there is not enough time to adequately learn concepts and practice skills in different contextual circumstances. At times the depth of context that students are required to study have no

relation to discussing daily social occurrences that involve mathematics (D'AMBROSIO, 2001). This can derail the ways in which they associate with mathematics in the future, labeling mathematics as a disconnected and non-contextual school subject.

Although the school district continues to struggle with low high school graduation rates and low standardized test scores, the former mayor of Newark - Cory Booker - insisted in 2010 that: "Newark, New Jersey can become one of the first American cities to solve the crisis in public education." This vision for a better school district is also shared by Facebook founder Mark Zuckerberg, who made a \$100 million donation to Newark Public Schools in 2010. "Every child deserves a good education. Right now that's not happening," he said.

The ways in which Black students receive subpar mathematics education and are subsequently assessed is a violence against them. It is a much more subtle violent act than the catalyst for the riot that occurred in 1967.

Martin Luther King Jr. predicted just such a riot in a speech titled "The Other America," which he delivered at Stanford University on April 14, 1967, three months prior to the unrest in Newark. "All of our cities are potentially powder kegs," he said. While King maintained his commitment to nonviolent civil disobedience, he also recognized the psychology of oppression, stating:

But in the final analysis, a riot is the language of the unheard. And what is it that America has failed to hear? It has failed to hear that the plight of the Negro poor has worsened over the last few years. It has failed to hear that the promises of freedom and justice have not been met. And it has failed to hear that large segments of white society are more concerned about tranquility and the status quo than about justice, equality, and humanity. . . And as long as America postpones justice, we stand in the position of having these recurrences of violence and riots over and over again.

To fight against the current injustices, there must be riots in opposition of these subtle acts of violence. This might include awareness and attention to the ways in which students identify and perceive their possibilities within mathematics and their futures.

3. Mathematical Identities

“My life is a plot twisted from directions that I can’t see” – (LAMAR, 2022)

The quote above is from the song Father Time, and it highlights that one’s trajectory can be influenced by causes unseen, yet can have impactful consequences. Identities are created and developed in a multitude of directions, and there are countless experiences in one’s life that will piece together to form these moldings of our being. The ways individuals come to relate to the world may not be recognizable in present environments or contexts. These experiences can come to form fragments of one’s foregrounds.

One can think of identities as ever-evolving notions, parts of individuals that are under constant production (HALL, 2021). In this production there are external contributors - such as communal, cultural, and sociopolitical contributors - and these inputs are in negotiation with the internal self as it continues to make sense of the world and decide what it likes and what is best. We can think of identities as being critical, as they are in a constant exchange of dialogue (SKOVSMOSE, 2023) with the hidden inside world and the visible outside world.

According to Skovsmose (2023), dialogue is essential for critical mathematics education and a key resource for facilitating critical activities in mathematics. There are opportunities for students to translate their identities into their mathematics classrooms. Having the space to speak about their identities through mathematics is an opportunity for students and teachers to share and listen to the interests and perspectives, developing and connecting life to their mathematics learning. Therefore, attending to the identities of students can be essential to both their understanding of mathematics and the world of critical mathematics education.

In this chapter, I will discuss the different ways in which Black students may identify with mathematics. To do this, I will create a space to talk about identities, how they are formed and how they can continuously change and grow. Next, there is a discussion about the different theories of how one identifies with mathematics, following discussions pertaining to mathematical identities in the classroom and mathematical identities for Black students.

3.1 Exploring identities

To best understand mathematical identities, it is imperative that there is a conception of what identities are as well, and the different ways in which they are developed and constructed. Throughout the text I will refer to *identities* in plural various times, as there are multiple identities that one person can have and develop.

Who we are, how we are, who we become, and how we become are complicated, in-depth topics to discuss. There are various ways in which identities can be constructed, coerced, manipulated, or destructed, and in addition to these prospects there are different possible areas of life which identities can be built from. The construction of identity is complex and influenced by familial circumstances and an abundance of sociological factors.

Let's first understand what identity is with a review of the root of the word. I refer to Adrian Poole and their description of identity:

“The roots of the word ‘identity’ come from (late) Latin *identitas*. ‘Identity’ represents the idea of ‘sameness’ (from *idem*), parallel with the ideas of ‘likeness’ (*similitas*) and of unity (*unitas*). Identity, likeness, unity: this is a powerful trinity, and its three terms easily blend into each other. In 1855 Herbert Spencer observed that: ‘Resemblance when it exists in the highest degree of all...is often called identity.’” – (POOLE, 2010)

Poole refers to this idea of a trinity with identity, likeness, and unity. The ‘sameness’ that Poole mentions makes identity sound as if everyone is the same or progressing toward being identical. However, in this excerpt, what is described is the ability to become the same or embody the ‘likenesses’ with another entity (NICOLSON, 2016).

In this sense Poole's definition connects with a definition of identity given by Erik Erickson who gives another layer to ‘sameness’, which states:

“The term identity expresses ... a mutual relation in that it connotes both a persistent sameness within oneself (selfsameness) and a persistent sharing of some kind of essential character with others.” - (ERICKSON, 1959)

Erickson not only associates sameness or sharing with others, but also within the individual themselves. This sameness within the self appears to mean that one fully assumes and accepts their unique identity, possibly to be the same in moments but with the ability to make the conscious

choice to share this sameness with others. These others I can see as being a community, other people, a subject, or interests. It is not about being identical but about sharing characteristics that allow one to relate.

To be the same can be boring; it also restricts an individual from growing into the fullest potential of their true selves (OXFORD, 2023b; POOLE, 2010). This can be potentially harmful or dangerous to an individual as it limits the ability to consider, approve, disapprove, maintain, or expand identities.

Williams (1989) argues that there is a paradox of identity, where nothing can be the same as another thing, but relation and sameness can exist between a thing and itself. Though his point of view stems from mathematics, the idea can be applied to identities of human beings as well. I argue that identities, while possibly able to share similarities and a variety of relations, are not copies or indications of ‘sameness’, unless we are speaking of the person themselves and the multitude of identities within them (such as the selfsameness that Erickson (1959) refers to). Even if there are resemblances between people’s identities, they are not replicated exactly; there are differences, which might be slight, but need to be considered.

Christopher Williams gives the following example as a possible way to view identity:

“Identity is a rather puzzling thing at first sight. When you say ‘Scott is the author of *Waverley*’, you are half-tempted to think there are two people, one of whom is Scott and the other the author of *Waverley*, and they happen to be the same. That is obviously absurd, but that is the sort of way one is tempted to deal with identity.” - (WILLIAMS, 1989)

In this excerpt, the subject is the author Scott, where there are three things to consider: their name, how they identify, and a title that they hold as an author. These markers are what identify Scott and his role as an author of the book *Waverley*, and these are some of his identities. Perhaps there is another person with the name Scott, and they might also be an author; their identities will share similarities, but they cannot be exactly the same.

Identities are important for helping to identify individuals and understanding their interests and relations to their environments. Within societies, different identity markers are created, and we come to assume them as sociological members. Although identities are socially constructed

(HALL, 2021; SILVA, 2000; VARELAS; MARTIN; KANE, 2012), they are also personal and require self-reflection to regulate and resolve what works well for the self and what does not.

I draw from other sources to better understand the concept of identity and the different perspectives on defining the phenomena. First I draw from the Oxford definition of identity, which states that “[..] identity may be introduced as a primitive relational expression, or defined via the identity of indiscernibles” (OXFORD, 2023a). From this definition, the concept of identity is not an easy one to simply grasp or describe, although framed as primitive (which could be considered as simple). It is a form of expression which can be understood as a way one can become aware, recognize, and communicate their thoughts, understandings, or emotions.

These expressions can be between person to person, or internal as negotiations with oneself on how to be, because identities are personal agreements of self (DEAN, 1997; NICOLSON, 2016; POOLE, 2010). In the second part of the definition, it mentions the identity of indiscernible, which means the identity of what is not easily recognized. I see this as a description of the internal identities that one has. These can also be viewed as personal identities, and as requiring dialogue to access.

Oxford’s definition of personal identity is

“[..] A phenomenological sense of oneself as a separate individual being with a distinctive personality and a ‘true self’ persisting over time; a self-image. The problem of whether ‘the same person’ can exist over time. The social particulars of an identifiable individual.”
- (OXFORD, 2023b)

The interpretation of identity in this sense highlights the differentiation of the self from the social environment around it, the desire one’s self possesses to be separate and unique, and to blossom into its ‘true self’.

One can imagine that it is immensely difficult to determine one’s ‘true self’ or ‘true identity’ in a society full of ideas and systems that seek to control and manipulate, just as one can imagine one’s true self as sharing the sameness with the world around them. As the world continues to change, the manners in which identities form morph as well. When films were created, this may have greatly influenced identities; a major influence for the current generation is the

increase of technology and impact of social media (BOLIN, 2017) which can make it difficult to discern a ‘true’ identity. This may or may not have harmful consequences in the present or future.

There is a myriad of relations between external and internal identities, and there are benefits to their coexistence. I refer to a quote from Kathryn Dean:

“Individuals only feel at home in the world if they develop a strong sense of personal, individual identity which resonates with and finds its validity in an accompanying collective identity.” - (DEAN, 1997)

Looking at these different takes on identities, one can come to see that they are indeed formed and developed internally and on a communal level. As we come to grow our sense of engaging with our internal thoughts and the symbols and happenings of the world around us (RUIZ; RUIZ; MILLS, 2010), it can contribute to our developing identities. That is, there is a dialogue that occurs between the internal self and external worlds that supplies all identities with ways of being. This might be in relation to how individuals make meaning and adapt their ways of being with these meanings and life experiences.

The social particulars of an identifiable individual speak to the influences of life that affect and manifest our identities (HALL, 2021) that is, the social context and the way our identities are negotiated between the self and social determines our decision-making and who we can become. Some important considerations within these social particulars are the home, communities, people we come to know and build relationships with, and schools (especially when considering students).

Our identities are created through a combination of developing contexts, psychological and social exposures - which are further negotiated through lived experiences - learned behaviors, and coping skills (NICOLSON, 2016). As we begin to mature and are exposed to more throughout life, our identities continue to develop. Identity formation is a never-ending process or ‘evolving configuration’ (HALL, 2021) which requires a balance between continuity and discontinuity such as to enable the individual to absorb new developments and to meet new demands without suffering from ‘identity diffusion’ (DEAN, 1997). By ‘identity diffusion’, Dean is referring to something that causes an individual to dismiss central parts of themselves, or a manner that causes dispersion or confusion.

Diffusion or concentration of identities can occur within schools, as the identities Black students develop outside of school has the potential to welcome or refuse the identities within the

school, depending upon the dialogue between these identities. This can also become dependent on the motives to learn mathematics (SKOVSMOSE; SCANDIUZZI; VALERO; ALRØ, 2018) or to participate in other activities outside of school. There are probabilities of the identities inside of school and outside of school embracing or rejecting the other, and this could cause success or problems for the students' academic mathematical development.

Understanding the possibilities of how identities are defined, formulated, welcomed or ignored can help us understand the ways in which other identities may be constructed, and concurrently, inform us on how to possibly attend to the identities and mathematical identities of Black students. To understand how to best support Black students through their mathematics development, it is important to understand their racial identities²¹ and cultural identities, as this contributes greatly to their identities and therefore is related to their mathematical identities. In the following section I will discuss cultural identities and how they might be shaped.

3.1.1 Cultural identities

“[T]he discourse of identity suggests that the culture of a people is at root ---- and the question of roots is very much at issue ----- a question of its essence, a question of the fundamentals of a culture”
- (HALL, 1995).

Building on the discussion of identities, it is necessary to explore cultural identities. Cultural identities are at the center of social, political, and economical concerns. Culture encompasses many aspects of individual and group human life, such as shared beliefs, values, customs, and behaviors (NAIK; BAKER; MOHIYEDDINI, 2023) It is also about roots, origins, and beginnings. The roots that Black students fortify themselves on are eclectic, and vary depending upon their ancestry, environments, learned behaviors, and preferences. They become the foundations of one's cultural identity and overall identity. These foundations have the potential to shift or to remain sturdy, but a grounding nonetheless where individuals can return. However, the roots can be problematic, as cultural identities of Black people are almost impossible to locate.

Hall (1995) states that roots are the very issue, and goes on to say that histories, people, and situations may come and go, but somewhere deep down there is a culture to which all belong.

²¹ Racial identities are further discussed and explored in Chapter 4.

The cultures that Blacks identify with through choice, selection, and sociological imposition are possibly distant from their origins. Thinking of the cultural representations in American society, including the educational systems, there are things that are incredibly distant from the culture of Blacks. Appealing to one's cultural identity implies that there is some form of connection between sociological environments and the identities of individuals.

According to Gilbert (2010), cultural identity refers to both individual and collective identity. First, an individual's identity involves cultural aspects in various regards, such as their linguistic and literary backgrounds, their religious and education backgrounds, socially acquired attitudes and manners; second, it involves membership in a cultural group, therefore it is necessarily a collective.

The fluidity that exists between personal identities and one's cultural identity is essential to consider in education as it may cause altering views and perceptions of mathematics and their future possibilities. These aspects of identity make up the multitude of identities that every student has. There is an ever-changing acceptance and refusal of cultural identities, as cultures of various environments contribute.

Characteristics such as the chosen modality of language and dominant local culture are also factors within cultural identities. There can be influences from global, international, national, and local perspectives (ZAJDA, 2022). These effects from a global and local level can be problematic, as the processes of globalization seek to homogenize cultures, and local cultures aim to maintain their identity-defining characteristics. Zajda (2022) tells us that the forces of globalization shape cultural identities through the presence of information technology and mass media; the increased marketing of socially desirable goods and commodities has affected cultural and self-identities. Promoting the desires and identity of one society may diminish the value of another.

The identities of Blacks and African Americans have been affected by early displacement and "civilization". Hall (1995) speaks of the first trauma to the identity of the Caribbean, for example, as the eradication of the indigenous people of the land. The first trauma of identity for Black people is being removed from their origins, and input into a system of labor that aids in the empowerment and development of influential global economic systems - systems that will not benefit their descendants, but leverage cultural customs of ancestry for capital gain.

One can see the history of education in Newark as having an effect on cultural and mathematical identities of Black students. The causes displacement into insufficient learning environments, or inadequate access to learning resources. The history of education affects discourse of what is necessary to learn and what is not. Considering the use of different languages and cultural traditions, which reflect different colonizing cultures (HALL, 1995), the manner in which Black youngsters experience mathematics may make them feel that there is no connection between the subject and their own worlds or futures.

In the following section I will explore the theory of mathematical identities and their importance.

3.2 Identifying with mathematics

“To do mathematics means more than just learning the facts of mathematics—it means seeing oneself as a capable mathematical learner who has the confidence and the habits of mind.” (p.5, (SU; JACKSON, 2020))

Identities comprise our beings - the ways in which we have come to learn to be, react, interact, and process the world around us, whether that is with fellow human beings or in our own internal worlds. We take on many different identities, some of which we may be conscious or unconscious of, some of which may be built, destructed, and possibly rebuilt again over time depending on one's life journey, some of which can be turned off and on at will, and some of which may carry on with us for a lifetime, either in an active or dormant state. There are also identities that must be built, sustained, and continuously developed because of politics, constructs, and institutions in the society that we are a part of, and the success or consequences that can ensue if these identities are neglected. Academic identities are imperative to master to gain access to an abundance of opportunities in the present and future for students. Academic identification refers to our self-perception of success in a domain, in this case schooling and academics (LEGETTE; KURTZ-COSTES, 2021; OSBORNE; JONES, 2011; OSBORNE; KELLOW; JONES, 2007). Matthews, Banerjee, and Lauermann (2014) suggest that academic identities can be viewed through two frames, the first of which is internally negotiated (i.e. how students tend to think of themselves as learners), and the second which is externally supported (i.e. how students feel in their learning environments).

Discussing mathematical identities includes considering how students may think and feel about academics. Mathematics is a topic area that is frequently assessed and can provide barriers for individuals if it is not understood (BJÖRKLUND BOISTRUP, 2016) It can be structured in such a way that maintains White supremacy and neglects ways that Black students may relate to and understand mathematics (JOSEPH; COBB, 2019). I think that it is important to mention that this may impact students choosing whether or not to participate in mathematical fields in the future or deciding whether mathematics is a true interest for them. However, developing a healthy, positive mindset and identity towards mathematics will at the very least provide Black students with the option of taking these opportunities (MOORE; GROVES PRICE, 2015).

The construction and formation of mathematical identities is an example of a type of identity which is imperative to build upon and sustain for academic success in the United States. Success in mathematics is reliant upon adequate mathematics education. Recognition of success in mathematics is completely dependent upon one's ability to perform well and demonstrate mastery on standardized state assessments; it is imperative to be aware of what practices may affect these outcomes (DAVIS; MARTIN, 2018). Understanding how students identify with mathematics may aid in this issue.

To understand the theory of mathematical identities I refer to Danny Martin's definition, which states:

“one's beliefs about his or her mathematics abilities, one's beliefs about the instrumental importance of mathematics, one's beliefs about opportunities and constraints that exist to participate in mathematics, and one's motivation to obtain mathematics knowledge.” - (MARTIN, 2000)

Using Martin's definition of mathematical identity, I understand it to be the perspective of mathematics and the value that mathematics can have in one's life, and the views that others may have on an individual - this can be for people of any age, which includes both students and educators. Based on what is understood about identity above, mathematical identities can continue to evolve over a lifetime and be constantly negotiated through social context or through self, specifically in regard to mathematics. But what does this look like?

Gonzalez (2020) states that: “It has been posited that mathematics identity affects one's perception of the discipline, one's academic identity and, ultimately, one's success in the subject.”

Martin (2000) recognizes that this phenomenon is extremely hard to observe or analyze, and it is important for us to study and consider deepening our understanding about how individuals feel about learning mathematics and alternative ways in which people learn mathematics (MILLER; WANG, 2019). We know that it exists in some capacity for us all, because we all have an opinion about mathematics and are capable of doing mathematics. But are we always permitted and encouraged to do mathematics in our own way?

The goal of this study is to provide more possibilities, perspectives, and additional data and analysis on the different ways that we may continue to improve the mathematics education experiences for students in mathematics classrooms. Although there has been extensive research and contributions to the field, there still exists minimal and poor-quality mathematics education opportunities, especially for students of color (GHOLSON; WILKES, 2017; GONZALEZ; CHAPMAN; BATTLE, 2020; MARTIN, 2000). Within the realms of mathematics education, critical mathematics education, and education for social justice there are plenty of different approaches to mathematics which foregrounds the students as the learner (SKOVSMOSE, 2012) rather than subordinating the learning to teaching (GATTEGNO, 1970; POWELL, 2022).

Attending to mathematical identities will involve viewing the entire student for who they are when they walk into the learning space. Students walk into the classroom with their own unique banks of indigenous knowledge (POWELL, 2022), practices and skills, and ways of perceiving the world, themselves, their foregrounds (SKOVSMOSE, 2012), and mathematics. To cater to students holistically in mathematics classrooms, it is necessary to vary the learning curriculum and teaching styles to meet the needs of the students in which they are intended to educate (LADSON-BILLINGS, 1997; TATE, 1994; YOUNG; RAYGOZA; MADKINS; LAWLER *et al.*, 2022). This may include slowing down, as the concept of understanding is not a speed game, such as what is communicated through the expeditious pace of most curriculums in mathematics education in New Jersey, as well as taking the focus off assessments and seeking a different approach to assessing mathematics understanding all together.

State assessments in recent research have been shown to be inconsistent with the cultures of all students, racist, and ignorant to the different contexts of which people live in (DAVIS; MARTIN, 2018). Although these claims are valid, the fact of the matter is that in the current

context, students must perform well to access different options for their futures (JOSEPH; COBB, 2019).

Research into ways that mathematics education should be improved has occurred in various areas, such as an increase in the presence of African-American culture in mathematics pedagogy, curriculum, and reform in mathematics to move away from solely teacher-directed classrooms (MARTIN, 2009a; WINKLER; WINKLER, 2012). But the point is not only to change the curriculum and practices in the classroom, it is to connect to the lived experiences of Black students that are coming into the classrooms to learn (TATE, 1994).

To facilitate these connections to lived experiences of the students it requires much more than mathematics knowledge and sets of assessments; it requires curriculum writers, school staff, leaders, and teachers to view students exactly as they are - individuals and human beings - allowing students to feel as though they belong (LEGETTE; KURTZ-COSTES, 2021; MATTHEWS, 2020; ROBERTS, 2018). As each student comes to learn, understand, react, interact, and participate in different ways, therefore they will come to identify in different ways. As a result, the mathematical identities of students need attention to improve their understanding and confidence in their ability to do mathematics.

This increase of confidence in their ability to do mathematics may deepen their interest in and awareness of mathematics in different contexts and environments, with respect to other context and conditions (SKOVSMOSE, 2014a). Fear and lack of belief in ability may come to vanish and be replaced with a feeling of wonder, assurance, and the ability to accomplish in the present or future. This effect can have a further influence on student performance in assessments, whether the evaluations are geared toward their culture or not, as well as in classroom environments.

Below I explore what mathematical identities can mean inside and outside of the classroom.

3.2.1 Mathematical identities in mathematics classrooms

Mathematics classrooms are the spaces in which students are instructed about the different types of mathematics, and often in these spaces they are directed on how to be, and how to do mathematics in specific ways. The teacher gives a direction or a set of steps, and the students are

expected to understand the concept of the current topic and repeat the steps previously modeled, perpetuating old styles of teaching and learning from the early manifestation of instruction (NEWARK, 1855; TATE, 1994); however, for certain lessons students are challenged to try the skills on their own before instruction with their teacher.

However, these classrooms are restrictive. Tate (1994) referred to this method as “foreign” pedagogy and had this to report, which remains true today:

“[T]his conventional mathematics pedagogy is exactly the kind of “foreign method” of teaching described by Woodson. Few, if any, attempts are made to build on the thinking and experiences of African American students...[P]edagogy for African American students is hampered by the following conditions of their schooling: 1) persistent tracking, 2) less access than other students to the best qualified teachers of mathematics, and 3) fewer opportunities to use technology in school mathematics.” (p. 478)

These learning environments are not providing sufficient learning opportunities in the communities that they serve or considering ways in which they may be beneficial for their understanding (MARTIN, 2000). This not only concerns the matter in which they learn, but the context and significance of what they are learning and how they are learning. The activities that students are exposed to and engage in can affect their identification with mathematics, as well as their motives for learning in the future (BLACK; WILLIAMS; HERNANDEZ-MARTINEZ; DAVIS *et al.*, 2010; SKOVSMOSE; SCANDIUZZI; VALERO; ALRØ, 2018). Classrooms should prioritize mathematics learning that relates to cultural backgrounds (AMIT; ABU QOUDER, 2017), and consider the interests and identities of students to access the greatest potential that they can offer.

Taking on an academic identity in environments where the identity is in contrast can lead one to feel as if they are out of place, leading to detrimental feelings and thoughts about the self (MOORE; GROVES PRICE, 2015), particularly when compared to others rather than in the frame of self-improvement (OSBORNE; JONES, 2011). This can cause one to internally negotiate their identity and look for other ways to fit into their community and other social environments, possibly leaving mathematics out of the possible choices. It is therefore important to consider these feelings and perspectives of students, ensuring that they are encouraged to learn in their own ways (GUTIÉRREZ, 2018).

Students come to school with an abundance of knowledge and the proven record of being able to learn without formal education, just by communicating with you (POWELL, 2022). Learning to use language can be accomplished in many ways, and the same is true when learning mathematics (GATTEGNO, 1970). Embracing this ability to learn individually, in their own way and in ways of formal schooling can be empowering for students; it can build confidence and awareness of ability, and influence the way learners come to view themselves.

Learning is not only about digesting information, or being force-fed what is important. It is about awareness, building connections of knowledge and understanding. It is a continual process that requires personal transformation, and is about developing and becoming (NASIR; MCKINNEY DE ROYSTON, 2013). It is about applying what you have learned with what you will learn; therefore, it is important to also consider how students learn in all contexts to maximize their learning in the classroom.

3.2.2 Mathematical identities outside of mathematics classrooms

As stated above, students already have a storage of knowledge which they have accumulated over time, through experience, before they ever step foot into a classroom. Academic learning spaces can serve as bridges between their worlds and formal mathematics, where students can learn to translate their thinking to mathematical models (MARTIN, 2009b). The ways in which they have learned skills and forms of knowledge most likely did not follow the same flow of learning which is provided in school - that is, to listen to a lecture and then perform a set of exercises to prove their understanding (GATTEGNO, 1970). In mathematics exercises are typically performed on paper, with little external context, only the exercises and stand-alone concepts. This form of learning is at times necessary but there can be other ways to make connections, broadening the landscapes of their demonstrations of knowledge (SKOVSMOSE, 2022a).

The disconnect that exists for Black students may cause a feeling of discomfort or disregard, where they perceive no benefit in learning mathematics (MATTHEWS, 2018). There is anxiety and fear that clouds the conversation and thoughts around mathematics (MARTIN, 2000; WEBER; RADU; MUELLER; POWELL *et al.*, 2010). Often, people mention that they do not have an interest in mathematics, or they are not good at mathematics. Due to this direction of

thinking, individuals can miss out on the various ways one can look at mathematics in different life contexts, other than purchasing goods from a store or paying a bill. Because of the fear or disinterest in math, some may not have the awareness of the mathematics activities in which they partake.

Although this fear exists, some students show positive mindsets towards mathematics (MARTIN, 2000). But there are some noticeable limitations, not in capability, but in performance in assessments and awareness of the extent of mathematics (for example, its use in advanced concepts and professions).

There are various ways in which mathematics can be communicated and understood. The knowledge of mathematics is not unique to academic settings but seems to be the only form of learning that is accepted and respected. In formal classrooms, students are told what to do, and don't have much of an opportunity to use their indigenous knowledge (POWELL, 2022). This knowledge could be displayed through activities that position the involved students at the center of learning, as sources of knowledge.

In a study by Amit and Abu Qouder (2017), they connect elements of the ethnomathematical activities that occur in a neighborhood²² that serves marginalized students and incorporates them into the curriculum for 7th graders. Aspects of mathematics were explored in methods of both traditionally communal and formal mathematics. In their discussion, they stress the importance of not abandoning academic mathematics for alternative ways of learning, but rather learning to use variations of communicating mathematical knowledge to supplement and support their in-school learning.

In a curricular approach, Gholson, and Robinson (2019) engage students in an activity that allows Black learners to develop positive mathematical identities. The activities are grounded in a curriculum founded by the first author, which is called Mathematics for Justice, Identity, and metaCognition (MaJIC). Understanding the importance of mathematics in students' futures, this approach was implemented to provide Black students with more opportunities to access universities and have: "(1) active exploration of self as a mathematics learner in various contexts

²² Negev Bedouin community in Israel. "The word Bedouin originates in the Arabic word for desert, and means desert dweller. The Israeli Bedouins are part of the Arab population of Mandatory Palestine that remained in the State of Israel after its foundation in 1948" (AMIT; ABU QOUDER, 2017)

to develop criteria for success in mathematics, (2) cultivation of agency and identification of key decision points that lead to different pathways, and (3) construction of a mosaic of images to measure success and navigate pathways” (GHOLSON; ROBINSON, 2019).

Attending to Black students’ identities means that it is necessary to view their ability and potential as explorers, and constructors of knowledge. There are possibilities both in and outside of the classroom, and they can be connected. To do so it is essential to understand how Black students may identify with mathematics.

3.3 Mathematical identities for Black students

Attending to the identities of all students makes it possible to rehumanize mathematics for all, allowing individuals to learn in their own way, encouraging and embracing this “uniqueness”, can prove to be a more effective way of teaching mathematics and building a culture of people that don’t fear math and have the belief that it is learnable (GUTIÉRREZ, 2018). Many students and, as a result, working adults have assumed a fear of mathematics and their relationship with mathematics. As a consequence, their identity with mathematics can become skewed (MARTIN, 2000). Current mathematics is restrictive, strict, tyrannical, and at times contradictory, claiming to relate to the real world but failing to appeal to sources of knowledge from the community (BOSE, 2022). You must attend to how people understand before demanding everyone speak in the same language (ISEKE-BARNES, 2000) or at the same tempo and pace; even in an environment where the language of English is primary for all, terms in mathematics may not always be clear.

We all have identities and particular ways in which we communicate, participate, and react with the world around us. As individuals, none of us have a singular way of thinking and being. We cannot simply be broken down into categories that are preorganized by society, as being part of one category may not always guarantee you access into another. For example, Black students who are high-achieving scholars may experience difficulty in their communities because of the perception of academics and the conflict of interest between Black society and schools (MARTIN; GHOLSON, 2012). All humans are extremely complex, ever-evolving, and comprised of many different identities and mindsets that make up who they are. This is also true when it comes to mathematics (MATTHEWS, 2014). Black students must be fluid in the ways they move through their identities to ensure success in mathematics and gain opportunities for their futures.

There is constant shifting through identities, and this may occur more often for children as they continue to grow and learn more about the world they exist in, continuously being exposed to knowledge and different ways of being. This is true for the Black students in middle school as they may daily negotiate with their identities, learning how to be in their home, communities, and schools (MARTIN, 2000).

Unfortunately, identities of Black students are usually communicated from a deficit perspective, pertaining to their ability to do mathematics and produce knowledge (AGUIRE; MAYFIELD-INGRAM, 2013a). However, in various studies there are demonstrations of positive mindsets in relation to mathematics from Black students (GHOLSON; ROBINSON, 2019; MARSHALL; ROSADO; BATTEY; WILSON, 2022; MARTIN, 2000; ROBERTS, 2018), as well as an awareness that Black students are more than capable of high achievement in mathematics (GHOLSON; WILKES, 2017; MARTIN, 2009b; 2012).

Continuing to raise awareness of the disconnect between academic learning spaces and cultural identities of Black students could possibly address the systemic and intentional barriers placed before them (NASIR; MCKINNEY DE ROYSTON, 2013). To do so is not only an action of humanity but an act of justice and liberation. Martin (2009) states that to move towards liberating:

“Liberatory resistance can also include generating new knowledge aimed at deconstructing and challenging existing understandings and explanations of African American children’s mathematical experiences, development, and outcomes.” – (p. 4)

Generating new knowledge requires changing mindsets - and specifically changing the way that we view the mathematical ability of Black students. If they are capable of viewing themselves positively in regard to doing mathematics, this should be respected by peers and educators alike. Observing their modes of identification in mathematics may enlighten us as to the different ways in which it is possible to construct new knowledge (GHOLSON; ROBINSON, 2019) It may be helpful to have teachers reflect on their own mathematical identities to support their Black students (AGUIRE; MAYFIELD-INGRAM, 2013a).

3.4 Conjoining identities and future possibilities

There is no one way to generalize one group of people, as there are nuances in the ways people decide to live their lives and learn, and differences in where, who, and how they want to be. In Newark, NJ, you will find African-American people from all different walks of life, all of whom share the goal of being successful, but some of whom may not have access to the resources.

Success can be very different from person to person, but most people view success from external factors such as status symbols - for example, being able to purchase nice clothes, jewelry, or cars (ZAJDA, 2022). Some find success from doing what they love or purely from learning more,, whether they are acquiring new knowledge or deepening their previous understandings (SU; JACKSON, 2020). Of these two forms of success, while both are valid reasons of wanting to do well, the joy of learning is more sustainable. But when success in learning is scarce, it is difficult to sustain the mindset of joy in it.

It is necessary to build connections between academics and the identities of Black students to discover pathways of future success. Many barriers already exist for them, such as deficit perspectives, generational poverty, and systemic racism. There is a need for relevant resources and opportunities to connect, learn, and explore.

Curriculums need to make space in lessons to meet students' needs, especially for African-American students, as their needs are clearly not being met when it comes to mathematics. The manner in which they are required to learn is not adequate, and has not been for many decades. There has been progress in using SEL (Social Emotional Learning) to attend to the social needs of students, but I believe there is a need for this in mathematics too, to pause and verify how students are feeling about the mathematics and what other thoughts and imaginations they may have (SKOVSMOSE, 2014a).

4. Racism and Racial Identity

Racism continues to plague the US, as well as much of the world, due to the absurd notion that one group of people is better than another due to sets of visual physical characteristics and cultural differences (BONILLA-SILVA; YAMASHITA, 2022; EDWARDS; HARRIS, 2018; MAHMOUDI, 2022; SEARS; HENRY, 2003). For African Americans, this includes traits that make them apparently different from European descendants such as skin color, culture, language or accents. The social construct of racism seeks to maintain the idea of superiority, power, and systematic control through differences of race (GROSFOGUEL, 2016). Race is the category into which people are placed due to external physical or cultural characteristics; in referring to it as a social construct I am alluding to the embedded views in society where it seems justifiable to treat one group of people in a certain way because of their race, or where race is used to justify why a certain group of people behave in a certain manner (THOMPSON; CARTER, 1997).

Before an understanding of racism can be formulated, one must also consider race, because racism stems from this structured concept. Therefore, race will be discussed from a structural standpoint. Examinations and discourse of race, racism, and racial identity require thought and dialogue outside of the realm of mathematics education. Consideration of psychological, sociological, and political influences is necessary to discuss the role of racism within mathematics education. I will draw from various definitions of race and racism to understand the different ways in which it exists.

The goal of this chapter is to discuss the theories of racism and racial identity, and to peel back some of the layers in which it exists in our society, in everyday occurrences, and within mathematics education. An understanding of racism and racial identity is imperative for this study because race is part of our identity. In some cases, it may be the first characteristic of an individual that is recognized or acknowledged. Race is not a secondary category of group association (BONILLA-SILVA, 1997). To better understand the phenomenon of racism I believe it is important to observe and discuss the different ways in which racism can be perceived and communicated. Racism has detrimental effects on some groups and beneficiary effects on others, and it can occur in various contexts and situations.

Race is also part of society in the sense of racial identification. There are different markers used for racial identification, not only color, but also other sociologically constructed traits such as sex, class, or gender (GROSFOGUEL, 2016) which are intersectional. This chapter will also attempt to define what race, racism, and racial identity are and what implications they may have on the self and mathematics education.

In this chapter, I will discuss the theory of race, racism, and possible origins of racism. In the racism section I will explore aspects of structural racism. Then I will connect the ideas of racism and racial identity. Finally, I will follow up with a section on the ways in which racism infiltrates and influences mathematics education.

4.1 Race and its complexities

There are many aspects which separate one person from another, which differentiate groups, communities, possibly cities and states, and certainly countries and the cultures within them. One can think of the race of mankind, referred to by those such as Immanuel Kant. However, the term race has been further expanded throughout history. Inspired by an example given by Benedict (2019), Frenchmen in the late 1880s would separate people or groups of people by their cephalic index; that is, individuals were separated by the size of their head. One can also think of the example we use in the Épura research group: the separation of people by the size of their ears. There are various ways of differentiating between people. But the modern way of differentiating is primarily skin color, which can dictate one's race.

“Human beings are infinite in variety, and when they are agglutinated in groups, great and small, the groups differ as though they, too, had integrating souls. But they have not. The soul is still individual if it is free; the group is a social, sometimes an historical fact. And all that I really have been trying to say is that a certain group that I know and to which I belong, as contrasted with the group you know and to which you belong, and in which you fanatically and glorifyingly believe, bears in its bosom just now the spiritual hope of this land because of the persons who compose it and not by divine command.” - (DU BOIS, 1923)

W. E. B. Du Bois makes a claim that there are many differences among human beings. He identifies as a Black man and compares himself to another man, who happens to be a White man. He speaks to the soul (one can also think of an individual's identity) as it is separate, and the social

aspect of belonging to a group, and acknowledges that his identification with a particular group contrasts with the other (a White man) because of the societal history and structure. Here the only contrast that is mentioned is the difference between skin color, their physical appearance. These variances amongst different groups or different races can cause one group to feel a sense of superiority and impose a sense of inferiority on another (CORLETT, 2003; DOANE, 2006; DU BOIS; ZUCKERMAN, 2004b). This sense of superiority is not a matter of fact, based on science or justice, but rather a sociological construction.

Discussions of race demand attention to ethnicity as well, as it concerns cultural differences. Corlett (2003) states that analyses of "ethnic groups" are not bound to the strictures of physical characteristics and ancestry ; instead, they look primarily to culture, nationality, and other factors in understanding what were once termed the different "races of mankind."²³ I think it is important to be aware of these differences and similarities. Objections against certain groups can stem from ethnic prejudice and ethnic discrimination, which will be further discussed in the section of racism below. In this text, I will remain focused on the ideology of race and racism, rather than ethnicity due to the nature of its use in categorization and its interchangeable use in the United States and in mathematics education.

Inspired by a statement from Battey (2013), race is not a matter of fact; it is fictitious and created by society to categorize groups of people. The outward and visible signs that people have can be recognized as race (BENEDICT, 2019), but are never just restricted to the physical (DU BOIS; ZUCKERMAN, 2004b). Race is not something that is chosen, but rather traits that a person is born with and subsequently classified by. In other words we are born as we are and dependent upon our characteristics a race is assigned to us. These hereditary traits can then become part of one's identity in society.

The hereditary traits that most people have come from the same lineage, albeit at different frequencies (INGLE, 1965). The proposal from United Nations Educational, Scientific, and Cultural Organization (UNESCO) in 1964, based on research by scientists and anthropologists, states that there is no clear distinction between humans besides physical appearance, that all humans belong to homo sapiens. More specifically: "Biological differences between human beings

²³ See p. 63 in *Race, Racism, and Reparations*.

are due to differences in hereditary constitution and to the influence of the environment on this genetic potential.” The claim on race, especially superior race, is one of social creation, causing manipulation of the mass perspective.

It is important to note race as a social construct and mass perspective. Robert E. Park in the 1920s highlights in his Race Relations Cycle theory²⁴ the influence of social interaction and how races can be welcomed, viewed as strange, or assimilated. He breaks the cycle down into four stages: 1) contact, 2) competition, 3) accommodation, 4) assimilation. During these four stages different moments occur in which people of different races or ethnic backgrounds are introduced to another community (contact), and need to make space for themselves validating their need and right to be there (competition and accommodation). In the final stage, there is a moment of acceptance, welcome, and possibly even hybridization of culture (assimilation). Robert E. Park speaks specifically about examples of Europeans and Euro-Americans, and states that this process is much easier for these communities than it would be for the African-American community. The possibility is there; however, the need for the eradication of racial prejudice is absolutely necessary (O'NEAL, 2020). One can see how this may be possible over many centuries, blending many cultures and practices together. One can also see how this theory can be applied to the forceful assimilation of communities, or refusal of assimilation, and, instead, conquest of one culture over another.

Cultural practices are learned behaviors (BENEDICT, 2019). In the instance of learned language, which is a cultural practice, one can begin to see the various ways in which race may be associated with social traits other than what is biologically transferred to individuals. Black people can come to speak many different languages depending upon the country they were born and where their ancestors may have been brought in the years before; it just so happens that Black people born in the United Kingdom or in the United States learn to speak English, but Blacks in Angola or Mozambique learn to speak the countries' official language of Portuguese (there are many other languages spoken). In a classroom, all of these individuals could be classified within one race, Black. These individuals may have their own categorization, depending on other learned cultural practices including, but are not limited to, selected music, food preferences, celebration tendencies and customs, even the manner in which people work in present day. If we think about the overall

²⁴ See p. 510 in *Civil Rights Movement: Past and Present: A-K*.

race, humankind, all of the aforementioned practices and customs have evolved and changed even if the biological traits of human beings have not.

These specificities and differences which are considered as racial characteristics have been used to carry out persecution in violence, war and domination over others in the time of conquest of new lands and territories (BENEDICT, 2019; KENDI, 2016), and to establish and maintain a position of power, forceful influence, and privilege. Race is used to create a narrative about a group of people that subordinates their validity and importance in society, placing other races in a superior position. The idea of race is then followed by racism, which can be considered as the act of believing that certain races are inferior to theirs. In the following section I will discuss the action of racism further.

4.2 Origins of racism

“Is it only a matter of unearthing that which the colonial experience buried and overlaid, bringing to light the hidden continuities it suppressed? Or is a quite different practice entailed - not the rediscovery but the production of identity. Not an identity grounded in the archaeology, but in the re-telling of the past?” - p. 111 (HALL, 2021)

To discuss the origins and colonial effects of racism, we must understand what has come before and how it has come to be. As Hall (2021) suggests, retelling the past can show us how cultural and racial identities may be produced and reproduced through recall.

Racism stems from the construction of race and the maintenance of superiority (ALMEIDA, 2022; RAY; MAHMOUDI, 2022). Race can be based on more than just physical appearance, therefore there are various forms of racism. Prejudice and racism can occur on various levels, such as individual, interpersonal, intergroup, and institutional (AUGOUSTINOS; REYNOLDS, 2001). Racism and prejudice are interchangeably referred to when discussing discrimination, where prejudice is typically individual and racism is usually more broad and connects the beliefs of individuals to larger social systems and institutions. White and Frideres (2001) state that race prejudice and racism are attitudes and sets of beliefs that are not always in direct relation, where it is possible to be racist without being prejudiced, for example, though the sets of beliefs have many connections and are subsets of a broader context and system.

Systems and policies that maintain and promote racist ideas have been implemented over time. These ideas were formulated long before the societies we now know of today, and they have been communicated through dogmatic forms such as religion, legal measures, and education (RAY; MAHMOUDI, 2022). In the United States, the first known people to bring slaves to colonies were the Puritans who sailed the Atlantic from Britain. Using ideas of superiority from Britain they justified their right to own slaves, specifically African slaves. The justification that they used was on the basis that their work was communicated in a divine fashion from God; it was part of their mission to build a better world through the use of slave labor, and this slave labor could be carried out by anyone who was not white, and more specifically anyone non-Puritan. These ideas of superiority branched from the theories of Greek philosophers, who believed that they were superior to all non-Greek people (KENDI, 2016).

Aristotle's theory of natural slavery, for example, claims that there are those destined to serve others. In Book I of *Politics*, he gives characterizations of what it means to be a natural slave: psychological limitations such as lack of ability to deliberate, physical attributes which make one more suitable for manual labor, and those who are rightly considered to be part of their master's body (their property) or who are marked from birth to be slaves²⁵. These theories were not always in direct relation to skin color; they could be based on geographical location. However, these ideas were later used as foundations for racist beliefs that fueled enslavement and its subsequent institutions. There is no conclusive evidence that there was a clear difference between "black" and "white", but only a belief of being superior to those deemed inferior (WARD, 2002). Many groups of people adopted theories such as these, and over time the attention was then completely focused on people with Brown and Black skin as the group of people who were intended to be inferior to all.

This idea of inferiority was used by groups of people such as the Moroccan Empire, the Portuguese, the Puritans, the Spanish, and many other slave-owning nations to support their claim of the right to own and exploit Black Africans for slave labor; Africans who were of lighter shades also came to believe that they were superior to other Africans due to their skin color.

²⁵ See (SMITH, 1983)

Understanding these ideologies is of great importance. According to Almeida (2022), to understand race we need to understand the formation of the concept of man under the ideology of modern philosophy. Almeida traces this back to the period of Enlightenment, as man declared themselves vessels of knowledge, grounding themselves under the ideal “I think, therefore I exist”. Affecting the psychology of (wo)men can affect the decisions and mindsets of the future.

Racist ideas were formulated earlier than the 1400s, such as when it was deemed to be holy intent for Black people to be slaves to European and Northern African conquerors (in the case of a Portuguese missionary expedition), which made it justifiable to portray Black people of all shades as inferior in every way (AZURARA, 2016; KENDI, 2016).

These holy and ordained assumptions were passed on to the Puritan and colonial slave owners in what would later become the United States. This caused one group of people to have the preconceived notion that they are better than other groups because of the traits they are born with, consequently leaving others with the mentality that they may not be good enough. This is all too real for many people of color, as they can be perceived as the unconscious, or the shadow in society (THOMPSON; CARTER, 1997). This form of racism is based on color, but there are many different forms in which racism exists and permeates society. Racism occurs through the act of racializing a group of people.

4.3 What is racism today?

Racism persists in various facets. “[R]acism is defined as a combination of prejudice and power that allows the dominant race to institutionalize its dominance at all levels in a society” (CORLETT, 2003). Corlett (2003) states that racism consists of ethnic prejudice and discrimination. It is the negative beliefs about individuals or groups of people because they belong to a specific ethnic group. These beliefs are widespread and exist in different areas of society, some which may be obvious, and others that may not claim racist ideologies but contain undercurrents of racial inequality and discrimination.

As stated, racism persists in manners that concern more than the physical, therefore racism can be carried out in different ways as well, such as economical restriction and segregation (DOANE, 2006). Grosfoguel (2016) claims that racism is a hierarchy of superiority and inferiority

along the line of the humans that has been politically, culturally and economically produced and reproduced for centuries by the institutions of capitalist, colonial, western-centric, Christian-centric, and modern world systems.

In Grosfoguel's definition, racism is a systemic power which informs this chain of command or ranking of human of importance which is enforced upon societies. With this enforcement there are groups of people that are considered to have greater importance, and given access to more realities and possibilities of our living society, with the benefit of doubt if they do wrong or poorly. Unfortunately, it can mean the complete opposite for those that are on the other side of this enforcement.

Through diverse institutions come varieties of racism marked by culture, language, religion, and color. Discrimination against race can be seen as hatred or dislike toward the other. This can also be described as xenophobia: prejudice towards those from another country. Frederickson (2002) says that racism is not merely xenophobia; xenophobia may just be the beginning. There is often hostility towards newcomers from "Third World" countries into "modern" countries, where individuals may face cultural racism (BONILLA-SILVA; YAMASHITA, 2022; FREDRICKSON, 2002).

Racism may be viewed as minimal or insignificant, as if it does not truly exist. An example is nonracism in Brazil, which has been further explored by race relation scientist (FREDRICKSON, 2002). Brazil is a country that claims there is equality amongst everyone based on the ideology of "racial democracy" but the Blacks (majority of the country) are consistently among the bottom dwellers economically, often unable to compete for higher status (NASCIMENTO, 2004).

Acknowledging racism may be an uncomfortable feat, as it may require addressing a racist. In an example of Oluo's book, *So You Want to Talk About Race*, she describes an exchange of conversation about the difficulty in referring to people as racist: "You can't just go around calling anything racist. Save that word for the big stuff. You know, for Nazis and cross burning and lynchings. You're just going to turn people off if you use such inflammatory language" (OLUO, 2019).

What should be recognized as racism, and disregarded as so-called “little stuff” that may not be that racist? Let’s look at some definitions of racism to make an informed determination of what can be considered racism.

Oluo gives her summation of what racism means:

“[...] (1) Racism is any prejudice against someone because of their race. Or (2) racism is any prejudice against someone because of their race, when those views are reinforced by systems of power.” – (p. 10)

Retaining power is a primary goal of racism, therefore it is necessary to infiltrate multiple areas of society, perhaps in ways that are difficult to detect. This (in)visibility of racism persists in systemic variations in the United States (RAY; MAHMOUDI, 2022). It either directly sustains or proposes to establish a racial order, a permanent group hierarchy that is believed to reflect societal norms and the best interests of the proclaimed superior race (FREDRICKSON, 2002). Below I explore examples of structures of systemic racism that disable Blacks from their ability to access equivalent rights.

4.3.1 Structural racism

“But if racism is embedded in our thought processes and social structures as deeply as many critics believe, then the ‘ordinary business’ of society—the routines, practices, and institutions that we rely on to effect the world’s work—will keep minorities in subordinate positions” – (DELGADO; STEFANCIC, 2001).

There are structures and intentional actions within our societies that allow the racist ideal to persist and create gaps between groups of people, furthering the mentality that one race is superior to another, and that they operate as normal parts of a well-oiled machine. According to Myrdal (2017), structures such as the promotion of certain talents of Blacks, which may be in arts or sports, with the simultaneous promotion of acceptance of subpar understanding in academics can create an extremely narrow interest for students of color, leading to fewer opportunities and choices in the future.

Actions such as these aim to keep Blacks in an inferior position as it can minimize the importance of education over quicker financial gain and a flashier lifestyle. This can also come to affect the identities of Black youth.

This lack of emphasis on education mirrors some of the statistics of the slavery era. Mahmoudi (2022) compares the current situation of Black students to the ability of enslaved children. During slavery, about 10% had the ability to read; in the United States currently, Black students may be two grade levels behind their White counterparts when it comes to reading. Mahmoudi attributes these academic gaps to disparities in wealth between Whites and Blacks.

The want for greater wealth is not just a desire, but a necessity, as it can also affect the acquired education for Black families. In a study by Perry et al. (2024), it is revealed that wealth of Black families has grown, but the gap in wealth has grown as well. Between 2019 and 2022, the median wealth increased by \$51,800, but the racial wealth gap increased by \$49,950, a total difference of \$240,120 in wealth between the median White household and the median Black household (PERRY; STEPHENS; DONOGHOE, 2024). They found that for \$15 of wealth that Blacks have, Whites have \$100 of wealth. In 2019, Blacks accounted for 13% of the population but only 3% of the wealth. As Perry et al. shared, the wealth is increasing, but at this rate it would take about 200 years for Black families to catch up (MAHMOUDI, 2022).

Disparities between education and wealth are staggering when comparing the Whites and Blacks in the United States. These gaps occurred over time, spanning from slavery into the subsequent years, which shifted from violent and overt hatred and mistreatment, to legal racist segregations laws, to lawful imprisonment based on laws that usually played against African Americans.

Systemic racism stays in place because it benefits the group of Whites as a whole (BONILLA-SILVA; YAMASHITA, 2022). A form of segregation and discrimination of wealth building is redlining and the prevention of acquiring proper housing, or the ability to purchase housing, in which federal associations also took part (ROISMAN, 1995). Bonilla-Silva and Yamashita (2022) referred to these actions as “new racism”, along with the development of White suburbia in some areas which consequently destroyed and neglected Black neighborhoods. Although these actions have now been deemed illegal post-civil-rights era, many of these practices still persist.

Laws were passed for equal rights; it is legally barred to discriminate based on race, but the history of mistreatment is still present (CURVIN, 2014). Blacks are more likely to receive subprime loan offers than Whites - that is, if an offer is even extended to them. Due to current

laws, it is difficult to prove that housing access is based on racial discrimination because banks or loan offices can claim that denial is based on credit scores, for example, which is also dependent upon wealth management (BONILLA-SILVA; YAMASHITA, 2022).

Access to wealth and housing also affects the homeless. Edwards and Noguera (2022) found that 48% of sheltered homeless families with children were Black. It is a staggering statistic, especially considering that only 14% of families in the United States are Black with children.

These unfortunate circumstances can all be traced back to racialized systems that intended to place Black people in disadvantaged situations (BONILLA-SILVA, 1997). It is a form of oppression; it is a part of the identity of American society. To address this requires attention to the institutions and systems that are the root and foundations of American government (DOANE, 2006). There is much resistance, from both the system, that intends to maintain control, and groups of people who continue to hope for freedom and equality.

Below I explore the ideologies of racial identity and the role racism has played in this phenomenon.

4.4 What is racial identity?

“Depending on the different colonial histories in diverse regions of the world, the hierarchy of superiority/inferiority along the lines of the human can be constructed through diverse racial markers. Racism can be marked by color, ethnicity, language, culture and/or religion.” (Grosfoguel, 2016)

Although the action of racializing and the presence of racism is more common when it comes to differentiating by color, the possibility of racializing other characteristics exists. This means that even where color racism lives, so can other forms of racism, which also leads to the prejudice and psychological predetermination of people (AUGOUSTINOS; REYNOLDS, 2001). This leads to people being described in ways that may not directly be associated with color, and facing ethnic prejudice; coincidentally, these characteristics may also describe subgroups of people who share the same shades of color or other physical characteristics (CORLETT, 2003).

Unfortunately, racist acts may go unnoticed because of their subtle nature and indirect manner. However, the manners in which they affect identity may be relatable, as far as being subtle or physically intangible.

This can be done through identification by color, religion, customs and different ways of life - any marker that can be used that differentiates the colonizer from the colonized (GROSFOGUEL, 2016). Markers are identifiers used throughout society that individuals can decide to use to promote one group and demean another. These forms of racialization can lead to adverse feelings for both groups of people.

Racial identity characterizes the way in which one relates to a socially related category such as being Black, Latin, White, or Asian. There are different ways in which race can be applied to people: we might be assigned a race by society and entities within that society, we might assign ourselves a race as a result, and people might assume us to have a certain racial identity by looking at us, which may have diverse hierarchy implications (BONILLA-SILVA, 2003). These racial identities can be viewed as positive or negative. Let's stay focused on Black racial identities: there are positive and negative narratives about Blackness and what it means to be Black, and assumptions about what Black people are capable of, as well as adverse effects on how Black people may perceive themselves (LEE; AHN, 2013; MYRDAL, 2017). It is important to remember that conceptions of race are based on social meanings, particular to place, and are constantly being redefined, in line with changing methods of racial identification (WINKLER; WINKLER, 2012).

Following Winkler and Winkler (2012), who state that race conceptions are based on social meanings in our ever-changing society, it is important to remember that race is a presumptuous categorization of people according to their cultural learnings and physical appearances. Cultural learnings stem from origins and Hall (2021) tells us that the cultural identity of Black folks is steeped in traumas and experiences of the past. Societal experiences heavily influence one's racial identity.

Racial socialization refers to the process in which individuals are taught certain cultural values and beliefs that pertain to their racial group membership (BERKEL; MURRY; HURT; CHEN et al., 2009; LEE; AHN, 2013).

Racial identity and racial socialization can be linked to discrimination and distress (LEE; AHN, 2013). Dreams and aspirations can become depressed because of circumstances due to hidden and intangible spiritual cost of oppression (MAHMOUDI, 2022). The experiences and events that Black children witness can be a heavy weight to bear, particularly when they are

witnessing people who look like them being discriminated against. To learn the history of their ancestry and what they needed to endure can take time to process and make peace with.

Racial identity can be very complex, and results from the societal construction of race and racism. When one thinks about race and racial identity, they can come to think about the physical characteristics that they see. But racial identity can relate to one's demeanor, social status, and perceived way of being. Those who identify as Black can also be assessed by their "Blackness." This judgment of Blackness can come from both White and Black people, the conditions for judgement stem from prejudice and stereotypes.

In *Dimensions of Blackness*, Sullivan et. al. (2018) raise an example of the presidential election of Barack Obama, and the lack of Black support he was predicted to receive. While there was no one in the Black community that questioned if he was Black, some did question his "Blackness" based on his background (SULLIVAN; WINBURN; CROSS, 2018). Some in African-American communities questioned if he shared the same experiences and ancestral history as other Black people in the United States.

What does it mean to be Black? What is Blackness? The social constructs of race and racism are everywhere, and with the increase of technology and globalization, individuals are exposed to more and more ideas of what it can mean to be Black. According to Winkler and Winkler (2012), African-American children can receive mixed messages on what it means to be Black, in a positive way (showing pride in culture and heritage) or a negative way (deficiencies in academics, beauty, productive citizenship). Other examples that they provide are possible pride in having a Black president but disparity when looking at the percentage of people incarcerated. The way that children interpret these messages will expand and change over time; however, it is important to stay aware of what they think and how they feel about these experiences.

Racial identity development, like the process of self-actualization, is lifelong (THOMPSON; CARTER, 1997). Therefore, although racial identity is socialized, it is also a phenomenon over which we have influence. It is essential to be aware of this for students and how it can impact their overall identity. What it means to be Black is ultimately up to the individual, but messages and experiences that they encounter can have an effect on their cognition, decision-making, feeling of belonging, and purpose.

One's racial identity can be affected in mathematics. The ability to relate to the subject and perceive one's capability to succeed is vital for success. Below I explore the possibilities of racism in mathematics education, and how it may stifle the success of Black students.

4.5 Racism in mathematics education

“A failure to link race in the context of mathematics education to the way that race plays out in larger societal contexts has been a major limitation of extant research. This failure has mistakenly rendered mathematics education as being disconnected from the systems of oppression that order the rest of society.” – (MARTIN, 2009c)

The connection of race to mathematics education is the lack of voice and representation of Black mathematicians, similar to the lack of Black professionals in mathematics and STEM fields (MADKINS; MORTON, 2021; TATE, 1994). This is the result of the paucity of opportunities for Black students in mathematics within our schools. This can be connected to the way that African Americans are assessed in mathematics and related to the way in which Blacks are portrayed in society as mostly entertainers or athletes, in contrast to academics, making it ‘uncool’ to participate in areas involving mathematics (MYRDAL, 2017). The continuity of this type of system and prejudices of Black learners leads people to view them as incapable or only having the ability to excel in certain ways.

There are assumptions made of people of different races. In the United States, for instance, those who are considered more competent in academics, especially in mathematics and sciences, are individuals who identify as White or Asian. The consequence of this assumption is the negative outlook that others may have of themselves when hearing that White and Asian people are more proficient in learning than other racial groups. This is typically communicated to Black students through a deficit perspective of disseminated assessment data based on racist ideologies (MADKINS; MORTON, 2021; MARTIN, 2009c; 2012). Consequently, Black people may not be considered competent when it comes to academics, especially in the sciences and mathematics (MYRDAL, 2017).

This way of thinking is all too often mentioned through the “racial achievement gap”, the “gap” that exists between the way that different races perform academically. The use of this statistic and narrative perpetuates deficit perspectives, racism, and the lowering of expectations for

students (MARTIN, 2009a). As a result, teachers can lower their expectations when teaching Black students.

This assumption contributes even further to negative consequences because it can lead individuals to have less belief in their abilities to learn or to improve academically (MATTHEWS; BANERJEE; LAUERMANN, 2014), especially when this narrative is continuously used to measure aptitude. The occurrence of this assumption over decades has also normalized the idea that Blacks are not good at mathematics; at times this idea can be communicated knowingly or unintentionally through teachers or other staff in school buildings. Attending to the confidence and belief of students requires that their self-efficacy is sustained and positive, meaning that asserting their racial identity and ability in mathematics may be highly beneficial for their success.

Strengthening the connection between a student's racial identity and mathematical identity should be one of the goals of teachers, school staff, and communities (MARTIN, 2009c). The perspectives that students and individuals have of themselves is a result of the experiences they are required to go through in school, as well as experiences in their communities.

Academic mathematics typically involves being lectured on how to do the mathematics; students are treated only as receivers of knowledge and not producers (MARSHALL; ROSADO; BATTEY; WILSON, 2022). They are usually provided with a curriculum that does not consider all the students it will inform, therefore does not serve their best interests (MARTIN, 2009a). It limits the ways in which students are allowed to explore mathematics in school and can possibly affect the way they will view mathematics in the future, if there are not additional opportunities outside of school. Students are told how to do mathematics in a certain way, how to perform well on an assessment, and if they perform poorly in either circumstance they are labelled as such - poor performers, or incapable. To guide students through their mathematics learning there is a need to take a deeper look at the mathematical content, practices and participation (Martin, 2000); as well as supporting students where they are and considering the knowledge they are capable of contributing.

“Understanding how these concepts impact student engagement with mathematics and the development of their mathematical identity is integral; however, all of these concepts are symptomatic of the epistemological racism of Western, and thus, school mathematics.” – (MOORE; GROVES PRICE, 2015)

There are many Black students that excel in mathematics, and there could be even more in the future granted that there is more flexibility and autonomy allowed in the creation of curriculum and didactics for mathematics. Black students need an opportunity to participate in mathematics that allows them to contribute as citizens, learn about the different functions of society, and discover more about the world around them (POWELL, 2022). This would allow them to transcend and deeply understand mathematical concepts. Unfortunately, much of their learning is dictated and restricted, subsequently minimizing their future liberties.

4.6 Connecting identities and racism

An observation that I have made of many of my students, as well as people that I know socially and professionally, is that it is all too common to hear the phrase “I am not good at math” or “wow, you majored in math, you must be so smart!” I raise this point because many (at least 90%) of my students were people of color, as well as some of my personal friends and co-workers that I encountered through my different fields of work.

The social effect of race, racism, racial identity is deeply rooted within our societies, and therefore it manifests within the psyche (NASCIMENTO, 2004; THOMPSON; CARTER, 1997), and particularly when it comes to one’s beliefs in learning mathematics (MARTIN, 2009b). The way in which we come to perceive ourselves and others is influenced by these ideologies. To learn about the history and ancestry of Black people is imperative, but history should not serve as the basis of what is to be in the present. Understanding the past allows for change to occur.

Belief in Black students as capable mathematicians and scholars - because they already are - is a necessity in education. For their liberation and future opportunities, they deserve to be observed as more than their socially appointed race. Their categorization has no limitation on their academic ability, and should therefore not restrict their relations to mathematics, nor their options for future success.

5. Black Identities, Backgrounds, and Foregrounds

The art of teaching and learning involves more than the content that is to be taught and requires educators to consider more than the individuals they physically have in front of them. For a full analysis to take place to discover the most effective strategies for creating change, Martin (2000) suggests that we look beyond the students that we teach, the teachers that we support, and the classrooms in which we try to create safe learning environments for our Black students. Martin states,

“[T]his meant analysis of the individual learner, school-level factors, perspectives of parents and other community members, and sociohistorical factors that include the historically based discriminatory policies and practices that have prevented African Americans from becoming equal participants in mathematics and other areas in society.” - (p.29)

From this statement I understand that there is a need for intentional analysis of individual students, as well as necessary insight into other factors that can manipulate or influence students' identities, education, and trajectory. These factors include, but are not limited to, their sociological environments, sociopolitical structures, and dominant influences (HESHMAT, 2014) in their lives (i.e. pursuit of materialism, power, and appearance) including experiences in school and in their communities.

Limiting access to an adequate mathematics education restricts students' access to opportunities and occupations as adults. For many students, their mathematics experiences are disconnected from their lived experiences (MARTIN, 2009a), the content and context in which they learn mathematics is not relevant to their lives or identities (NASIR; MCKINNEY DE ROYSTON, 2013), and the overall content of mathematics is limited and does not critically address sociopolitical factors that may affect their lives and the lives of others (SKOVSMOSE, 2016). To create channels to engage their identities with the subject of mathematics, students should be introduced to the work of mathematicians (GONZALEZ; CHAPMAN; BATTLE, 2020) that is relatable to their realities, aspirations, and imaginations as well as their concerns, worries, and doubts.

The work of mathematicians comes in many different forms. In classrooms, the opportunities to be involved with mathematicians' work can engage their curiosities, imaginations, or aspirations for the future.

Foregrounds becomes significant in this observation, because they consider the multiplicities and potentialities which social contexts make possible for a person (SKOVSMOSE, 2014b). These multiplicities position students to envision the realities and possibilities they experience or are able to imagine for themselves (STENTOFT, 2009). Envisioning these realities and possibilities involves the contrary as well - considering the absence of possibilities of realities.

Although not concretely stated in the quote above from Martin, it is through the lenses of foregrounds that we can attend to the perspectives of others and look at the sociohistorical, communal, and socioeconomic factors. An important consideration when accounting for these factors and ideas is that they are not definite, finite, nor conclusive.

Researching students' mathematical identities and foregrounds will require other perspectives and research outside of mathematics education, as we need to further understand the different aspects of an identity²⁶. This work requires us to do more outside of mathematics classrooms. Identities can be viewed in the classroom, but they are not only present or observable in educational environments. There is a need for sociological investigations. Although this study will look at more than what occurs during students' experiences in mathematics classrooms, I cannot fully commit to the sociological aspect, but will attempt to analyze the different components of student interests in mathematics as they pertain to their future aspirations and the way they identify with mathematics. As individuals, our identities in general are influenced by our education, from home and in school, and through our collective experiences.

Heshmat defines identity as:

“Identity relates to our basic values that dictate the choices we make (e.g., relationships, career)...However, few people choose their identities. Instead, they simply internalize the values of their parents or the dominant cultures (e.g., the pursuit of materialism, power, and appearance). Sadly, these values may not be aligned with one's authentic self and create an unfulfilling life.” (HESHMAT, 2014).

²⁶ See Chapter 3 Mathematical Identities for a deeper discussion about identities and their influence on mathematical identities.

Allowing students to reflect on their lives, their interests, in and outside of school, may give an opportunity for them to learn more about their own identities and the ways in which they can and want to identify with the subject of mathematics. This can also inform how they are influenced and give students the landscape to reflect and determine if their internalized values and ways of being are what they truly desire. This gives way to the possibilities of incorporating more interesting ways of learning about themselves, their worlds, and communicating mathematics.

Taking into consideration how identities are formed, I believe it is imperative to analyze the different components of students' mathematical identities - especially when it comes to the idea of "dominant cultures" in student mathematical identity development. Lerman (2001) states that: "In everyday situations of the child's life, he or she learns how to be, in gendered, ethnic, class, and other historical, sociocultural identities." Martin (2000) tells us that parents, teachers, school culture, and experiences in and out of school will largely shape a child's identity. Taking inspiration from Lerman (2001) and Martin (2000), it is crucial that we analyze the actions and factors that contribute to the influence of these identities, as there are dynamic overlaps and intersections of cultures and histories that constitute every student. To have a better understanding of these influences may allow us to better equip ourselves and educators to service African-American students, providing more channels to advanced academic opportunities.

The motivation for pushing this research forward is the pursuit of the opportunity of equitable mathematics education through diverse learning (ISEKE-BARNES, 2000; POWELL, 2022; SKOVSMOSE, 2022b), with care and awareness at the center (MATTHEWS, 2020), and an abundance of options in mathematics for African-American students to take (should they so choose). Lack of identification with mathematics and attending to Black students' foregrounds may lead to discouragement and a lowered level of interest in mathematics, possibly disbelief in their ability to do mathematics at some point in their academic experiences. The ability to identify academically or with mathematics is linked to both motivation and academic achievement (MARSH; CRAVEN, 2006; MATTHEWS, 2014). These pockets of invisible scarcity of motivation, ability to identify with the subject, and a disconnect with their realities may lead to a foreshortening in their long-term mathematics success, which can have various detrimental effects on their options and therefore future opportunities.

In this chapter I will attempt to connect the theories of mathematical identities and foregrounds. In the first section I will discuss the notion of mathematical identities. I will then discuss the importance of students' backgrounds. In the following section I will discuss the impressions and attitudes of mathematics, and how this can create space for Black students to engage with mathematics. Finally, I will endeavor to connect the conceptions of mathematical identities and foregrounds, discussing the possibilities, connections, and interrelations that form between them.

5.1 Identities

Identities are essential for development and are highly influential on the trajectory of a student's life. Gholson (2017) states that identities serve as the organizing link between macro-structural forces and the face-to-face moment in which we all live. In this sense, identities are composed of internally and externally imposed interpretations of ourselves through lived experiences or interactions, and these events occur through our socioeconomic and sociopolitical environments (NASIR; MCKINNEY DE ROYSTON, 2013). One's possible interactions and engagements with mathematics depends on their environments, how they come to perceive or be perceived in mathematics, and their ability to participate. Options in mathematics that are presented or barred contribute to the significance of interpreted meanings in relation to mathematics.

Following the definition given by Martin (2000), mathematical identities embody one's beliefs about one's mathematics abilities, the importance and role of mathematics in one's life, and one's beliefs about opportunities and obstacles that exist pertaining to mathematics, as well as one's motivation to learn mathematics. Mathematical identities are the ways in which one perceives mathematics and actions that involve mathematics.

These identities also include one's beliefs, self-conceived notions, and externally communicated perspectives about their ability to do and express through mathematics. Black (2010) tells us that mathematical identities can be considered as students' engagement and disengagement with mathematics, meaning that the experiences that students have in and out of classrooms with mathematics can influence this desire and form of engagement with mathematics. For this reason, it is crucial to consider the identities, backgrounds, and foregrounds of students to

intrigue this desire to engage, because it will indeed vary for different students. This is an indication that attending to identities is a worthwhile endeavor for the continued progression of education and development of students. Attending to and engaging students' identities may not prove to be enough; it is also imperative that their identities be supported as to bring positivity to growth and investment to the mathematics learning for Black students. This growth can also be in the form of becoming aware of their disinterest in mathematics but being comfortable in doing mathematics, In the same way as one may not have the interest in being an avid reader or writer, but can be literate.

Gholson (2017) mentions that identities in relation to mathematics can be supported, suppressed, or even denied in ways that disinvest in opportunities for African American students.

It is important to support students' mathematical identities because the act of not doing so cannot be viewed as a neutral attitude towards the growth or facility of their identities (GUTIÉRREZ, 2013). This act of non-support could very well be an action towards suppression of their mathematical identities and how they come to see mathematics, the ways in which they have come to learn and see their worlds. This suppression may transmute over time into a form of disinvestment, which is not obvious or seen as an issue, but which disrupts student development in mathematics learning, possibly leading to this creation of invisible pockets of scarcity of motivation. When disinvestment takes place, backgrounds can then be ignored, mistaking the value they can present in the motivation and understanding of students.

To gain understanding of how one identifies with mathematics, it is essential to inquire and learn about their background. Learning about a background can inform us about their interests, how one comes to see the formation of different concepts in mathematics, the meanings which they form, their resonations and reasons, and an overall insight for how one may come to see the purpose and definitions of mathematics, successes, and obstructions. This involves observing more than the ways students identify with mathematics; it includes recognizing and affirming students' many identities (i.e. racial, cultural, socioeconomic).

5.2 Backgrounds

Our identities are composed of where one comes from, what one has experienced, how one may perceive themselves, how they believe they are perceived, and how they may be perceived.

Backgrounds involve where we come from and how we come to perceive the world. One's backgrounds contains knowledge and perceptions about the world. Backgrounds are landscapes that can heavily influence decisions that we make and what we come to view as important in our lives. They are part of how comes to construct meaning and frame how one may come to see their future and opportunities. Backgrounds can be beautiful, complex, desperate, ill-favored, bountiful or barren, and depending on the conditions one can have an easier road to success or pathway full of obstructions. Backgrounds are crucial because in some instances they come first, before we, our present selves, are considered.

An example could be backgrounds checks²⁷, which are consistently taken when one applies for an occupation, a home, financial commitments, even when one applies to school. These checks consider not what we might be capable of, but what we have already accomplished, our race, socioeconomic status, criminal history, where we live, and where we come from. Depending on one's background and how it is assessed, one might be denied entrance into schools, universities, organizations, etc. Backgrounds can therefore prevent some from accessing further opportunities, therefore causing social, economic, and educational barriers, in effect altering students' possible futures and options.

In an academic context, Aguire and Mayfield-Ingram (2013) state that while teachers may affirm and support the racial, gender, cultural, ethnic, academic, and mathematical identities of students in classrooms, they should also be aware of the need to reframe negative views of the identities, which may reflect limited knowledge of students' background experiences and social realities. For example, in a country where Asian Americans may be viewed as "model minorities", African-American students may be viewed as having a cultural or racial background that does not value education (AGUIRE; MAYFIELD-INGRAM, 2013a), or viewed as inferior academically even if they have proven accomplishments (BATTEY; FRANKE, 2015; MARTIN, 2009c).

To be viewed as inferior can be a form of denial and violence. In a sense, one can consider the knowledge that students come into schools with to be their background knowledge. Knowledge

²⁷ A background check is the process of looking through the history of a person. This includes the occupational, educational, and criminal histories of an individual. It may also include double checking with affiliates and family members of this person.

can be informed by the schools that they attend, their homes, their communities, and their cultural backgrounds.

I am inspired by Skovsmose (2014) to discuss the different influences backgrounds can have on an individual and in educational environments. In his discussion about backgrounds, Skovsmose raises the importance of cultural backgrounds and its relevance and inclusion in mathematics classrooms. D'Ambrosio (2001) argues that cultural inclusion (ethnomathematics) is imperative for students and their mathematics education, to prepare students for their futures. D'Ambrosio acknowledges the necessity for formal mathematics education, as students need to understand this to access certain academic spaces. Skovsmose (2014) mentions that only considering students' backgrounds is not sufficient in attending to student needs or aiding in providing fully meaningful mathematical experiences for students; there is also a need to consider students' foregrounds.

These arguments are important and necessary because there is consideration of the entire student, their formulation and how they come to see and make meaning of the world. I argue that in addition to these considerations, mathematical identities need to be considered in classrooms to attend to students' mathematics learning and their future interests, whether it be in mathematics or not. To do so it is necessary to acknowledge the different backgrounds that students come with, reflecting not only the perceptions of others, but also considering their own feelings towards their backgrounds.

Backgrounds can influence how you perceive what you learn and the experiences that come with this learning. This is indeed an important consideration because perceptions can alter understandings and provide additional viewpoints. Previous difficulties and challenges can impact the ways teachers or students continue to feel motivated, finding a reason to persevere or sulk in doubt. These types of experiences can have a negative or positive effect, and influence productivity and sense of belonging in mathematics classrooms (AGUIRE; MAYFIELD-INGRAM, 2013b). Backgrounds can inform us that it is imperative to remain open minded about the different ways in which knowledge comes into formation - that we are all learners. To learn requires patience to relate new knowledge to what has been learned previously and use this new knowledge to continue to progress forward.

The backgrounds of students are somehow intertwined with mathematics identities and students' foregrounds. Skovsmose (2014) states that one's backgrounds and foregrounds can be taken together in what can be referred to as their dispositions²⁸. In one way or another, one can influence one or two of the others in a positive or negative manner. Therefore, it is an important consideration that comes between the notions of mathematical identities and foregrounds. In the next section I will discuss foregrounds and how they can be formed.

5.3 Foregrounds

The term foregrounds as it is referred to in this thesis was coined by Ole Skovsmose. Skovsmose (2012) states:

“A foreground is formed through the possibilities, tendencies, propensities, obstructions, barriers, hindrances, et cetera, which his or her context provides for a person. Simultaneously, a foreground is formed through the person's interpretations of these possibilities, tendencies, propensities, obstructions, barriers, hindrances.” (p. 1).

Foregrounds are fragments and pieces (SKOVSMOSE, 2012) that have the potential to comprise our entire being, physically, mentally, and ideologically. These segments of our being are constructed and built over time through our experiences and contexts in all our living tenses. Because they are existent through all our tenses, they are ever changing and evolving the more that we live, observe, and interact. These evolving entities are composed of two overlapping features: on one hand foregrounds are formed through the social context of which a person is born into, and on the other hand foregrounds are formed through the perspective and interpretations of the context which a person is born into (SKOVSMOSE, 2014b). It can be considered as the overlap of the “outside” and “inside” of an individual.

The social context one is born into encompasses many different sociopolitical and socioeconomic factors, which one has no control over (FILHO; SKOVSMOSE, 2014). These factors include - but are not limited to - possibilities, tendencies, propensities, obstructions, and barriers (SKOVSMOSE, 2014b). One can think of foregrounds as being a composition of their community. That is, they are constructed through the lived experiences of their neighborhoods and

²⁸ Notion of dispositions as defined by Skovsmose, can be found in Skovsmose (2014) p. 65.

communities, which can be narrow or rather far reaching. This depends on the practices and tendencies that form and govern these environments, and what possibilities exist for mobility or accessibility. These possibilities create connections that may lead to future opportunities or obstructions.

The perspectives that can be taken on one's social context are infinite, evolving, and subjective. One may come to see many opportunities within well-defined or objective forms of structured context. This all depends on an individual's disposition, and ways of coming to make meaning of their environment. That is, it depends on one's actions and resources, which are constructed sociologically, and how one uses their resources to manifest these actions. The subjectivities that are therefore possible are incredible and difficult to consider and analyze. A difficulty could possibly be possessing access to said resources and being unaware of the ways in which to leverage them. This can be a reality for many families that live in urban and impoverished areas.

Perceptions are crucial because they are not only dependent on an individual's physical environment. One can come to think and perceive in different ways through experience and contact with other individuals and cultures. One can have a depleted source of resources but view the world as an abundance of possible outcomes while others may not be able to see this at all. Skovsmose (2022) tells us that to understand the actions of individuals we must look at their intentions, which are phenomena that are deeply rooted in social factors. I see these intentions as being influenced by perceptions which are also swayed by society and communal environments; intentions can also be subjective, as what one considers to be best for them may not be for another, or for themselves, depending upon the context and the situation.

For some students and people in Newark, this is true. Newark was once ranked as one of the most dangerous cities to live in New Jersey, even in the country²⁹, but not all the inhabitants there may view it as so. Newark in recent years has been reformed with more resistance against

²⁹ Previously ranked in the top 10 most violent cities in the United States in 2013 by CNN, where it had ranked almost consecutively for 50 years, as reported by Yahoo News.

violence³⁰ and gentrification³¹, producing newly renovated locations, businesses, and homes around the city, most of which are in the downtown area of the city. This provides the city with a more pristine overall appearance, but for many residents there still remains an impoverished and violent aspect to the city. This can remain as an aspect of one's identity, background, and foreground.

As discussed above, backgrounds and identities affect our dispositions and intentions. Backgrounds involve our environments and communities. It follows that our backgrounds can then have a profound influence on how we come to make decisions, proceed with our intentions, or position ourselves in our future possibilities as we internalize the world around us. Therefore, students' learning intentions can be informed by their foregrounds (SKOVSMOSE; SCANDIUZZI; VALERO; ALRØ, 2018) and they are closely related to students' perceptions for purposes of their learning.

The subjective ways in which individuals make meaning of their intentions, foregrounds, backgrounds, and mathematical identities can influence the ways they come to view the world. This includes the way individuals come to view and understand mathematics. In the following section I will discuss the ways students may come to perceive mathematics, including how meaning can come to be defined in mathematics.

5.4 Perceptions of mathematics

The way one comes to observe and perceive mathematics can be formed by one's mathematical identities, backgrounds, and foregrounds. Each of these components can contribute to the ways that we view, define, and self-identify with mathematics. Mathematics can mean many different things depending on the individuals or groups of people we engage with.

³⁰ https://news.yahoo.com/newark-was-one-of-the-deadliest-cities-in-america-now-it-wants-to-be-a-blueprint-for-public-safety-reform-163320757.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlMnNvbS8&guce_referrer_sig=AQAAAA08HInNxPhXPjG0YaiCzEjitvIUB6-2KLO27unCVDUcBp_Cr8eqdmz4C6lwPpvLvbL_xehFoUVaMbZQEYR_ekrbjOGj-TtmdBryO_2MaMOlqZLH8EGGfbHfneNTxOUykBe1MNR6Xsx6VXd-pr6lD3ZkNJyv457OP7FUOahlBwB9#:~:text=As%20recently%20as%202013%2C%20CNN,cities%20in%20the%20United%20States.

³¹ The process whereby the character of a poor urban area is changed by wealthier people moving in, improving housing, and attracting new businesses, typically displacing current inhabitants in the process.

What is mathematics to you? This question has been in existence for a long time, and there are different responses to this inquiry. Many have attempted to define what mathematics is, describe its purposes and usefulness, as well as the importance, meaning, and key concepts in mathematics. Skovsmose (2014) states that meaning can be seen as a characteristic of actions, and through his interpretation this includes the motive for actions based on references made to mathematical concepts. Importantly, construction of meaning through actions should be performed by the student (see Skovsmose, 2014, p. 7). The perceptions that students have of meaning and their definitions of mathematics are often driven by what they are told in school, not what they discover themselves. Their perceived purposes and uses of mathematics can be influenced by their experiences both in and outside of school. Therefore, the determination of meaning through action is essential.

However, the school dictates definitions of mathematics that are held to be axiomatic. Stipulations about the conceptions of definitions (CELLUCCI, 2018) can be made but ultimately the academic mathematics definitions must be learned and remembered. This means that it can be debated where definitions originate and what their contextual significances are; however, definitions in mathematics as they currently stand are mandatory and conducive to one's mathematics learning.

Carlo Cellucci raises five stipulations of definition. The first two state that “(1) A definition merely stipulates the meaning of a term; (2) A definition is an abbreviation” (see Cellucci, 2018, p. 606). One can say that the mathematical definitions that students learn in schools are abbreviations of mathematics concepts that are taught out of context, which to them are stipulations of ideas and theories that they are unable to connect with. Students are rarely given opportunities to create their own conceptions and definitions of mathematics. Mathematics is therefore communicated in a dictatorial manner, in which students are subordinated to their teachers, mitigating their potential to imagine and relate. According to Powell (2002), this style of teaching continues the idea of the colonization of mathematics, which stifles student ability and potential.

Because of this lack of opportunity to create or build bridges to their realities and identities, it can affect their formation of significance in mathematics (MATTHEWS; BANERJEE; LAUERMANN, 2014). Therefore, the purpose and importance of these connections is linked with the present self and ultimately how it can impact future outcomes. These bridges, whether weak

or strong, can embrace and support one's mathematics identities and foregrounds, and connect their backgrounds. This affects the distinction of mathematics for learners.

The lack of opportunity to create links to their reality minimizes the significance and relevance of the content learned, and can significantly influence their motives and intentions to learn (FILHO; SKOVSMOSE, 2014; SKOVSMOSE; SCANDIUZZI; VALERO; ALRØ, 2018). The aim of connecting to their mathematics understanding needs to be emphasized because it is not only about having mathematics education and experiences that students are familiar with; it is about including this aspect and connecting to what students need to learn and why it is important. There are many different ways to do just that, possibly through projects, incorporated interests in lessons and assignments, or dialogue with students about what they think and understand about the mathematics and how they feel about their mathematics learning³².

Only attending to what students know keeps them in the same place, which can be a form of oppression, and replicates the same sociopolitical structures in place which have prevented Black students from being able to advance in equitable ways for decades (VAN BELLE, 2011). This may contribute to students' intentions of learning or not learning (SKOVSMOSE, 2018). Prioritizing test scores can also have a similar effect. Unfortunately, this is the reality for many public schools in Newark as well as other urban school districts, as African-American students are typically pegged as having low test scores and can be seen as inferior in mathematics compared to other racial counterparts (MARTIN, 2009a; c). Martin (2009a) states that this focus on assessment scores contributes to the racial hierarchy, continuing the myth that Black students perform lower in mathematics.

Combined with biased views of cultural backgrounds, this can also lead to lowered expectations of teachers and students in relation to their ability in mathematics, contributing to detrimental mentalities. Additionally, when mathematics is viewed as important and validated through assessment, this may lead to warped views of the role and influence mathematics has on day-to-day politics and structures.

³² See Skovsmose (2022) for suggestions and perspectives from different communities on how to integrate critical mathematics education into traditional academic spaces. (SKOVSMOSE, 2022a)

Opening up new perspectives allows for imaginations and mindsets to be challenged and piqued. It also gives way for exposure to new landscapes and ideas which can aid in building curiosities and motivations (SKOVSMOSE, 2022b).

Many students have expressed and boasted positive mindsets and perceptions when it comes to mathematics learning, but so many students seem to be left behind when it comes to the advanced mathematics courses and being able to access particular STEM field programs³³. For this reason, however, the deficit perspectives seem to speak so much louder when speaking about the narratives of Black mathematics learners (MARTIN, 2012).

A common narrative that can be heard, generally in the United States, is that “I am not good at math” (GONZALEZ; CHAPMAN; BATTLE, 2020) or “Why do I need this?” (MATTHEWS, 2018). It is very common to hear phrases like these from students. The majority of people would admit that this type of narrative would sound strange if it surrounded the ability to read or write but it is widely accepted when it comes to mathematics topics.

I think it is important to consider that perhaps there is the possibility that students may not want to pursue an occupation in fields related to mathematics, but the ability to have the option provides one with so much more social mobility. Perhaps this mobility can affect other parts of the psyche that lead or contribute to fulfillment or better quality of life. Certainly, the possibility of having more mobility or options can be a route to increased success. This of course depends on how one comes to see success in life. In the following section I will discuss perceptions of success and obstructions and how students may come to see them.

5.5 Mixing of mathematical identities, backgrounds and foregrounds

The way that one identifies with mathematics influences how they may perceive their future possibilities, and the same can be true for the way they perceive their futures and how it influences their identification with mathematics. Perhaps one can determine through their sociopolitical and cultural experiences that mathematics learning is not pertinent for their progression, or that it is essential for them to advance. One may know that it is important but not understand why it is, as many students may hear that “mathematics is very important”, without an

³³ Refer to Chapter 2 for particular STEM field programs.

explanation, context, or developing a sense of ownership as to what makes it so important (MATTHEWS, 2018). There is a need to make connections between learning, their experiences, and interests.

Backgrounds influence mathematical identities and foregrounds. Mathematical identities contribute to foregrounds, and foregrounds are affected by backgrounds. These concepts are in a cycle with one another, and they can very well move in different directions at various moments of life and development, where one concept may begin to sway the other two with more vigor. Figure 1 shows a cycle of Backgrounds, Mathematical Identities, and Foregrounds, what I refer to as the BMF cycle. Although they are intertwined and have the possibilities of overlapping (especially since they are all influenced by sociological factors), there are differences in them. Their interconnectedness is what creates the space for fascinating mathematics inquiries, possibilities, and additional ways of building interest for students. This can also be a possibility for creating spaces where Black students can build healthy identities, spaces that consider themselves, identities, backgrounds, and foregrounds of different contexts.

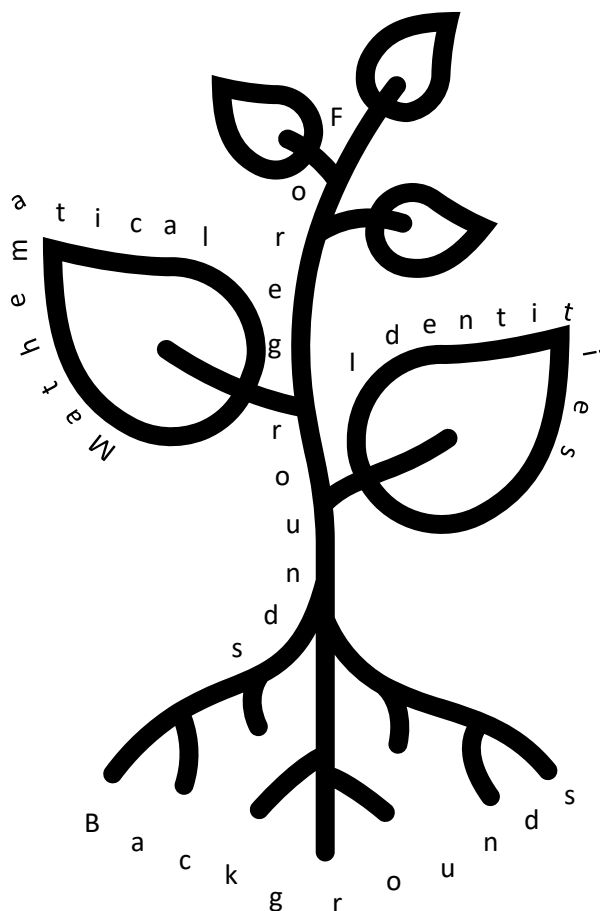


Figure 4: Backgrounds, Mathematical Identities, Foregrounds Cycle (BMF Cycle)

The interconnected characteristics of these concepts are linked by thoughts, perceptions, and experiences. Our foregrounds embody where we come from and our communities, as do backgrounds of individuals. One can think of the backgrounds being the foundation of individuals, their “roots”. As with the roots of plants that absorb the moisture and nutrients around them, so we absorb the knowledge and customs that are practiced around us. Our foregrounds can be seen as the stem that grows from our roots, as they are what peek beyond the ground into our future, but are also part of our foundation in where we come from and how we envision the future. One can view identity as the flowers and fruits that bear from a plant. As our identities come to bloom like fruits and flowers, some come to form mathematical identities. One can also view the entire cycle of this growth metaphor as being a mixture of backgrounds, foregrounds, and mathematics identities - possibly as a single plant working as its own ecosystem, learning, and surviving its environment.

These aspects become part of who we are, part of our identities and beings. We learn ways of speaking that may become particular to our area, we learn daily practices and ways of being, we learn to identify with our worlds. The lessons absorbed from these environments can shape the way that we come to view many possibilities, mathematics, interests, and can come to limit or expand what we envision as realities. These possibilities and realities may include the exciting or frightening occurrences one sees for themselves, and they are variant and multiplicative due to sociological and personal factors.

Skovsmose (2023) tells us that:

Foregrounds are social constructions. Simultaneously, foregrounds are formed by personal factors. Thus, students located in apparently the same social situation might experience different possibilities in life. They might encounter the same difficulties, for instance with respect to preconceptions, but they might deal with such preconceptions in different ways. One student might be more optimistic than the other, and one might have different levels of support from their parents and family than the other. In this sense, foregrounds are not only social but also personal constructions. (p.66)

The relationship that we come to build with mathematics can change the way that we perceive our environments, and the way that we view our environments can manipulate and expand the way we communicate mathematics. Both concepts are ever changing occurrences meaning that this process of mathematical identifying and foregrounds is ever evolving, growing, changing, expanding in a multitude of directions.

When thinking about academic mathematics, there is much that is foregrounded before any student or the knowledge that they bring to the classroom is considered. Correctness, steps and methods, memory of formulas, assessment performance and mastery, and formal definitions and terminology in mathematics have been fixed in many curricula for students to learn. This formation of mathematics knowledge is distant from the reality of many Black students and therefore may create foregrounds for mathematics they may not perceive as identifiable.

Foregrounds are concerned with the past, present, future, and backgrounds, as are identities. When one considers the mathematical identities of individuals, it consists of the experiences that students have had and currently have, and the way in which this may influence their motives for learning and engaging with mathematics in the future. If the motives for learning

are not captivating for students, it can lead them to lose interest or categorize the topic being discussed as unimportant.

One can see the mathematics identities and foregrounds of students being intertwined because they are concerned about one's possibilities and interpretations of these possibilities. Foregrounds, however, may consider more than just mathematics; they consider all possibilities including those that involve mathematics. They are also based on more than mathematical experiences, which could possibly affect perceptions of mathematics.

Mathematical identities are concerned with how one comes to think of themselves and their abilities in mathematics, possible opportunities in relation to mathematics, and the overall importance mathematics may have in one's life (MARTIN, 2000). This can include experiences in and out of school.

Either of these concepts for an individual can be ruined depending on their realities and attention to their experiences and interpretations. These phenomena can also be empowered depending on the awareness of them. Both are viewed in the plural because the potentialities for either are infinite. The unfortunate reality for many Black students is that foregrounds and mathematical identities are restricted. They remained confined to limited experiences in mathematics that they are unable to relate to and cannot peek beyond to imagine the functionalities and value of mathematics in their worlds.

PART II – CONSTRUCTION OF DATA

This part includes the methods used for the research, how the data was produced and analyzed. The data that was used for the analysis is summarized.

6. Methodology

The methodology of this study is qualitative, seeking to understand the interconnectedness of the mathematical identities of African American students and their foregrounds. As mathematical identities and foregrounds are ever-changing phenomena, this research has undergone many changes as well. One of those changes was to learn more about the concept of foregrounds (SKOVSMOSE, 2014b), and how this concept can be interrelated with mathematical identities of Black students. Methods needed to be adapted to the ongoing research of theories, narratives, and continued analysis of the data. An adaptation of the study was to completely conduct the data production virtually due to the Covid-19 pandemic. Part of the data production occurred after I relocated to study in Brazil, and for this reason interviews continued to be conducted online.

This research seeks to understand and discuss experiences, perceptions, beliefs, and attitudes of individuals and others (O'REILLY, 2012; SCHENSUL; LECOMPTE, 2013). In this study, these “individuals” and “others” are Black students and their teachers, respectively. Although the students are other from myself, there is also a connection between me and the participants. Their shared stories have differences from mine but there are many similarities and shared experiences as well, where I can identify with the participants.

The methodological steps of this research are discussed in this chapter, along with a description of the organization of the research, participants, structure and considerations.

This research is guided by some of the following questions:

- How do Black students experience their foregrounds?
- In particular, what is the relationship between the mathematical identities of Black students and the formation of their foregrounds?

I stated that there are some similarities between the experiences of the research participants and myself; there are also differences, of course. I express this to acknowledge the biases that I need to be aware of while continuing to work through this research, such as when evaluating perceived emotions or dialogue, so as not to stifle the knowledge of subjects or to extremely alter their narratives (SCHENSUL; LECOMPTE, 2013). The process of research is not neutral, it is not

apolitical, it is not free of judgment, free of individual bias, or subjectivity (DENZIN; LINCOLN, 2005; HANDFORD; GEE, 2023). Research is dependent upon the researcher and thus individuals need to be aware of their biases, preconceptions, and awareness in development of knowledge. This can also determine the theories, pathways, and lenses that the data is viewed through. The data and analysis produced is subjective and vulnerable to assumptions and perspectives taken by the researcher, meaning that there are possibilities for alternative interpretations (HAMANN, 2009).

Generically qualitative research is a situated activity that locates the observer in the world. In this world the research consists of a variety of empirical materials such as interviews, artifacts and relevant cultural texts, and is filtered into a series of representations (DENZIN; LINCOLN, 2005).

In this study, interviews were conducted, artifacts were created by the students, relevant cultural texts were created by both teachers and students, and observational notes of the different emotions and reactions during the interviews were recorded by the researcher. The stories and experiences that participants shared, including those of the researcher, are valid and valuable to the progression and contributions of this investigation. All the texts and artifacts provided possible further elaborative explanations of how one can come to look at the foregrounds and mathematical identities of Black students.

In this way, this study is qualitative and ethnographic, as I am using artifacts and texts from their perspectives and thoughts to produce knowledge and voice their stories (DENZIN; LINCOLN, 2005; MOERMAN, 2010; SCHENSUL; LECOMPTE, 2013). The general goal of this research is to learn more about the development and growth of African-American students' foregrounds and the correlation between their foregrounds and mathematical identities, as well as assisting in building their confidence in mathematics. To achieve this, the perspectives of students and teachers are explored, including their thoughts and feelings about mathematics.

Some aims and interests of the research are:

- Learn about the different influences and contexts of Black students' lives in Newark, NJ, to discover more about their foregrounds. What are the effects on their motivations and education?

- Learn the different ways in which Black students can identify with mathematics. How is this connected to their foregrounds and their lived experiences?
- Discuss the different ways in which racism still exists in mathematics classrooms in Newark, NJ, and the obstacles it creates (visually, physically, and non-tangibly).
- Explore the possibilities in mathematics classrooms in Newark, NJ for embracing students' mathematical identities, foregrounds and contexts, and providing ample future options.

These aims and interests initiated with the author and evolved into more robust ideas and considerations through conversations with professors and the author's research group (Épura). In this chapter, I describe how the path of this research was created, the participants involved in this research, and how the data was produced and analyzed.

6.1 Research journey

This research aims to understand the multiple differences and possibilities that exist within the process of learning, understanding, and identifying with mathematics (MARTIN, 2000; MATTHEWS, 2014; ROBERTS, 2018), and its focus is the possible connections between their mathematics learning and their future aspirations. Through this study, I engaged in conversations with students and teachers about their experiences in and out of school (NASIR; MCKINNEY DE ROYSTON, 2013). There were many interesting stories shared. The methods selected to carry out this research are varied, as this study takes inspiration from multiple theories when viewing and analyzing the data (CRESWELL; HANSON; CLARK PLANO; MORALES, 2007; DENZIN; LINCOLN, 2005).

In this sense, a path is laid out that is formed of different segments and bricks. Each of these bricks may be of a different shape and size in some moments, possibly the same in appearance at other times; this may depend on the individual or the topic of focus. This theoretical path can be used to move toward future understanding and improving learning opportunities for Black students. To understand the possibilities, it is necessary to understand the experiences through the perspectives of students (FRANKE; WEBB; CHAN; BATTEY *et al.*, 2007; VARELAS; MARTIN; KANE, 2012). There is a gap in the literature when it comes to middle school Black students' experiences and attitudes in relation to mathematics, which is one reason this study's focus on the connection between mathematical identities and foregrounds. In this study, the perspective of teachers is also considered because of their pertinence in mathematics

classrooms, and influence on student learning (AGUIRE; MAYFIELD-INGRAM, 2013a; CORTAZZI, 1993; MATTHEWS, 2020). A goal of this study is to move towards furthering possibilities in mathematics learning for Black students; to do so, one must have paths to proceed on. All of the fragments of a path compose a potential journey. These pieces are made up of the ways we perceive, what we believe, and how we identify. Through this research, segments of the path are built through these components of the participants, myself, principal theories of this thesis, and chosen strategies for methodology and analysis, shown through a theoretical Path Forward Through Inquiry (See Figure 5).



Figure 5: Path Forward Through Inquiry

Source: Author

The hexagonal bricks chosen for the methodology path are grounded in theory and narratives. While it is necessary to rely on theory in scientific inquiry, observing the phenomenon while realizing the theory is not the only possibility permits further learning and alternative perspectives (WILLIAMS; BLACK; HERNANDEZ-MARTINEZ; DAVIS *et al.*, 2009). Narratives allow the stories of those under study to be heard and recognized (MOERMAN, 2010). The methods were not completely established before the design of the study, but rather it evolved after considering what was necessary in order to capture an image of the desired occurrences with students and the ways in which they come to think about mathematics, as well as the importance it may have in their futures. The theories of foregrounds, mathematical identities, and backgrounds shaped the framework in which the study could be facilitated. It set the landscape for which to view the participants. The other aspects, assumptions, and possibilities, including the presence of the researcher and the participants, are the core of the study. Each of these parts of the path create the potential to move forward with knowledge that may otherwise have gone unrecognized.

In the following section I will describe the participants in this study, and then continue to explain how the data was produced.

6.2 Participants

The population of the study are Black and impoverished students, and their teachers, in Newark Public Schools (NPS) in the city of Newark, NJ. The students are in grades 7-8; this includes students aged 11-14. I have experience in working with this age group as a 7th grade mathematics teacher and grade K-8 mathematics coach; my assigned focus as the coach was to primarily support the middle school math teachers, who teach those aged 10-14 (i.e. grades 5-8).

“Middle school is an important period in students’ mathematical education. It is where important decisions are made about which students go to algebra and, perhaps, college-track mathematics.” (MARTIN, 2000).

During the middle-school period there are various important factors that are negotiated in terms of future academic opportunities, and possibilities that students come to envision for themselves. Students are still developing their mathematical knowledge, agency, and overall skills of communication; for the purpose of this study, I prefer to work with this grade band as I may potentially receive more in-depth responses about their self-perception and experiences in

mathematics during interviews. Students at this grade level are intent on learning algebra concepts and skills that will serve as precursors for advanced mathematics opportunities. However, not all students receive this opportunity, and there are instances where students are not even exposed to algebra in the 8th grade (GARET; WARNER; (U.S.), 2010).

There were a total of 20 participants interviewed: 18 students and two teachers. There was a mixture of 7th grade participants and 8th grade participants among the students involved (16 and two respectively). The teachers and students selected for this research were also participants in the Mathematical Thinkers Like Me (MLM) project, which is a study conducted through Rutgers University – Newark. The participants were selected from two schools, which are in the North Ward and Central Ward of the city. This diversification of schools provided a perspective of different realities for students, as well as insight into teacher vision and philosophy. I believe that this diversification of participants also contributes to the “representativeness” (CONE; FOSTER, 2006) and validity of this study.

Pseudonym	Status	Grade
Barbara	Teacher	7 th
Heather	Teacher	7 th /8 th
Alana	Student	7 th
Chase	Student	7 th
Destiny	Student	7 th
Fluffy	Student	7 th
Isabella	Student	8 th
Jedco	Student	7 th
Jordan	Student	7 th
Lacey	Student	7 th
Michelle	Student	7 th
Nate	Student	7 th
Omar	Student	7 th
Peter	Student	8 th
Petunia	Student	7 th
Robert	Student	7 th
Sophia	Student	7 th
Tiana	Student	7 th
Wade	Student	7 th
Xavier	Student	7 th

Figure 6: Research Participants

The teachers were contacted through email - one directly and the other through their mathematics coach - to ask about their interest in participating in the study. Both teachers were asked to present the opportunity of participating in interviews to their students, and students were free to volunteer to participate. For the students that volunteered to participate, notices were sent home to their parents to make them aware of the interview and to confirm that it was permitted to do so. Once I concluded the interviews with the students, I then interviewed the corresponding teacher. Before any of the interviews were conducted, an interview protocol³⁴ was read to inform participants that any participation in the interview is voluntary and that they are free to request to stop at any time.

6.3 How the data was produced

The data in this research was completely produced using two online meeting platforms, Cisco Webex and Zoom. The interviews took place after school and were recorded using the online cloud feature. Interviews were transcribed by the author using the Descript application.

Online platforms offered both strengths and weaknesses. Because the interviews were conducted online, I was able to meet with participants despite Covid restrictions, which would have prevented me from visiting any schools other than where I was employed. I was also able to meet with participants in New Jersey while located in Brazil. A weakness was the instability of internet, and some conversations were interrupted. Another was that there is no replacement for a face-to-face conversation. However, all participants communicated that they enjoyed the interview, some mentioning that they had not thought about their mathematics experiences or their feelings towards mathematics before.

An interview protocol was written for conducting the interviews. There were three versions of protocols due to the learning that occurred after interviewing students and furthering research in conducting interviews. Some students had a lot to share and to discuss about their experiences, future aspirations, and thoughts about the questions; others did not.

To gain more access to participants' thinking and experiences, multiple protocols were created to ensure a wider variety of questions and question styles. In the protocols, some questions

³⁴ The interview protocol is shared in the appendix.

repeat, but a distinct difference in the third protocol is that it is much reduced in the number of questions and includes the creation of an artifact by the students.

The questions were composed of three subgroups: 1) Personal Perception, 2) Personal Experiences, 3) Success and Future Outlook. Within each subgroup were questions related to the mathematics experiences in and outside of school, their perceptions of success in relation to mathematics (and in general), and their thoughts of future goals and possibilities.

In the following, I explain the process of conducting and analyzing the interviews. With this population I used the following strategies to produce the data:

Phase 1. *Interviews*: The interviews are semi-structured. The questions were formalized through discussions with the research group and based on what the author wanted to learn from the participants. Below are the questions presented from the third protocol³⁵.

Interview Questions

Personal Perception

1. Name and grade.
2. How do you identify racially?
3. Where did you grow up?
4. Describe your community.
5. What are your hopes and dreams?
6. Draw/describe a mathematician.
7. What do you think about mathematics?
8. Do you like mathematics?
9. What do you like/dislike about mathematics?

Personal Experience

10. Can you bring yourself into mathematics?
11. What about yourself do you relate to mathematics?

Success and Future Outlook

12. What do you aspire to be or have in the future?
13. Can mathematics help you accomplish your aspirations in the future?
14. Can you be a mathematician?
15. What makes you think so/what makes you think not?

³⁵ All three versions of the protocol are in the appendix.

Depending on the responses and reactions given by participants, additional questions were asked, or deeper inquiries were made. The purpose of the interviews was to gain more understanding of the participants' perspective of mathematical experiences, influences of mathematics in their education and culture, and their experiences in mathematics education as learners and educators.

A goal for student interviews was to understand their senses and feelings regarding mathematics. This will offer deeper insight into how students identify and see themselves in mathematics, their opinions of their own mathematical abilities, and their belief in mathematics giving them chances to advance in life, as well as how mathematics is embedded in their lived experiences. I was also interested to learn more about their views of success and what their future hopes and aspirations are. I wanted to know how mathematics played a role in any of their future plans and interpret any possible connections.

In teacher interviews, I inquired about the student expectations that they have, their view of student performance and ability, their opinion of mathematical identities, their training and experience in mathematics and mathematics education, their experiences as learners, and what their beliefs about mathematics are. I believe that this can give insight into how teachers communicate and teach mathematics. There may be correlations with how they teach, and how their students come to learn.

The interviews are interrelated because I interviewed the students of the teachers that are involved in the study. In this way, I used a between-participants approach as there were also comparisons between the respondents.

Phase 2. *Analysis*: This phase considers the analysis of the data, which is discussed in detail below.

6.4 Analyzing the data

The study examines the role of mathematical identities and the correlation of foregrounds, the perceptions of Black students' abilities and those of their teachers, and how one perceives one's

own ability to succeed. Because of my interest in understanding identities and foregrounds, to analyze the data I used a blend of thematic content analysis and narrative analysis.

The history of content analysis started as early as the 17th century. The first texts were hymns and songbooks, analyzing the lyrics of these texts, determining whether the lyrics should be viewed as literal or metaphorical (as some scholars noticed that symbols that appeared in the songs did not always occur in the same contexts as they did in the song or those taught in official churches). However, content analysis was more widely used during the 20th century as there was a sharp uptick in the production of newsprint. Scholars analyzed this text for evidence of the newspapers communicating “news”, and carried out in-depth analyses of the meaning and purposes behind the content and context of print. Over time, newspapers elected to use more space in print for gossip, entertainment, and sports (KRIPPENDORFF, 2004).

During the early 20th century, there was an emergence of intellectual growth in content analysis, with an increase in acceptance of the theoretical proposition in the behavioral and social sciences. An important concept also arose during this time, which was “attitude”, which added evaluative dimensions, redefined journalistic standards of fairness, and opened the door to the assessment of bias (KRIPPENDORFF, 2004). The perception and interpretation of “attitude” allows additional layers of one’s story to be told. This can be communicated through direct words or body language and reactions. Therefore, much can be communicated through the stories of others, and inferences can be made through their experiences.

Various interpretations and inferences can be made from content and experiences that are shared verbally. One can analyze tone, body language, and the words used to describe said experiences. Thematic content analysis considers the distinctive themes that are deducted from the data by the researcher (WHEELER, 2022).

Through discourse, individuals can communicate their experiences and perspectives. Williams et al. (2009) argue that it is possible to understand how aspirations can evolve, how identities grow, and how key moments are said to deflect trajectories in significant ways for the students through the analysis of their narratives.

Thornborrow (2023) states that: “We structure our experiences, account for our actions and display our understandings of the human condition to others through the stories we tell.” Discourse

gathered from participant interviews can be used to gather information about the core narratives and counter-narratives, therefore opening up pathways for connections to individual narratives and the given investigation (THORNBORROW, 2023). Through narrative analysis, one can observe different processes of social identity construction. Social identity construction is dependent upon context. Meaning is related to content and context. To explicate the meanings it requires stating the context of the participants (MOERMAN, 2010). Their context can then be drawn back to the overall social investigation and proposed questions.

Narrative analysis provided a framework to examine the experiences of others and make connections to aspects of their mathematics learning and to the concepts of foregrounds and mathematical identities. As Thornborrow states, it gives insights to the core narratives and counternarratives of one's identities and foregrounds.

To understand and analyze the data it was necessary to listen to and watch the interviews multiple times. With each view, more could be learned, or a new feature might arise. Through these various viewings, many themes arose. Below I present a table of the principal themes that I noticed.

Racism	Mathematics Identities and Speed Obsession	Learning Environments/How to See Mathematics	Black Students' Foregrounds: Evolutions and Deformations
Experiences that correlate an individual's racial identity with their mathematical identity; Experiences in general that correlate with racial identity and ability	How individuals identify with mathematics; How individuals choose to communicate mathematics; Individuals' beliefs about mathematics	Different environments and contexts in which individuals learn and communicate about mathematics; Different contexts in which individuals see, understand, and enjoy mathematics; Includes a spectrum of different feelings in mathematics and activities that involve mathematics; Moments where students feel safe or unsafe	Perceived conceptions about success and failure; Possibilities and fears of the future; Limitations and aspirations

Figure 7: Themes through analysis

These themes are further explored in the following chapters. Below, I will discuss the ethics of the research that were taken into consideration.

6.4 Ethical Considerations

When conducting research, there are many ethical considerations one must consider, such as not harming the participants, or putting them in an unsafe situation, so as not to taint the research or the knowledge that can be produced from the inquiry (O'REILLY, 2012). Many precautions were taken, especially because there are minors who are involved in the study. This project was added to the Institutional Review Board (IRB) request of MLM and was granted access to the participating middle-school classrooms in NPS.

As stated above, there was a protocol that was communicated to all participants before starting any of the interviews. Full consent was gained from the teachers and the legal guardians of the students to allow their participation in the study. Full disclosure of confidentiality and purpose of the research was dispersed to all of the individuals involved and their families if necessary.

To protect the identities of the participants, pseudonyms were created by the participants themselves to assure anonymity. As the researcher, I was aware of making sure that participants felt comfortable during all phases of the interview, and they were reminded at the beginning of the conversation that they were permitted to stop or request a break at any point. At the conclusion of the interviews both students and teachers were posed the question of "How do you feel?" to gauge whether or not participants felt the environment was safe.

In the following chapter I will present the participants in more detail, along with the data of the study.

7. Presentation of the Participants

In the previous chapter, the methodology of the research was described. Because the interview data in this study is extensive, only the data chosen for the analysis will be shared in this chapter and throughout the analysis chapters to follow. Therefore, this chapter will serve as an overview of the participants whose data was used for the analysis. In each of the summaries, there are some field observation notes taken during the time of interviews and post transcription.

A total of 20 participants were included in the study. For the analysis of the thesis, the data from ten interviews was selected: eight students and two teachers. These ten interviews were selected because they provided greater connections to the themes that arose. Each interview could be correlated with the experience of another helping to express the experiences of the students and educators involved. The interviewees included in the analysis are Barbara, Heather, Isabella, Robert, Omar, Petunia, Michelle, Jamar, Nate, and Tiana.

First, I will provide details of the student interviews, followed by descriptions of the teacher interviews.

7.1 Presentation of students

Below is the interview transcript data from the students. The interviews were conducted over Webex or Zoom, and they were recorded. The recording captured the entire conversation; the data below are snippets from a larger data set. I asked students about their mathematical identities and their experiences so far in and out of school, both regarding mathematics and in general. We also discussed dreams and aspirations they have for the future. I recorded some notes below on what I observed from the interview as well as notes embedded in the interview if silent reactions were made.

Summary: Petunia Interview

Notes on Petunia:

- Mathematics can be hard and cause stress, but not to the point it wants to make her quit or give up, at least not all the time.

- Feels confident in mathematics and has had a lot of success so far. She does well in mathematics, has high grades, and has participated in mathematics contests and events.
- Success in mathematics not only means doing well, but also understanding.
- Aspires to be different things in life, for example, a singer, a (computer) hacker, or a designer.
- At times she feels underestimated because of her background and where she comes from; doing well in mathematics allows her to feel like she is overcoming this feeling of being underestimated.

Petunia's Data:

Petunia: Um, I dunno, like, um, I don't know. A lot of the time I feel underestimated because of where I come from and I just. I just like to prove people wrong and doing good in math helps me with that to prove people wrong. And it really has helped me become who I want to be. And like what I want to do. Like, I want people to look at me differently than what they did look at me like.

Petunia: I've seen a lot of people doing like their work and like math and everything to impress people because of the kind of family they come from and where they come from. Because of my parents, there was a point where I tried to do that, and I realized I didn't have to impress anyone just to feel good about myself. So, I just seen a lot of times where people were trying to impress their family with their work or their math or like anything really, that's just a lot of the stuff I've seen.

Petunia: Okay. If you come from a Hispanic family and if you come from an immigrant family, a lot of the time they want you to do really good for how hard they worked to be here. And maybe in like a house that is either Hispanic or if you're African American or Black, or like if you're Asian, like a lot of those, like yeah.

Summary: Michelle Interview

Notes on Michelle:

- Mathematics can be hard and cause confusion, but she maintains a positive mindset towards the subject.

- Aspires to be a doctor or a therapist.
- She believes that it is a privilege to learn mathematics and it can have an influence on your success in the future.

Michelle's Data:

Michelle: Well, that's a good question. Um, racial identity wise with working as math, I have seen people outside looking at me when I'm helping my dad calculate something, looking at me like I'm weird because I'm Hispanic. It's based on my race. So, I would see myself having a little bit of issues depending on the person.

Michelle: Not really, because I feel like every person has, it's not just because of the race that can make a person be good at math or not be good at math. It depends on how person, how that person understands.

Michelle: Sometimes I would see people look at other people that have different races than them look at them. Like, like I said, it's just, wow, they can do it. And they're different from me. Why can't I do the same thing or sometimes it'll be the same race. Oh, they have the same race. They're Black and I'm Black, but why can't I do it. So, I guess some people get confused or some people get offended by it.

Michelle: We use everyday examples to actually represent what we do. [...] exponents, fractions, multiplying, dividing, length times, width, base times height. And right now, I'm learning about population and that's my favorite so far.

Michelle: We're learning about populations and samples, we were talking about how a person can use a population for voting for rights.

Michelle: Well, using math outside, helping calculate money. Helping my father calculate what he needs to design, how much the length is, how much the width is base height. I try to help at times to design things cause length and width, I don't know if I mentioned this earlier, but length and width is also easier for me.

Summary: JamarChase Interview

Notes on JamarChase:

- Mathematics can be both easy and hard. Although there was evidence in the interview that he feels very confident in mathematics.
- Talks about the increased focus allows him to do better in mathematics, but getting distracted can cause the mathematics to be more difficult. Sense of ownership and responsibility for his own learning.
- JamarChase is able to observe his father and how he plans to do flooring. Watching his father do epoxy flooring piqued his interest, as it involves aspects of mathematics, but he does not talk about mathematics directly or explicitly.

JamarChase's Data:

Jamar: As of right now, I am pretty confident.

Jamar: Because I'm like learning new concepts, like kind of quickly.

Jamar: Because in mathematics, most of the time, like science and stuff like that, as say an architect you'll need to use like math in order to like sculpture and design the place. Sometimes, you know, just in case you need to find a job, like a quick, like little job, like for example, you might work as a cashier at a store and you'll need to like make quick calculations in order to, um, give the customers their change back.

Jamar: It's my dad. He does like epoxy floors and it's kind of similar to architecture. I was actually kind of interested in that. Usually now when I go to high school, I'm like looking for like a high school with architects.

Summary: Nate Interview

Notes on Nate:

- Nate was overall gave brief responses during the interview.
- Confident in mathematics and is not afraid to be challenged. In fact, it is what he enjoys most about mathematics.

Nate's Data:

Nate: Sometimes I am rushing with things that I find easier. I move fast and I'm done before everyone else.

Summary: Omar Interview

Notes on Omar:

- Does not really like his community or living environment; it inspires him to be better.
- Perceptions of mathematicians are old White men, typically shown in movies or other forms of media.
- More comfortable doing mathematics quickly; doing it faster makes him feel that he has a better understanding.
- Tough on himself when he gets things wrong.

Omar's Data:

Omar: Like when you really understand it, it's fun because then you like, let's see, then you start to, well, then the class gets easy and then you're done faster.

Omar: Yeah.

Omar: Yep. Well, some things.

Omar: I would like to learn it quicker... But if I don't understand it, then I would take time to learn it.

Omar: Nope... Like if we have to learn it quickly, like to get through, like to get to something like a test, I would, I think that that would help me focus more because of like, let's see, because of like the thing that's approaching. So, yeah.

Omar: When I have to move slow with the other people. If they don't understand it, and I do, I don't wanna sit on something for that long...When we're doing something on like the smart board and then the people keep guessing wrong, that just makes me mad cause what are you doing?

Omar: Well, me. Like understanding things fast, that makes me feel like I'm doing something right.

Omar: Because that's usually what I see.

Omar: In movies.

Omar: Like a white man with a beard, a hat. And with severe back problems.

Omar: Retarded.

Omar: Because it'd be a whole bunch of, you know, people who be wildin out there.

Omar: Just wildin. I wanna leave it right there.

Omar: To not be like those people outside.

Omar: Like probably finishing college and not being outside selling drugs.

Summary: Isabella Interview

Notes on Isabella:

- Describes her neighborhood as both calm yet dangerous in some moments.
- Not too enthused about mathematics and not too certain about its purpose.
- Has a peer who does mathematics quickly; she uses this as a measure of a good mathematician.
- Has a desire to work with fashion or interior design and is motivated by a close family member.

Isabella's Data:

Isabella: Jerome, one of my classmates, Jerome, he's very, he doesn't really know how to explain things, but he's like a quick thinker and he like can grasp onto like any sort of information whatsoever.

Isabella: Yeah, he's quick.

Isabella: Um, no. I feel like it depends on how quickly you can understand something. Doing it quickly can cause like a little bit of like mess ups and things like that. Being able to understand it quickly helps you move quickly.

Isabella: Yes.

Isabella: The South Ward.

Isabella: It kind of depends on the season really. Winter is kind of dull. And summer is kind of like the crime rate goes a little bit upward.

Isabella: I think most of them do like security jobs.

Isabella: I don't think so. No.

Isabella: It's kind of like mixed emotions, you know? Sometimes it's like fun cause I know what I'm doing and then other times it's just like, why do I need to learn this? It's like, okay. Kind of confuses me.

Isabella: Multiplication, working with variables, I'm good with variables. Um, okay. I think that's [it], like multiplication, division, and like variables.

Isabella: Like right now we're doing geometry. This is like the most confusing subject I've done in math. There's like so many rules and like all these like terminologies that you gotta remember. It's kind of difficult.

Isabella: I want to do acting or future in fashion design. And mathematics doesn't really relate to that. I guess like when it comes to like percentages and stuff like that. That's probably good to know since I have to do like management sometimes and like money and like contracts. But other than that, I don't think so.

Summary: Tiana Interview

Notes on Tiana:

- Reflects on life moments and how they apply to mathematics; for example, working in a corner store. Everyone uses mathematics.
- Aspires to attend Rutgers University and wants to become a doctor.
- Seems to have an awareness of how others observe her, and is empathetic to other's experiences.

Tiana's Data:

Tiana: I feel like that there will be, for some reason I don't, I'm not sure if this is actually gonna happen. I feel like some people are gonna judge me by the color of my skin, basically racism or so, like people saying I'm not smart enough or I'm not like some people that, that's trying to put me down to what I really wanna do.

Tiana: No, but my cousin, as I said before, she's been through this and I'm scared that I'm gonna be through this too. Cause she's still going through it. She's telling me that she's getting used to it, but she still doesn't like it. I wouldn't like that either.

Summary: Robert Interview

Notes on Robert:

- Robert enjoys mathematics and shares a lot of his emotions in relation to mathematics. He believes mathematics is the way to a better life.
- Wants to be a professional football player.
- Sees mathematics as one of the most important subjects to learn to be successful.

Robert's Data:

Robert: Nervous.

- Robert:* Yeah.
- Robert:* Hmm. Pretty much mixed feelings. Sometimes it be a little hard, easy, but always find a way to get through it.
- Robert:* Yes.
- Robert:* Um, happy, sad, mad, um, nervous. Courageous, curious, and a lot of determination towards fixing the problems.
- Robert:* A lot of new stuff. Multiplying decimals, dividing, wondering when was this ever possible?
- Robert:* Hmm. It's like when we start the lesson, it's like impossible to do, but as the teacher explains, more understanding comes into play.
- Robert:* Okay, um, when. I get the answer correct or able to help somebody that doesn't understand. Just brings joy.
- Robert:* How do I say this If I get something wrong, like wondering how I got it incorrect? I did everything correct, but probably messed one thing up.
- Robert:* Yes, sure. One of my favorite subjects.
- Robert:* You find out a lot of interesting things with math that involve the real world. Same thing with science in but math, it's an everyday thing. Money. Mm. Buying something. You're in debt. Anything that involves math could be used.
- Robert:* Yes, it very much can.
- Robert:* Like I said, you use it in real world. Um, you can make it far in life knowing a lot of things about math. Because in some states in life, if you don't, if you're not good at math, you won't make it as far and you don't wanna just give up cause your life could go downhill pretty quick.

7.2 Presentation of teachers

Below is the interview transcript data from the teachers. The interviews were conducted over Webex or Zoom, and they were recorded. The recording captured the entire conversation; the data below is made up of snippets from a larger data set. I asked teachers about mathematical identity and their experiences so far in and out of school, both regarding mathematics and in general, including their experiences as students and as teachers. We also discussed dreams and aspirations they had when they were younger. I asked them about their philosophies of teaching, and about their relationships with their students. I recorded some notes below on what I observed from the interview as well as notes embedded in the interview if silent reactions were made.

Summary: Barbara Interview

Notes on Barbara:

- Barbara is highly passionate about teaching mathematics and loves teaching urban students. She has experience in teaching in special education and she brings that approach of diversifying lessons for her students to her current classrooms.
- Establishing a safe and welcoming environment with structure is a priority for Barbara. This environment is vital for embracing and nurturing students' potential.
- As a person who experienced hardships while growing up due to her ethnicity, she identifies with her students and the struggles they may have currently. Understanding these struggles, she does not use this as a crutch; rather, she acknowledges that these circumstances exist and do not limit their ability academically.
- She shows gratitude for her students and the ability that they bring, and the support that she receives from staff at her school.

Barbara's Data

Barbara: I think so. I think so for sure. I mean certain times, definitely, when I went to college, I did my undergrad at Montclair state. Definitely for sure. I remember I had to go through an interview before I got into the school, even though I had already had an acceptance letter I had to go to an in-person interview. (This is not a usual occurrence)

And it was mostly because they couldn't figure out what my ethnicity was based on my name. They just couldn't figure it out. Cause I only put the first four letters of my first full name. I didn't put the full name on anything because that's what I went by. Everybody knows me just from that nickname. Nobody uses my full name. So, I was like, why do I have to go? I already have an acceptance letter, but I guess they just, you know, they wanted to, you know, see what my ethnicity was, but I felt like I was, you know, throughout college, even to when I did my student teaching, like I remember struggling through my junior year.

Because I was placed in a district that was not predominantly my people. It was not people of my color. And I remember struggling through the junior field. And I remember when I went into student teaching, like literally like having to prove myself every single day. And you want this lesson plan here it is. You want me to teach this unit here? I'm gonna teach the unit. What else do you want me to do? Literally, that was what it was. Whereas other people that were not of my color were having like the time of their life in the same school that I was in so for sure. Yep. There's been some ups and downs.

(This was at a Predominantly White Institution (PWI), and the people judging were predominantly White)

Barbara: I feel like in all these years of teaching, um, and coming across students of many races, I mean, I've had students who I can say something one time and it's like, they're brilliant. They can do all the work, but they can't, they can do it procedurally, but they can't do it conceptually. So I'm like, okay, so you could do it this way, but not this way. But I don't think it has to do with race. I don't think that has to do with the learning. I really think that it really comes down to how much the educator is willing to put in because every child can learn. You know, I've always, I'm a firm believer that every student can learn. It's just the way that you can reach the child. It took me years to understand this before you can teach, you need to be a person, like you need to know who you have in front of you. Once you break through and you know, who's in front of you, that's it. You can teach them anything.

Barbara: She was just so just so, just. The way she kind of finessed like the math for us, like the way she spoke to us. It just kind of all like came full circle. Like she was a person, she made it known that, you know, I'm human just like you, and we're all gonna make mistakes, but she would always tell us we're all in this together, and we're all gonna get through this together. She was just like; she was just so caring. She was just so compassionate. She loved math, like the way she spoke about math, like her eyes lit up and I was like, wow, I wanna have, you know, and that was probably the only class that everybody was like, so quiet and attentive in was in her class.

Barbara: Yes, exactly. It's really about building those relationships, not just speaking of math, but just in general. That's the best part. I love doing that just in general.

Barbara: So, oh my God. They're so great. It's a beautiful thing. Yeah. It's a beautiful thing to see. Like it's making, it's making me smile. Like it just, yeah. They're so, oh my God. It just, that is great. Yeah. It's such a blessing. They're really, they're really so great. Like, you can walk, like you can walk into my class at any given time and like, it's just like the environment, like, and everybody says it.

Barbara: They're like, oh my God. Like the environment in here, like they just like, they love it. One of my things is organization. Like, I, I always tell 'em I have a little OCD, so I need things to be organized. You know, a clean room is a happy room and they get me like they know when it's time to like go, they cannot leave things unorganized. Like the floor has to be swept. Like they know, and it's not like I'm telling them you need to do this, but they just know like they get me, they know. You know, and that, that relationship with them, that since September, it's just, it's just great. And I'm, I'm so proud of all of them. Like all the ones that I recommended for the interview. I'm like, yes. Yes. so proud of them.

Barbara: Always. It's always been like that. And even this year doing like the interactive notebooks with them, you know, just they're literally on

autopilot with the notebooks. They know what to do. They know where to open to. They know, they know a table of contents has to be updated daily. Like they already know that and they know it has to be organized. They know everything has to be in its place. And I always tell them everything belongs in its place. We need to keep everything organized. But I feel as though that fosters an environment that is welcoming, like they like that. Like they know that they're being welcomed into the classroom. I have Glade plugins in the wall and the room smells nice. [...] but it just fosters like that type of environment. And they love it. They absolutely love that everything is clean. They love that things are organized, that if they need to find something in the classroom, they don't have to like rummage through things they know right. Where it is. So, yeah, it's that type of environment.

Barbara: My experience in Newark has been fine. I feel as though I'm very blessed to have people that are supportive, especially admin and our math coach. I'm definitely very blessed in that manner. I can't really complain. Last year there was a lot of like struggling through the material and the curriculum, because I didn't know it. But this year I'm like, oh, I know it. I know this, I already know this. I know what's next. I know the next unit. It's good, but I will say that having a team in place to support.

Barbara: I went to an urban school district and I excelled just fine. And I feel like if students just have that consistency with all educators that they will excel just as well. And they have as much opportunity as any other student in any other district. When I worked at St Benedict's, I would always tell the students, it doesn't matter, cause we were right in the center of Newark, Martin Luther King Boulevard. I just, I fell in love with the city. I fell in love with the culture.

Barbara: I bump into students that I had, and I'm like, I'm sorry, I don't remember your name, but they're like, oh, I'm, I'm a physical therapist. You know, because they doubt themselves, you know, when they're in the city of Newark and they're, you know, walking to go to school, you know, they doubt themselves. Well, you know, I'm not in this district, so I can't do anything. Well, you can. And I always tell students, I'm like, you always have to remind yourself that education is the most powerful weapon that you can have against the world.

Summary: Heather Interview

Notes on Heather:

- Prioritizes developing relationships with students. Shows support to her students even if they are not part of her classroom.
- Sees mathematics as joy.
- May view mathematics as more procedurally in moments. Has a desire to learn mathematics in a more conceptual way so that she can better support her students.
- Did not start off as a teacher. Actually, never wanted to teach when she was younger. Decide to teach after a stint of working in corporate environments.

Heather's Data:

Heather: Um, no. I would say no. I've been, I would say for the most part I've been fortunate, in math. Math. I like math. I've always liked math. Um, even like in college, I had a Black professor for my math teacher. So like, when I think about it, I think, I can't remember, junior high school so much. High school, I had a few Caucasians and, elementary, I had predominantly Black, they weren't male, but I had predominantly Black teachers. So, I don't think that really impacted me. Sometimes I see it. The attitude. Yeah, I don't see it in the sense that like, when we look, at like, test questions and like the biasness or, just when you just look at the real world, right? You look at all the examples past, um, not so much present, but you know, you can see the biases, but I've never, I don't feel, I've never really experienced it. Like, I've been fortunate in that way. You know what I say that, and this, not mathematically, but I remember in high school, talking, having a meeting, and they were saying that others felt as if the person was rushing me along. I went to predominantly White high school. The person was rushing me along and they were like, that's rude. But maybe I was just oblivious to it. Like I didn't even, like, it was a after.

Heather: I did go to a workshop on that and that workshop also, I feel like it gave me a better insight on the curriculum and how better to use it because was just given to us. But we don't really have the planning time that we should. I think it's a combination of the time, the time allotted and the expectations within that timeframe. So, it is twofold. That's what I was saying before when I was talking about that system of equations, we didn't really go into it.

Heather: The lower academic ability needs more time to be able to think. Even though it's a pacing guide, it's so jam packed with so much stuff. It's like the lessons are supposed to be for 50 minutes and I'm not taking 50 minutes to do my lesson. Actually, I sat with my VP one day and we went through, we planned the lesson together and when we planned the lesson, I looked at her, I was like, with my kids, I don't think we could do this in 50 minutes. She said, nah, you got it. The abbreviated version. I had to call out and she ended up covering the class. She actually taught the class, and she took the

entire block, which it was supposed to be half of the block. She took the entire block to do the lesson with both classes.

PART III – PRESENTATION OF THE DATA ANALYSIS

The themes are related back to the theoretical notions of mathematical identities and foregrounds. Each theme is interdependent, and one can certainly come to see the interconnected possibilities of all themes in relation to the theoretical framework.

8. Perceptions of Racial Experiences

Injustices in education happen in a variety of ways. Over the last few decades there has been tremendous growth in educational opportunities and attainment for Black people in the United States. However, there still seems to be a pessimistic view when correlating Black students and mathematical ability (MADKINS; MORTON, 2021; MARTIN, 2009c; 2012). The negative impact that this has on students' self-perception can influence their mathematical identities and how they come to view its importance and relevance in the future (MARTIN, 2009b; NASCIMENTO, 2004; THOMPSON; CARTER, 1997).

Struggles in mathematics for Black students can be caused by unreliable and biased data tracking, inequitable opportunities, and occurrences in educational spaces that may cause them to think disparagingly of their mathematical abilities. This contributes to preconceptions that Black students do not prioritize, have pride in, nor care about their learning (BATTEY, 2013; GHOLSON; WILKES, 2017).

Education is essential to further one's future and attain a quality life. Mathematics has proven to be an indicator of opportunities to gain an occupation with higher wages, which can aid in the production of a life with higher quality. In a study by Battey (2013), the wage-earning differential between racial groups in the United States was examined, determining that there is a significant difference between high-earning occupations gained by White people as opposed to those low-earning occupations gained by Black people. This disparity is a consequence of histories of inequitable education opportunities.

Lower expectations in academics, specifically in mathematics, can lead to the marginalization of knowledge, reduced confidence in one's ability to do math, and weakened mathematical identities (MARTIN, 2012; MOORE; GROVES PRICE, 2015). There is little attention paid to day-to-day occurrences in education systems (including those outside of academic spaces), and there exists a concealed layer of racism, maintaining some as subordinate participants academically and socially. Social constructs such as the educational system leave Black students in a disadvantaged situation and lacking sufficient future career options, especially in mathematics and science fields.

“A necessary step in countering these negative social constructs is to acknowledge that racism including structural racism, institutional racism, everyday racism, and what has come to be termed colorblind racism - is a major factor contributing to these impoverished views of African American.” – (MARTIN, 2009a)

Acknowledgement is a possible key to progress in mathematics education for Black students. Following the realization of the existence of inequality, there needs to be thoughtful and compassionate change, with offers of equitable opportunities. Many African Americans experience racism every day, even in areas of the United States where some would assume it does not exist, such as the northeast region. However, some forms of racism are so minimal that it can barely even be detected, or is simply downplayed, which Martin (2009) describes as colorblind racism.

Tate (1994) argues that the neutrality and objectivity of academic mathematics portrays school mathematics as an accepted colorblind discipline. Consequently, cultural relevance may not appear to be important when it comes to mathematics learning. Although this argument was made three decades ago, this idea remains true in many classrooms and curriculum resources: one mathematics for all students, even if the materials provided do not align with the realities of Black students.

Bonilla-Silva and Yamashita (2022) define color-blind racism as the new dominant racial ideology anchored on the abstract extension of liberal principles to racial issues, furnishing seemingly non-racial explanations for race-related experiences in the process. In other words, racialized experiences are minimized through the argumentation for all to be equal and the improvement of circumstances for Black and Brown people to be appreciated as is. They provide an example of a White person referring to “affirmative action” as “reverse racism” as they believe in equal opportunity for all, therefore “affirmative action” for one group should not exist.

Ideologies such as these can minimize the racialized experiences of Black students (MARTIN, 2006). Attention to these experiences is greatly absent in research agenda (VALOYES-CHÁVEZ; MARTIN, 2016). It is necessary to amplify and speak about these experiences as they can affect one’s education and future encounters.

In this chapter, I seek to connect ideas of racism, pessimistic views of the mathematical abilities of African American students, and the ways in which mathematics knowledge and

attainment can be viewed from a positive standpoint. I will primarily use data that was produced in this study to provide examples of this through the voices of the interview participants.

8.1 Education and racism

Assumptions are made of people categorized within marginalized races. In the United States, for instance, those considered to be more competent in academics, especially in mathematics and sciences, are individuals who identify as White or Asian (AGUIRE; MAYFIELD-INGRAM, 2013a). Research shows that those attending advanced mathematics courses tend to be White and Asian, constructing an ideology that Black students are inferior (DAVIS; MARTIN, 2018). The consequence of this assumption is the negative outlook that others may have of themselves when hearing that White and Asian people are more competent when it comes to learning than other racial groups - primarily Black or Latinx students - especially in mathematics performance (BATTEY; FRANKE, 2015; DAVIS; MARTIN, 2018). On the contrary, Black students are considered as incompetent or low-performing when it comes to academics, and their very presence in advanced academic environments is sometimes questioned.

A teacher, *Barbara*, shares her experience as a student at a university in New Jersey:

Jamaal: Okay. Do you ever feel like you've been underestimated because of your racial identity?

Barbara: I think so. I think so for sure. I mean certain times, definitely, when I went to college, I did my undergrad at Montclair state. Definitely for sure. I remember I had to go through an interview before I got into the school, even though I had already had an acceptance letter I had to go to an in-person interview. (This is not a usual occurrence)

And it was mostly because they couldn't figure out what my ethnicity was based on my name. They just couldn't figure it out. Cause I only put the first four letters of my first full name. I didn't put the full name on anything because that's what I went by. Everybody knows me just from that nickname. Nobody uses my full name. So, I was like, why do I have to go? I already have an acceptance letter, but I guess they just, you know, they wanted to, you know, see what my ethnicity was, but I felt like I was, you know, throughout college, even to when I did my student teaching, like I remember struggling through my junior year.

Because I was placed in a district that was not predominantly my people. It was not people of my color. And I remember struggling through the junior field. And I remember when I went into student teaching, like literally like having to prove myself every single day. And you want this

lesson plan here it is. You want me to teach this unit here? I'm gonna teach the unit. What else do you want me to do? Literally, that was what it was. Whereas other people that were not of my color were having like the time of their life in the same school that I was in so for sure. Yep. There's been some ups and downs.

(This was at a Predominantly White Institution (PWI), and the people judging were predominantly White)

In this scenario, *Barbara* feels the need to prove herself to be intelligent enough or good enough to be among her White colleagues. Although they have the same responsibilities as her, *Barbara* perceives that there is more pressure for her to do well. Corlett (2003) claims that racism can be intentional or unintentional and is the result of ethnic prejudice and discrimination. *Barbara* deals with discrimination here, as she is subjected to a mandatory interview before accessing the university, although she had already received a letter of acceptance (her racial/ethnic identity could have been detected by her last name). This can be perceived as an intentional act of racism.

The racialized experiences that she had as a student teacher (junior field) may possibly be perceived as unintentional. The responsibilities that were given to her were within the scope of her duties in the junior field. However, her perception of the workload and expectations of those around her shows a possible disparity. While some of these experiences may appear to be minor or “little” to the other people she worked with, they can be an exercise of racism or prejudice (OLUO, 2019).

Barbara currently works with many students who identify as Black. She is fully aware that there is a possibility that their academic success may be doubted, but she shows belief in their potential. *Barbara* reflects on her years of teaching, and the observations she made about mathematical ability and race:

Barbara: I feel like in all these years of teaching, um, and coming across students of many races, I mean, I've had students who I can say something one time and it's like, they're brilliant. They can do all the work, but they can't, they can do it procedurally, but they can't do it conceptually. So I'm like, okay, so you could do it this way, but not this way. But I don't think it has to do with race. I don't think that has to do with the learning. I really think that it really comes down to how much the educator is willing to put in because every child can learn. You know, I've always, I'm a firm believer that every student can learn. It's just the way that you can reach the child. It took me years to understand this before you can teach, you need to be a person, like

you need to know who you have in front of you. Once you break through and you know, who's in front of you, that's it. You can teach them anything.

This reflection from *Barbara* is beautiful, and it echoes the theories from researchers that focus on race within mathematics education. Black students are more than capable as mathematicians (GHOLSON; WILKES, 2017), and they are entitled to have access to adequately trained teachers who are aware of their identities, racially and academically (MARSHALL; ROSADO; BATTEY; WILSON, 2022).

Barbara's attention to the need of her students rises above the apparent importance of standardized testing. Rather, it is about the potential of the students and how to *break through* (MATTHEWS, 2020). Aguire and Mayfield-Ingram (2013) claim that teachers' interactions with their students can stem from powerful experiences connected with race, class, gender, and culture. One can interpret the experience that Barbara had as a student who persevered through racism and discrimination as a motive to view her students as more than just Black or Latin, but as capable mathematicians, because all are capable of learning.

The inability to view students as capable Black learners, and the ranking of race in comparison with mathematical ability, is widely considered and overly utilized (JOSEPH; COBB, 2019). This contributes even more negative consequences because it can lead individuals to have less belief in their abilities to learn or to improve academically. The occurrence over decades has also normalized the idea that Blacks are not good at mathematics; at times, this can be communicated knowingly or unknowingly through teachers or other staff in school buildings, based on social constructions to maintain the ideology of inferiority of Black students when it comes to mathematics (MARTIN, 2009a).

In the data produced during this study, there are several students that share that there is no correlation between their racial identity and their ability or skills in mathematics. There are some instances where participants make notice of observations, but do not have the feeling that they have had the experience of racism themselves, or at least have not succumbed to the negative stigmatism that may come with academic racialized experiences.

8.2 Racial and mathematical identities

Strengthening the connection between a student's racial identity and mathematical identity should be a goal of teachers, school staff, and communities (Martin, 2009). An observation that I have made of my students, as well as people that I know socially and professionally, is that it is all too common to hear the phrase "I am not good at math" or "wow, you majored in math, you must be so smart!" I raise this point because many (at least 90%) of my students were people of color, as well as some of my personal friends and coworkers that I encountered through my different fields of work.

Observations of negative thinking in relation to mathematics by Black people does not mean that this happens for all students I have or have had, nor do I think it describes the standing or outlook of all Black students in other urban school environments. Another common occurrence is for students that do well to feel the need to prove that they are indeed smart enough, similar to the case of *Barbara*, to prove that they belong among those that are competent in mathematics (MILLER; WANG, 2019).

When carrying out data analysis, it was observed that there were various students that felt as though they were good in mathematics, and some that stated that mathematics was their favorite subject. An intriguing finding in the data is that most students identified positively with mathematics, even if they did not particularly like mathematics or it was not their favorite subject. I asked the students about their ability to do mathematics and the correlation between how they identify racially, and there seemed to be doubts, but they maintained their confidence about their ability in mathematics.

A student, *Petunia*, identifies as both Latina and African American. *Petunia* informs me, "[M]y grandparents are from Puerto Rico and Peru, and they're also African American, well, one of them and then the other one is ethnicity is like from Peru and stuff like that." *Petunia* is a 7th grade female student. Our discussion below explores the connections between racial identity and mathematical identity, as well as how she feels in thinking about this comparison and her opinions on the matter.

Jamaal: What connections do you see between your racial identity and your performance in mathematics?

Petunia: Um, I dunno, like, um, I don't know. A lot of the time I feel underestimated because of where I come from and I just. I just like to prove people wrong

and doing good in math helps me with that to prove people wrong. And it really has helped me become who I want to be. And like what I want to do. Like, I want people to look at me differently than what they did look at me like.

Above *Petunia* admits to the stress and extra mental load of thinking of the need to prove others wrong, and others may look at African American students as if they are not as capable when it comes to mathematics. In *Petunia's* response I also observe strength and responsibility as she makes a connection between her ability to learn mathematics and her future desires (SKOVSMOSE; SCANDIUZZI; VALERO; ALRØ, 2018). *Petunia* wants to be recognized and respected as a mathematician and competent student.

Another student, *Michelle*, who identifies as both Hispanic and Black, had this to say when asked the same question:

Michelle: Well, that's a good question. Um, racial identity wise with working as math, I have seen people outside looking at me when I'm helping my dad calculate something, looking at me like I'm weird because I'm Hispanic. It's based on my race. So, I would see myself having a little bit of issues depending on the person.

Michelle notices and feels that people may give her strange looks when she is doing mathematics. Here she is describing an example of helping her father with calculations, which it seems she enjoys doing, as she mentions it multiple times during the interview. In this case, although it takes place outside of the classroom, she correlates an awkward look while doing mathematics to be in relation to her racial identity. Although it seems like a fleeting moment, occurrences like these can be common and become a trending thought or preconception, possibly influencing future outlooks.

Experiences such as these can cause one to feel a sense of inferiority. This experience was based on race for *Michelle*. Blatant - or overt - actions of racism are not common everywhere in the United States (DOANE, 2006), but certain experiences can leave one feeling estranged in their surroundings. In *Michelle's* response, one can also see that she is aware that due to her race, she could be viewed as “weird” within the hierarchical structure of mathematics (MARTIN, 2009c).

Another student, *Tiana*, shares the same sentiments about possibly being doubted because of her skin color when asked about her future and potential obstacles to success. Below, she shares with me:

Tiana: I feel like that there will be, for some reason I don't, I'm not sure if this is actually gonna happen. I feel like some people are gonna judge me by the color of my skin, basically racism or so, like people saying I'm not smart enough or I'm not like some people that, that's trying to put me down to what I really wanna do.

Tiana states that she does not know if this is something that will occur for certain, but it is something that she has observed before or heard about. Unfortunately, this can become an extra weight on a student during the process of learning. Additional stress can infiltrate from a multitude of sources and influence students' racial and mathematical identities. Due to systemic and sociological structures, students can come to feel that they are not "smart enough". This is due to decades of perceived intellectual deficiencies (GHOLSON; WILKES, 2017) based on prejudice and racism (DU BOIS; ZUCKERMAN, 2004a). Gholson and Wilkes (2017), just like *Petunia*, claim that mathematics posits an opportunity to indeed show their cognitive status, and that they are smart.

It is not only schools that may communicate or place additional stress on performance in mathematics. It is possible that it can also stem from the community or from the home; parents can pass on their anxieties of math or overload children with stress about performing well on standardized tests. Martin (2000) states:

"We also need to consider the fact that although parents and community members can make pro-mathematics statements, indicating that it is an important school subject and that they want their children to do well, the legacy of their own mathematics experiences can sometimes unwittingly undermine these sentiments."— (p.128)

Formulating a healthy combination between racial and mathematical identities may also involve allowing students to find joy in their learning and not worry about the impression they are leaving on teachers, parents, or significant others in a student's life.

This may vary depending on the home environment that a student comes from. Home environment includes the neighborhood, as well as the members inside of the home. *Petunia* and

I engaged in a conversation about what she noticed about the correlation between math competency, those who have racial identities other than her own, and the influence of one's home environment.

Jamaal: What connections do you see between other racial identities and their interest and performance in mathematics?

Petunia: I've seen a lot of people doing like their work and like math and everything to impress people because of the kind of family they come from and where they come from. Because of my parents, there was a point where I tried to do that, and I realized I didn't have to impress anyone just to feel good about myself. So, I just seen a lot of times where people were trying to impress their family with their work or their math or like anything really, that's just a lot of the stuff I've seen.

Jamaal: Any specific races that you've seen doing this, like where they're trying to impress their family?

Petunia: Okay. If you come from a Hispanic family and if you come from an immigrant family, a lot of the time they want you to do really good for how hard they worked to be here. And maybe in like a house that is either Hispanic or if you're African American or Black, or like if you're Asian, like a lot of those, like yeah.

Being observant of my bias, it was a surprise that she included an African American home within the group of students trying to impress their families. In my experience in the city of Newark, parents seemingly showed little interest in academics; that is not to say that they did not care, or that all families did not care, but they were not concerned by it. However, I had a much different experience at a charter school that is also in the city of Newark. There were many active parents, and so was the school about active communication. The influence of the neighborhood, culture of the school, and the home can have an impact on how students view their academics and mathematics (MARTIN, 2000).

There is a plethora of reasons as to why there was limited communication between the home and school, just as there are many reasons why African American students seemingly appear to be less competent in mathematics. In many scenarios, there are factors unknown to the school which explain why families are unable to be heavily involved, such as the need to work more to provide for families, living outside of school zones to send students to a better school (even if the desired school is not a well-performing school), embarrassment about coming into the school (this can be due to many reasons, i.e., financial struggles, drug abuse, homelessness), or unawareness.

The direction to improving and aiding to solidify racial identities for students is to build awareness for school staff; this includes everyone in the building, and the community.

Although community plays a large role in how an individual may come to think, individuals have the ability to learn and determine their own ways of thinking as well. Conversely to ideas of African Americans not performing well in mathematics, *Michelle* shares in another moment that although she notices how she may receive awkward looks for her ability to do math, she does not correlate this with her own ability, or that of others. Below she shares her opinion on the correlation between racial identity and mathematics:

Michelle: Not really, because I feel like every person has, it's not just because of the race that can make a person be good at math or not be good at math. It depends on how person, how that person understands.

Above she states that there's no connection between an individual's ability to do mathematics and their race designation. Although this is her thinking, she does admit that she notices others do look at some people, she mentions Black people, as if there is offense taken when doing mathematics or that there may be some prejudice when considering some races and their ability in mathematics (GHOLSON; ROBINSON, 2019). She has this to say when observing other in class:

Michelle: Sometimes I would see people look at other people that have different races than them look at them. Like, like I said, it's just, wow, they can do it. And they're different from me. Why can't I do the same thing or sometimes it'll be the same race. Oh, they have the same race. They're Black and I'm Black, but why can't I do it. So, I guess some people get confused or some people get offended by it.

Here I understand that *Michelle* perceives that others may judge people on their skills in mathematics based on their race. It is possible that there is a bit of doubt in her ability due to race, but when talking to *Michelle* about her ability she was nothing but confident about it. I notice that she is also aware that individuals may become offended by the occurrence of awkward stares which could be associated with prejudice or racism. Gholson and Robinson (2019) claim in their MaJIC curriculum that for one to find success in the discipline (mathematics), one must successfully navigate prejudice and discrimination.

Stated above, it is important to raise awareness of this threat of offensive nature, which may be intentional or unintentional (CORLETT, 2003). It may also be a practice that is, unfortunately, learned over time as part of the culture. Raising awareness of these occurrences is a step in creating change. *Michelle* was not the only participant who observed instances of others receiving looks or insults for their race. In the following section I will share the experiences that participants had in a different context and how this may have changed their view of racist situations in regard to mathematics and learning.

8.3 Observing other racial struggles and their effects

Ray and Mahmoudi (2022) claim that racism occurs on three different levels: the first level is individual, where racism operates via attitudes and face-to-face social interaction. However, in these moments there are individuals who may not be the target of a racial attack or insult, but perhaps, racist actions are observed or are shared with a person whom that victim is close with. These instances of racism can have lasting effects on people, and in varying ways, can leave one damaged and quite possibly change their perspective on the world. This can have lasting effects on how one may view themselves or how they come to view others.

In the interview with *Tiana*, she shares an experience from her older cousin whom she is close with. Through their words, tone and body language during the interview, it seems that these moments shaped their thinking around how things are or can be when it comes to presumptuous thinking involving race and academics, as well as what the truth can be for people in other contexts. Her cousin expresses to her that she has had to deal with racism, and *Tiana* anticipates that she may have to deal with similar treatment. *Tiana* tells me:

Tiana: No, but my cousin, as I said before, she's been through this and I'm scared that I'm gonna be through this too. Cause she's still going through it. She's telling me that she's getting used to it, but she still doesn't like it. I wouldn't like that either.

She has an understanding that this treatment is wrong and that she would not like it. This experience of knowing someone close to her who shares similar physical traits is worrisome for how she may also be treated in other environments. This, in a sense, is reassuring that the current

school space and community are safe zones for her, as this is something that she anticipates will happen, and has not occurred to her personally as far as she has noticed.

Heather shares her experiences with racism as well:

Jamaal: Have you ever observed any doubts or praises for your racial identity and your ability to do mathematics?

Heather: Um, no. I would say no. I've been, I would say for the most part I've been fortunate, in math. Math. I like math. I've always liked math. Um, even like in college, I had a Black professor for my math teacher. So like, when I think about it, I think, I can't remember, junior high school so much. High school, I had a few Caucasians and, elementary, I had predominantly Black, they weren't male, but I had predominantly Black teachers. So, I don't think that really impacted me. Sometimes I see it. The attitude. Yeah, I don't see it in the sense that like, when we look, at like, test questions and like the biasness or, just when you just look at the real world, right? You look at all the examples past, um, not so much present, but you know, you can see the biases, but I've never, I don't feel, I've never really experienced it. Like, I've been fortunate in that way. You know what I say that, and this, not mathematically, but I remember in high school, talking, having a meeting, and they were saying that others felt as if the person was rushing me along. I went to predominantly White high school. The person was rushing me along and they were like, that's rude. But maybe I was just oblivious to it. Like I didn't even, like, it was a after.

To *Heather*, encounters with racism are more of an occurrence from the past. In her opinion, assessments and current day education do not present racialized forms of experience for Black students. However, it appears to have positively affected how she approaches the subject matter of mathematics. *Heather* had many models of Black mathematicians and educators in her academic career, a level of representation that researchers state is often absent yet important for Black students' mathematical development (MARTIN, 2000; 2006; MATTHEWS, 2018). At the end of her reflection, it appears that she started to perceive that there may have been a few moments of discrimination in her life that she may not have previously been aware of.

8.4 Acknowledgement and awareness

Awareness of an issue is the first step in moving toward solutions. Attention is being raised in recent research to the racialized experiences of Black students in mathematics education (VALOYES-CHÁVEZ; MARTIN, 2016) and education (CARTER, 2022). Through the

perspective of participants, racism in and outside of school settings can be sensed. There are underlayers of racism, possibly both intentional and unintentional, in our school systems and there is a need to improve circumstances for staff in schools and give guidance about attending to the development of racial and mathematical identities at all levels. This should also be considered for communities and at home. These interviews informed me greatly and I think they will be valuable moving forward in becoming more aware of how students feel and noticing their identities both racially and mathematically.

The interviews conducted displayed evidence of positive mathematical identity; however, there were noticeable disparities in how they were acknowledged for their abilities. There is still more left to be seen and researched with students who may have negative mathematical identities, with correlation to their racial identities, and how they feel acknowledged when it comes to their performance.

9. Mathematics and Speed Obsession

Earlier in this thesis there was a discussion of the way in which backgrounds influence foregrounds, and vice versa. The background of any individual involves their environments, cultural communities, observed practices, learned identities and behaviors (DIVISION OF HEALTH, 2023; ZAJDA, 2022). Their community is composed of their homes, peers, and their everyday and educational experiences. Through these experiences in our ever-advancing society, students come to learn that they need to do and accomplish things with an expeditious pace, and this is true for many areas of their lives - so much so that this can lead one to believe that learning at a quick pace may also prove that you are more advanced than others.

Speed allows one to move from one point to another in less time, but much is sacrificed in the process. For example, pictures and images can be blurred as you pass through; objects and ideas may be passed over because we do not take the time to look. The speed of the curriculum that is forced on students, and the high priority assigned to testing (BJÖRKLUND BOISTRUP, 2016) can cause important factors or meaningful moments to be overlooked and ignored, such as the thoughts, ideas, possibilities, and identities of students.

Speed can be learned through habits of daily life and beliefs that are instilled by one's community. The theory of students, especially Black students, coming to prioritize speed in mathematics learning is underdiscussed. In this text, I refer to this phenomenon as *speed obsession*. This way of thinking about mathematics can be passed on to students through the various education experiences they encounter. *Obsession with speed* considers the primary pragmatism of mathematics to be the act of doing and understanding quickly.

Learning mathematics in academic spaces can put pressure on both students and teachers. Due to fast-pacing, mathematics is typically taught within a narrow view and frame, often with worksheets or lessons that tend to be remedial (DAVIS; MARTIN, 2018). This burden is caused by the expectation of students having a certain understanding and mastery of standards³⁶ at the end of an academic year; this trend has taken over since the 1990s, from kindergarten to high school

³⁶ The standards in New Jersey are guided by the New Jersey State Learning Standards (NJSLs) and Core Curriculum State Standards (CCSS). To learn more information about specific grade level standards you can visit: <https://www.nj.gov/education/standards/math/Index.shtml> or <https://www.thecorestandards.org/Math/>

(CLEMENTS; DIBIASE; SARAMA, 2004). Many lessons and skills have to be rushed for students due to demands from greater governing and sociopolitical structures (KOLLOSCHE, 2017), oftentimes requiring them to learn based on memory and application of steps to meet the expectations of mastery to ensure success on assessments.

In academic spaces, forms of assessment to gauge students' understanding and progress are requirements. Mathematics is acknowledged as a highly important subject; it is necessary for students to pass or excel to access further and advanced education (DAVIS, 2022), and it comes with the requirements of high-stakes testing (MARSHALL; ROSADO; BATTEY; WILSON, 2022). Therefore, in most mathematics classrooms, the focus and priority are to teach mathematical skills and concepts which are organized into a curriculum with a fast pace to ensure that all students are exposed to the material before they take an exam, and this mindset of quickness is impressed upon students. Assessments are often what drive instruction in mathematics classrooms, and the assessments are created in alignment with the CCSS and NJSLs. Therefore, to ensure that students are demonstrating mastery in mathematics, students must reach a level of proficiency on these tests, but it does not necessarily guarantee learning for students.

A result of this mastery is the hope that students will perform well on tests and assessments to obtain a proficient score:

The potential problem with the current increased emphasis on testing is not necessarily the test, per se, but the instances when tests have unintended and potentially negative consequences for individual students, groups of students, or the educational system more broadly. (American Psychological Association, 2000)

As a consequence of increased emphasis, mathematics is taught in superficial ways that undermine the ability and opportunity for Black students to learn mathematics in an in-depth manner - a manner which could possibly help to resolve issues of students failing state mathematics assessments, or in a more significant way aid students in understanding how mathematics works and influences many of the happenings around them. The ways that Black students are assessed can be viewed as reproductions of racial discrimination and limit them to lower-level forms of mathematics to prepare for externally generated, unrelated tests (DAVIS; MARTIN, 2018; JOSEPH; COBB, 2019). It promotes the idea of achieving a sufficient score so that one can move on to the next phase in their education. These underlying racialized forms of experiences are

perpetuated through actions such as prioritizing proficiency on assessments, forcing an acceleration of teaching and learning to meet the demands of standard mastery (MARTIN, 2006).

The mindset of needing to be quick can affect Black students' mathematical identities, foregrounds, and experiences in mathematics classes, as they can come to believe that if they are not fast enough in their mathematical thinking or actions, they may not be good enough to succeed or have the opportunities to do well in mathematics in the future - on top of the more immediate consequence of receiving a poor grade. As a result, this mindset can have a negative influence on the way students perceive intelligence and possibilities in mathematics.

Students' mathematical intelligence does not only depend on their aptitude and ability to do mathematics quickly. Mathematical intelligence is cumulative based on experiences, and the ability to think critically, explain, reason, and utilize a variety of thought processes. These processes can involve students' dreams and preoccupations with their past or present circumstances, as well as their future possibilities.

Unfortunately, in many classrooms, students may be persuaded that mathematics is associated with the speed in which they complete the work, and their opinion of how quickly they are able to *understand* mathematics. I emphasize the notion of understanding here because the notion of speed of understanding or 'getting' a concept (DUNLEAVY, 2018) can be greatly exaggerated; producing answers and responses does not guarantee understanding, as understanding relies on many different cognitive abilities (CRAGG; KEEBLE; RICHARDSON; ROOME *et al.*, 2017). It is possible to memorize a set of steps and repeat them quickly without any true understanding of the concept.

In this chapter, I seek to connect the speed of mathematical environments in mathematics classrooms, the importance of speed in middle-school students' perceptions of doing and understanding mathematics, and the impacts that these phenomena may have on students' foregrounds and mathematical identities. First, I will discuss the connections between students' focus on speed in doing mathematics and some possible impacts it may have on their foregrounds, then discuss the obsession with speed through interview responses. Finally, I will endeavor to further discuss how the speed of one's thinking may be aligned with one's understanding.

9.1 Speed obsession and connection to foregrounds

Associating speed with high performance in academics, and specifically mathematics, can also affect one's foreground. The future that one might imagine for themselves could be rushed. It could be influenced by the need to do things only for the sake of passing an assessment or passing on to the next grade. It could be overshadowed by a habit of doing mathematics in a bubble where it is only procedural and there is no meaningful purpose; therefore, what real purpose is there for them to consider mathematics as part of one's future?

In this sense, foregrounds for students may be unenriched for a long period of time in relation to their mathematics education, leaving only their backgrounds to nourish their dreams. This is not a terrible situation for individuals. However, over time it may prove to be restrictive, and for some students the effects may be even more directive for the choices they make, or options that will be available to them, creating even more inequitable scenarios for these students.

As stated above, there is an emphasis that is placed on testing in mathematics education which influences the curriculum; therefore, it influences the ways in which teachers give instruction and how mathematics is communicated to students. As a result, one can see that students (and possibly teachers) are developing an *obsession with speed* in mathematics. Being successful in mathematics demands that three actions are present and occur as fast as possible: thinking, doing, and understanding.

This makes sense as tests are emphasized and prioritized; this affects how students must perform in class and, therefore, they associate the need to move and think faster with successful mathematics learning. Unfortunately, for both those that can keep up and those that are unable to, this possibility facilitates inequitable environments. There are long-term damages that coincide with poor performance on assessments, which then has an influence on students' foregrounds.

9.2 Prioritizing curriculum

The students were expected to solve these tasks rather fast and students in some classrooms competed to be the first one to accomplish these tasks. Hence, the textbook can be considered an artefact that affects the interaction towards "Do it quick and do it right". (BJÖRKLUND BOISTRUP, 2016)

Academic mathematics is driven by curriculum designed by districts, and these curricula are usually based on materials that are external from the realities of the Black students that they are purposed for. Davis (2022) argues that aspects of education - such as policies, mathematics standards, standardized testing, racialized achievement gaps, curriculum, and instruction - are sources of anti-Blackness, whiteness, racism, and white supremacy. He adds that a quality mathematics education provided to Black students could possibly allow them to infringe on the white monopoly of intellectual, material, physical, and fiscal resources, improve the lived realities of the masses of Black people, and allow them to be self-sufficient. Perhaps this is why Black students receive subpar resources in many urban neighborhoods.

In addition, these culturally distant materials are expected to be covered within set time frames, followed by an assessment to “ensure” understanding of the content. The same pattern occurs year after year. This pushes Black students, as well as their educators, into inequitable conditions, because the goal communicated is to cover and absorb mathematics as fast as possible.

Dunleavy (2018) tells us that classrooms that move away from knowing mathematics and associating knowledge with speed communicate “striving toward equity.” She states that it is worthwhile to explore mathematics critically rather than rush through or simplify material. I second this argument: prioritizing reason and depth of understanding creates an environment for students who may need more time and space to understand, as well as students who may understand mathematics concepts more quickly. This also creates a space where curiosity and exploration can occur. Doing mathematics at speed possibly prevents one from developing an in-depth understanding and identity linked to mathematics, creating a landscape for unstable foregrounds.

When slowing down the speed of the process of learning mathematics, it not only gives students the opportunity to learn concepts and skills comprehensively; the expectations for understanding and competency also rise for everyone involved in the learning. Thinking and learning about mathematics through an exploratory and more methodical pace is a possibility that is often bypassed to satisfy the obsession with assessment mastery. This is also communicated through the focus on teaching the curriculum, not necessarily teaching the students.

Rochanda Jackson, executive director of the district’s Office of Policy, Planning, Evaluation & Testing in Newark Public School district states:

“We are investing in the professional development of our teachers so that they have a really clear understanding of the curriculum they need to cover in the year so that students can get the kind of quality education that they need to receive.”

While there are clear attempts to improve the quality of education, the focus remains on covering curriculum for the sake of the tests or the goal of covering the predetermined material for the year. Much of the professional development that teachers receive is geared towards this agenda of moving through a curriculum with haste, which can also pressure teachers to move quickly and keep things shallow.

A teacher, *Heather*, states:

Heather: I did go to a workshop on that and that workshop also, I feel like it gave me a better insight on the curriculum and how better to use it because was just given to us. But we don't really have the planning time that we should. I think it's a combination of the time, the time allotted and the expectations within that timeframe. So, it is twofold. That's what I was saying before when I was talking about that system of equations, we didn't really go into it.

Due to this prioritization of tests and covering the curriculum, mathematics can become superficial and simplified, lacking real-world complexity and context, compressing dense lessons into seemingly small timeframes.

Heather shares her experience of the need to condense a lesson. She also reflects on her experience of speaking with a school administrator (her VP, vice-principal) about the difficulty of teaching so quickly.

Heather: The lower academic ability needs more time to be able to think. Even though it's a pacing guide, it's so jam packed with so much stuff. It's like the lessons are supposed to be for 50 minutes and I'm not taking 50 minutes to do my lesson. Actually, I sat with my VP one day and we went through, we planned the lesson together and when we planned the lesson, I looked at her, I was like, with my kids, I don't think we could do this in 50 minutes. She said, nah, you got it. The abbreviated version. I had to call out and she ended up covering the class. She actually taught the class, and she took the entire block, which it was supposed to be half of the block. She took the entire block to do the lesson with both classes.

In this scenario, *Heather*, discusses with her VP that it is unlikely to teach the content in the designated time. Her VP in this case is unable to meet the mark set by the pacing guidelines of

the curriculum, even though she suggested to *Heather* it was possible to do. This also means that students, the majority of whom are Black, are receiving lessons that lack depth and time for them to develop a deep understanding of the content.

The process of doing things quickly can communicate that what is going on in mathematics is simple - they must avoid the complexity and instead follow a set of steps which will demonstrate understanding. This strategy is usually relied upon when one is running out of time for their lesson, such as in the scenario above. This shallow manner of learning may lead students to misunderstandings, giving them a greater possibility of lacking critical thinking skills and development (SYLVA, 1997). The downfall of simplification is that it is ultimately ineffective.

Sylva and Beveridge (1997)³⁷ argue that useful concepts in education include situated cognition, analogy, external representations, reasoning in context, acquisition of implicit knowledge, and the role of language in collaboration. They also state that educators seek simple solutions to address complex needs of learners. In this sense, it seems that this mindset may be imposed by governing powers such as district and administration. However, I agree that to address the more complex needs of students, we need to consider the useful concepts stated, but this requires more time.

By this I understand that patience is needed so that students have time to learn mathematical concepts in various ways. Dunleavy (2018) states, “I am interested in making a case for expanding what it means to ‘do mathematics’ and to be competent in mathematics, so that society values more than speed and accuracy in mathematics learning.”

To do something quickly can also take away the relaxation and naturalness of exploring and learning. “Moreover, in math, the effect of speed of processing masks the effect of inhibition, whereas speed of processing had no effect on reading or the relationship between inhibition and reading.” (ASHKENAZI; BLUM-CAHANA, 2022). From this statement I understand that it is even more important to understand how mathematics works and not to glaze over concepts with a masking process of skills and steps which may represent a mathematical concept. This can eliminate opportunities for students to act naturally, take risks, make mistakes, and develop

³⁷ Stated using arguments from Michael Beveridge (1997), their papers are related to one another in the same book, see (DOCKRELL; SMITH; TOMLINSON, 1997)

cognitively (BOALER; ANDERSON, 2018; BOALER; DWECK, 2016). Time to process mathematics increases opportunities to learn and widens the lens for viewing the world.

Mathematics functions at all times around us. Students recognize this in different ways. However, students are often unable to explain what is working and how exactly mathematics is involved in these workings. This phenomenon could be a result of the fast pace of mathematics classes, where there are missed opportunities to teach students pertinent life skills and information.

Often there are still schools that offer antique ways of teaching and learning where Black students are taught out of context about concepts and how to perform particular skills in mathematics, which can sometimes be referred to as drill and kill, intended to help one process and calculate quickly. Black students can come to learn that speed is a part of mathematics and associate this skill with what it means to be a mathematician. There are many consequences that can happen with this approach, bad or good, productive or counterproductive.

One can see speed as being a competitive aspect in the classroom for creating a space of challenge and fun. One can also see that going too fast can create a space for leaving others behind. One may come to see the speed as being a reason to disengage because the pace is too fast and there is no point in participating fully. There are many different scenarios that can come to fruition at an expeditious pace. However, slowing things down may give everyone an opportunity to see things clearly and build understanding, Giving the opportunity to learn without the burden of keeping up with the pace.

At an elementary school, Skovsmose (2012)³⁸ observes a classroom in which the goal is to complete a mathematics task. Some students are scurrying quickly to finish the task, some others are doing their best to be among the first, and there are some students that show disinterest in the task because they realize that they will not be among the first students to finish. In this scenario, there are many personalities and identities involved but I notice the two extremes: one extreme where students are competing to be first, and the other extreme where students become disconnected because they do not believe they have the speed, possibly the knowledge, to be first. Another perspective is of those in the middle of the extremes, possibly moving at a pace but without understanding.

³⁸ See Skovsmose (2012) for a description of the observation in full. (SKOVSMOSE, 2012)

In the following section, I will explore some of the responses from student interviewees and their thoughts about mathematics and the speed necessary to know and do mathematics.

9.2 Conversations with students and their focus on speed

When talking about understanding mathematics, for some students this means that they need to understand how to do mathematics faster - not only the action of doing mathematics but understanding the mathematical concepts as well.

In a conversation with a student *Omar*, he seems to be conflicted around understanding and doing mathematics quickly. He mentions the ability to do mathematics fast in a few different moments even when I ask him further about why mathematics is fun to him.

Omar: Like when you really understand it, it's fun because then you like, let's see, then you start to, well, then the class gets easy and then you're done faster.

In this statement, *Omar* is describing the class of mathematics as more fun and easier if you are able to finish the work faster. In this sense, I see *Omar* positioning mathematics as something just to do and get done quickly because it has little importance. He continues to prioritize doing mathematics quickly in the dialogue below.

Jamaal: Understanding math, is it about understanding it faster?

Omar: Yeah.

Jamaal: Do you feel like when you're in school, like it's easy to understand everything very quickly?

Omar: Yep. Well, some things.

Jamaal: When you have to learn mathematics, do you prefer to learn it quicker, or do you prefer to take your time?

Omar: I would like to learn it quicker... But if I don't understand it, then I would take time to learn it.

Jamaal: When you have to learn it quick, do you feel rushed or no?

Omar: Nope... Like if we have to learn it quickly, like to get through, like to get to something like a test, I would, I think that that would help me focus more because of like, let's see, because of like the thing that's approaching. So, yeah.

On one hand he wants to be able to do mathematics quickly, on another hand he admits in conversation that if he does not quite understand then he would take his time. After this admittance, he says that there are moments when he needs to do the math quicker in order to prepare for a test.

After talking about this need to move faster, his preference is to learn mathematics quickly over exploring topics in depth. This can create a perception of mathematics that is only viewed through mandatory testing: framed through assessment-like questions, completed in a time-sensitive manner. This also puts students in a particular mindset in relation to “the purpose of mathematics”, which can possibly lead exclusively to them doing well in math class to get a good grade and to do well on a test. In fact, when *Omar* is asked directly if the importance of learning mathematics is to pass tests, he replies “yes”.

When *Omar* is asked about what he dislikes in mathematics class he mentions that he does not like when he has to move slower because of others in class.

Jamaal: What do you dislike about math?

Omar: When I have to move slow with the other people. If they don't understand it, and I do, I don't wanna sit on something for that long...When we're doing something on like the smart board and then the people keep guessing wrong, that just makes me mad cause what are you doing?

The speed of needing to do the mathematics creates an atmosphere of hurry and competition. I think competition can be healthy, but in the sense that *Omar* describes, it creates an environment that benefits the few, similar to the observation from Skovsmose (2012). Another student, *Nate*, mentions:

Nate: Sometimes I am rushing with things that I find easier. I move fast and I'm done before everyone else.

Although it may be natural to move more seamlessly when they find it to be easier, to rush can reveal some form of pressure. It is not clear if there is a definite benefit of moving faster, but for some students, it may appear that way. There is a sense of pride when he states that he done before everyone else. These few that are benefitting, or processing through mathematics faster, are also the few in an overall school district that continue to struggle when it comes to these assessments, continuing to prioritize speed over understanding in their preparation.

Omar also states the following:

Omar: Well, me. Like understanding things fast, that makes me feel like I'm doing something right.

One can see that, for this student, the possibility of moving slower may also be perceived as wrong. The need to slow down and go further in depth in relation to mathematics may become a frustrating feat, although it is okay and natural to growing academically (BOALER; ANDERSON, 2018). The consistent act of rushing through without depth is a worrying occurrence as students will move on to high school and college, where mathematics will begin to become more complex. Using care and patience will become necessary to be successful when doing mathematics and embracing mistakes. From *Omar's* description, this could become one more obstacle that he has to overcome, ultimately creating yet another barrier in his foregrounds, and affecting his relationship with mathematics.

Isabella, when asked about what she thinks of a mathematician, refers to one of her classmates, Jerome³⁹.

Isabella: Jerome, one of my classmates, Jerome, he's very, he doesn't really know how to explain things, but he's like a quick thinker and he like can grasp onto like any sort of information whatsoever.

Jerome is what she describes as a “quick thinker”, although he struggles when it comes to giving explanations. To confirm her thinking around the idea of a mathematician, I asked the following question, “Oh ok, so someone that is quick?”, she responded “yes”, and she also responded “yes” when asked if a mathematician is someone who knows formulas.

From her response, I see that in her perception, mathematicians are quick thinkers; however, they do not need to necessarily understand or explain the mathematics that they are doing. They only need to do it quickly. I believe that this can be a result of the pacing of curriculum and prioritization of doing mathematics quickly to pass tests or complete tasks before others.

Later in the interview, *Isabella* also addresses understanding mathematics quickly.

Jamaal: I know that you also mentioned your classmate Jerome, who is quick with things, right?

Isabella: Yeah, he's quick.

Jamaal: Okay. Do you feel like it makes someone better at mathematics if they're able to move quicker?

Isabella: Um, no. I feel like it depends on how quickly you can understand something. Doing it quickly can cause like a little bit of like mess ups and

³⁹ *Isabella* recognized the confidentiality of this conversation and used a pseudonym to describe her classmate.

things like that. Being able to understand it quickly helps you move quickly.

Jamaal: Okay. So not to do it quickly, but to understand it quickly?

Isabella: Yes.

Isabella adds more to her conceptions of doing and understanding mathematics. Here she clarifies that doing mathematics quickly is not ideal, but understanding mathematics makes one better. The ideology of quickness still exists, but now it is aimed at the notion of understanding, which requires learning. This way of thinking can affect the ways students come to identify with mathematics. To understand quickly may influence students' thinking around learning fast, as well as what that equates to in mathematical ability.

A student *Jamar* (Chase) shares his level of confidence in his mathematical abilities:

Jamar: As of right now, I am pretty confident.

Jamaal: Okay. And what makes you feel that way? What makes you feel pretty confident right now?

Jamar: Because I'm like learning new concepts, like kind of quickly.

Learning and understanding are necessary components when it comes to excelling and achieving in mathematics. A sense of pride and confidence may also be necessary to fuel one's motivations to desire learning more. One can see that it this student's motives are energized by the ability to learn fast.

Coming to think about mathematics has differentiating effects on students' motives for learning mathematics and the way that they feel about the subject and their abilities. Martin (2000) tells us that mathematical identities describe how one views their abilities, expectations, and goals in relation to mathematics. Students involved in these interviews describe a sense of quickness that is needed to comprehend and therefore to do well in mathematics. The source of this mindset is not completely clear, but there are some aspects of Black students' daily interaction with academic mathematics that could certainly influence it.

9.3 Slow it down, look where you are going

While there are clear attempts to improve the quality of education, the focus remains on covering curriculum for the sake of tests. Much of the professional development that teachers receive is geared towards this agenda of moving through a curriculum with expedition. In my

experience as a mathematics coach in this district, many resources and time utilized in the classroom is to prepare for assessments. This pathway of learning and understanding mathematics is neither effective nor enriching for the mathematical development, identification, or equitable construction for Black students' learning or futures.

This form of mathematics education provided to Black students is detrimental and a continuous cycle of violence in their attempt to achieve present and future success (MADKINS; MORTON, 2021; VALOYES-CHÁVEZ; DARRAGH, 2024; VALOYES-CHÁVEZ; MARTIN, 2016). Black students are thus considered as “unable”. This analysis gives a different perspective on how the mindsets can be manipulated by the systems in which they are involved.

Black students in this system believe that speed is the way to learn and understand mathematics. While this does not describe all students, there is a trend, and unfortunately, it is damaging their ability to deeply understand the content, therefore, continuously diminishing opportunities in relation to (or not in relation) mathematics in the future. Possibilities can be ruined due to the significance of standardized testing.

The unsettling truth is that, despite the injustice and fairness of assessment, they are part of the current reality. The present performance in Newark is not where one would desire to be in mathematics. In an analysis through TAPintoNewark⁴⁰, only 6.8% of students were proficient in the mathematics Start Strong Assessment⁴¹, compared with the state average of 24%. On the NJSLA⁴², 13% of students were proficient, compared with the state average of 37%. From these recent test results it is evident that the current approach is not effective, and it is having an adverse effect on the way that students come to think of and relate to mathematics. The constant preparation and push to move on to new topics rapidly can lead students to believe that mathematics is exclusively about quickness.

⁴⁰ <https://www.tapinto.net/towns/newark/sections/education/articles/newark-school-district-4-8-graders-trail-state-average-in-reading-math-test-results-show>

⁴¹ The Start Strong assessments are based on publicly available released items, which enables educators to review the questions that students struggled with following the administration of the test.

⁴² The New Jersey Student Learning Assessments measures student proficiency with grade level skills, knowledge, and concepts in English language arts and mathematics that are critical to college and career readiness.

Embracing learning environments that allow students to relate to, feel comfortable with, and avoid the pressures of pushing through the curriculum to pass a test are necessary for Black students and their mathematics learning.

10. Learning Environments: Where to Position Mathematics

Dialogue is part of the learning process and learning environment.

“The only way forward, if we are going to improve the quality of the environment, is to get everybody involved.”

– Richard Rogers

Environments include our surroundings and aspects of life that allow or enable us to operate in the ways we need or desire to. They influence the possibilities in which we choose to learn, prioritize, and operate in our different realities. Rodgers (2002) states that learning environments allow the revelation of learning. She also mentions that teaching is an implication of learning, meaning that to gauge and understand what students know, teaching and curriculum need to allow the learning to be the focal point, subordinating the process of teaching to learning (GATTEGNO, 1970; POWELL, 2022).

Eric Gutstein talks about reading and writing the world with mathematics (GUTSTEIN, 2012). He is inspired by Paulo Freire, who offers the ideology of relating the world to education in the fight for social justice in *Pedagogy of the Oppressed* (FREIRE, 1972). My colleague Luana, who is inspired by both Freire and Gutstein, has studied this phenomenon with her students. The study was conducted with students who were in vulnerable and marginalized situations, many of whom identified as Black. Luana engaged her students in activities that they co-created to discuss occurrences in the real world through mathematics, in order for them to understand their environment and discuss social issues (OLIVEIRA, 2023).

In this project, Luana engaged students in dialogue about discrepancies between the wealthy and the poor. The students first shared the differences they were aware of between the two populations. The students were able to hear from their peers about some struggles that existed for them in their neighborhoods, such as access to regular waste removal, safe roads to travel on, and levels of violence. Students then began to look at the differences of wealth by country, and the things that different groups of people had access to. They created a map of the world using candy to model the wealth that some countries have. In this way, the students were able to visually compare the wealth around the world and a dialogue took place that involved mathematics and societal matters. Students were able to learn more about their realities, global realities, and

mathematics. They also influenced the teaching and learning by having the space to begin with what they know, empowering them as producers of knowledge (VARELAS; MARTIN; KANE, 2012).

In studies like this one, the professionals are aiding the improvement of student understanding in mathematics and creating sites for young scholars to develop their relationship with mathematics. By acknowledging students as co-creators and appreciating where they are in their development, scholars are granted the space to learn in welcoming environments, with the opportunities to listen to different ideas and strategies.

In this fight for social justice, one can say that these educators are utilizing critical mathematics education to break down barriers and open up opportunities to engage in mathematics (SKOVSMOSE, 2023) - often in ways that are more meaningful to students, but also in manners that connect necessary learning in academic spaces with societal realities (STINSON; BIDWELL; POWELL, 2012).

Both students and teachers can influence their learning environments. Teachers have their own experiences and preconceptions when they enter the classroom, as do students – and particularly, in the context of this paper, Black students. Some of these factors may mesh or clash depending on the backgrounds, foregrounds, and identities of those involved. There can be contrasts between the cultural backgrounds of Black students, teacher expectations, and curricular resources (GUTIÉRREZ, 2013). Something that is uncommon in the experience of the student, compared to the teacher, is the requirement to instruct with a set curriculum, which is accompanied by expectations from administration and governing powers. Depending on the required curriculum, students can be exposed to mathematics that will limit the ways in which it can be applied (EVANS; BOUCHER, 2015) and perpetuate racist agendas. This can determine the amount of critical mathematics they engage with, influencing how students may come to view the importance of mathematics in their lives and as part of their futures (SKOVSMOSE, 2016; 2023).

The environments in which students learn are extremely important in their mathematical development. As discussed earlier in the thesis, in Chapter 5⁴³, one's environment can influence their foregrounds and identities, which has an impact on the way students come to view and

⁴³ See Chapter 5 for a more in-depth discussion of the relationship between backgrounds, foregrounds, and identities.

understand mathematics. In an inverse way, students' (as well as other community members') identities, backgrounds, and foregrounds can influence how they come to interact with their learning sites.

In this chapter, I will discuss the relationships that students shared in their responses about the different environments for learning mathematics academically and socially, and the different ways that they come to see, understand and be taught mathematics. Students and teachers have shared in various ways how they came to identify with mathematics and the different modes and contexts it is used in. For this reason, I think it is important to highlight these different occurrences, which happen both in and outside of school. The following sections discuss the ways students relate to their mathematics learning and the environments in which these developments take place and flourish. There is an exploration of the different learning spaces through participant interviews, as well as of the ways in which these environments may foster positive mathematics identifications, and what possibilities may exist in merging some of these environments to invoke student interest.

10.1 Building knowledge everywhere

To move towards understanding how knowledge can be constructed and formulated, there is a need to acknowledge the sociocultural lens. That is, it is necessary to look at the identities, communities, backgrounds, and social interests of Black learners. This makes it possible to provide comprehensive and relatable learning opportunities. Gutiérrez (2013) states:

“[U]nderstanding and advocating for anti-racism, social justice, and transformation have moved beyond using the kinds of sociocultural tools that draw primarily from cultural psychology to highlighting identity in social interactions; they privilege the voices of subordinated groups and forefront the politics and power dynamics that arise from sites of interaction” – (p. 39)

Based on this statement is worthwhile to listen to the voices of both students and teachers. Their experiences can provide insights into their perceptions. Students can prove valuable in the production of knowledge, and teachers can prove valuable as external experts, guiding students and one another. The sharing of both voices can be conducted through discussions of sociocultural experiences, informing awareness of realities through mathematics.

Learning is largely considered to take place in schools - or, at least, most of the learning is. Through the discussions I had with participants, there is evidence that essential mathematics learning occurs outside of school as well, even if individuals are not completely aware of it. Many people do not consider knowledge constructed outside of conventional academic spaces to be meaningful towards their future success, as it may not be considered legitimate learning, depending on how it is transmitted (LAVE, 2019). It makes sense that students and educators alike can come to believe this idea, as opportunities to go to high quality schools or achieve a high quality of life requires success in academics.

Consequently, their mathematics learning can be restricted to only academic spaces, limiting the multifunctionality and utility of mathematics in daily societal happenings (YOUNG; RAYGOZA; MADKINS; LAWLER *et al.*, 2022). Within some of these settings they are unable to construct connections to their outside worlds. This is unfortunate because there are so many rich experiences that both students and teachers can bring into their schools to elevate their mathematics learning, when the space permits for discussion and exploration (SKOVSMOSE, 2023).

Both students and teachers are producers and receivers of knowledge, in relation to and aside from mathematics, opening up possibilities to connect different contexts to mathematics learning. Even if the intelligence is separate from direct mathematics learning, these experiences and opportunities can prove meaningful for their understanding of various mathematics concepts (reference). In some instances, individuals learn from a role model in their lives, whether it be a parent, a teacher, a close family member, or another person they idolize from their community or from one of their interests.

This reflexivity of learning and sharing information is essential for developing as a lifelong learner and increasing opportunities of becoming proficient in all academic subjects, including mathematics, as well as positioning themselves as potential doers and learners (VARELAS; MARTIN; KANE, 2012). Individuals can participate in lessons and activities provided by others to gain additional and alternative perspectives to their internalized and externalized realities. As stated earlier in the thesis, we learn from our backgrounds, and this contributes heavily to how we may prefer to continue to learn.

Learning from the backgrounds of others allows the landscapes of different possibilities to become visible. Imaginations and future prospects can expand, and bridges can be built to additional and alternative ways of thinking.

The foregrounds of all members involved in the learning site are drawn from their different backgrounds. Learning from your background can include learning from close family members and understanding the connections of mathematics to society.

Learning through identities allows for a variety of possibilities to discuss and relate to the subject of mathematics. This makes it important to observe other spaces in where mathematics knowledge can be formed and attained.

10.2 Environments to construct mathematics and learning

Universal Design for Learning (UDL; Rose & Meyer, 2002). UDL is a framework for curriculum development that seeks to give all individuals equal opportunities to learn. The UDL framework emphasizes the importance of providing options to address the wide range of skills, needs, and interests that students bring to learning. By providing multiple options for accessing information, expressing knowledge, and becoming engaged in learning, teachers can ensure that the learning environment is equipped to meet the needs of the widest possible range of learners. (EVANS; BOUCHER, 2015)

The authors present a framework (UDL) previously introduced by Rose and Mayer (2002). Their description of the framework describes an overall perspective that one can view academic environments from. Although Evans and Boucher (2015) refer to the use of this framework in traditional academic spaces, the ideology of addressing wide ranges of skills and needs through the access of information, knowledge expression, or engagement of learning has the ability to address the sociocultural and sociopolitical barriers for Black students both in and outside of the classroom. In the various forms of learning and knowledge formation, there are indeed preferences for each person. Within these preferences are valuable recognitions as to how mathematics can be taught through social connections and the different ways in which mathematics can be applied.

Below are some significant ways in which both teachers and students shared their different spaces of learning mathematics.

10.2.1 Relating mathematics to their worlds

Michelle discusses real-world relevant topics that they talk about in class. She was asked about what she enjoys or favors in mathematics so far from this year:

Michelle: We use everyday examples to actually represent what we do. [...] exponents, fractions, multiplying, dividing, length times, width, base times height. And right now, I'm learning about population and that's my favorite so far.

In this moment *Michelle* is able to relate to the academic mathematics she is engaging with in class. This is significant because she is also able to relate to what she is learning outside of the classroom. This might possibly influence both her interest and motivation to learn mathematics, as she even mentions that this is currently her favorite topic. She continues to discuss how this topic in mathematics is related to other societal realities.

Michelle: We're learning about populations and samples, we were talking about how a person can use a population for voting for rights.

Michelle is describing an aspect of a mathematics environment that is piquing her interest, connecting mathematics to an external reality aside from academic spaces, and helping to reinforce the importance of the subject matter in daily life. Real-world and sociopolitical connections are valuable in the classroom as they provide broad perspectives into the functions of their societies. Varelas, Martin, and Kane (2012) argue that learning involves a dialectical relationship of agency and structure, both of which, in turn, are influenced by the sociohistorical, collective experience of a group of people who share aspects of a particular social identity such as racial group membership. *Michelle* is not of age to vote yet, however, her identity as a young female Black student from Newark is empowered by the opportunity to discuss the structure of gaining rights to vote, how a population may be subjugated to restrictions, and how another may be more powerful. These types of discussions are important because they can create possible future imaginations for the students.

There are additional experiences that individuals have outside of academics that contribute to mathematics knowledge. These external learning environments help to expand the mathematics thinking for students. There are times where they can bring this into school, and times when it may remain more of a separate occurrence. Either circumstance might aid students to identify with the subject more.

Michelle continues to share the different ways in which mathematics can be used, including outside of the classroom:

Michelle: Well, using math outside, helping calculate money. Helping my father calculate what he needs to design, how much the length is, how much the width is base height. I try to help at times to design things cause length and width, I don't know if I mentioned this earlier, but length and width is also easier for me.

Her ability to engage with geometry outside of typical academic spaces widens her perceptions of where mathematics can be present. It also lays out possibilities for her foregrounds in relation to mathematics. Once again *Michelle* is sharing experiences where she can engage with mathematics in a way that is either fun or interesting for her.

Jamar shares his experience in learning about epoxy flooring with his father. This allows him to connect mathematics to other areas such as architecture, and for him this is what makes mathematics so important.

Jamar: Because in mathematics, most of the time, like science and stuff like that, as say an architect you'll need to use like math in order to like sculpture and design the place. Sometimes, you know, just in case you need to find a job, like a quick, like little job, like for example, you might work as a cashier at a store and you'll need to like make quick calculations in order to, um, give the customers their change back.

Jamaal: You brought up a couple of examples of how mathematics is important. What experiences have you had in your life? That brought you to say that.

Jamar: It's my dad. He does like epoxy floors and it's kind of similar to architecture. I was actually kind of interested in that. Usually now when I go to high school, I'm like looking for like a high school with architects.

These moments for *Jamar* and *Michelle* are valuable and influence their thinking for future goals, whether in relation to mathematics or not. Skovsmose (2023) claims that learning is performed by the learner; they are not simply just the subject of the learning. Their conception of being a scientist depends on many inputs. It could be based on what they experience in school, it could be based on films or commercials, or it could be based on personal experiences. *Jamar* shares a personal learning experience with his father. It influences his interest in mathematics as well as his motives (ALRØ; SKOVSMOSE; VALERO, 2008) to continue learning and study a related field such as architecture.

One can also acknowledge this learning occurrence as being what Skovsmose (2014) refers to as *foregrounds-for-learning* mathematics. Skovsmose claims that it is often difficult for students to relate particular issues from the mathematical curriculum in schools to their particular foregrounds. Foregrounds-for-learning brings meaning into the activities. This learning opportunity *Jamar* experiences outside of school allows him to identify an interest that he can pursue later in his education in relation to mathematics - thus, connecting an essential social experience to his academic possibilities.

Moments such as this alter the perspectives of Black students in powerful ways, which should be considered and monitored in order to guide them as well as possible. In the following section, I will refer to a student's view of mathematics that is persuaded by a source of media.

10.2.2 Perceptions of mathematics and mathematicians

The way we see mathematics is also the way we may perceive mathematicians. To some students, their perceptions of mathematicians or where mathematics exists in reality may be limited. Through media, sociopolitical structures, and educational materials, racist views of mathematics can be passed on to prevent correlations between Black people and mathematics. Mathematics is often viewed as the gatekeeper. Martin (2009) states:

“This gatekeeping process privileges White males as the group that benefits most from knowledge of mathematics and as the group that others must emulate, and whose interests must be protected if they are to gain access to economic and political power.” - (p. 309)

As a consequence, their opinions of what mathematics is and who is capable of being a mathematician or producing mathematical knowledge can become narrowed into this mindset. They are limited to relating mathematics to what they see and are exposed to.

- Jamaal:* Okay. And why did you select an old man to represent a mathematician?
Omar: Because that's usually what I see.
Jamaal: Okay. And when you say usually what you see, where do you see these mathematicians or these old guys as mathematicians?
Omar: In movies.
Jamaal: In movies. Okay. So, give me an example. Like when you see a movie, what does this old man look like?
Omar: Like a white man with a beard, a hat. And with severe back problems.

In this instance learning environments are extending outside of the school again. But the relationship is still significant because students can come to perceive the mathematics communicated in academic spaces may only be for certain populations. For *Omar*, media portrays most mathematicians as older white men.

10.2.3 Atmosphere of Learning

The surrounding influence of a learning environment is a strong determinant for students' comfort and sense of belonging. Participants shared aspects of classrooms and different environments that indicate a feeling of belonging and safety. The ambiance of the site includes the physical space, the manner in which learners are being communicated to, materials used for learning, and the opportunities available for experimentation and exploration.

Barbara reflected on one of her experiences as a student and how a previous teacher of hers made her feel safe making mistakes in mathematics class.

Barbara: She was just so just so, just. The way she kind of finessed like the math for us, like the way she spoke to us. It just kind of all like came full circle. Like she was a person, she made it known that, you know, I'm human just like you, and we're all gonna make mistakes, but she would always tell us we're all in this together, and we're all gonna get through this together. She was just like; she was just so caring. She was just so compassionate. She loved math, like the way she spoke about math, like her eyes lit up and I was like, wow, I wanna have, you know, and that was probably the only class that everybody was like, so quiet and attentive in was in her class.

Barbara shares her experiences with a previous mathematics educator and the manner in which it influenced her. Similar to the findings of Matthews (2020), researching teacher identity through their reflections being student learners, key themes that arose for these teachers were a perseverance ethic in mathematics and empathetic care. A perseverance ethic lends one the ability to push through difficulties (i.e. making mistakes). Empathetic care was perceived in the following ways: emotional consciousness to understand student frustration, affirmation of students' self-identity in mathematics, and partnering with student struggles in mathematics and beyond (i.e. various manners to be caring or compassionate (MALONEY; MATTHEWS, 2020)). These characteristics proved to be influential in teachers' lives in differing ways that were not always

evident contributors to their roles as educators. The trait that seemed to show the most correlation was the empathetic care.

The importance of being in an inviting and comfortable environment is evident, as well as having a member within the community that shows unconditional belief in those involved in the learning. This need not be solely in relation to mathematics, but the way one behaves in general. This aspect of behavior within the learning atmosphere can influence how individuals think about their relationship with mathematics.

Having another person believe in your potential to be a mathematician can be life altering for Black students of any age, the same way that it can be detrimental for them not to have these types of interactions (MARTIN, 2012; MATTHEWS, 2020; MILLER; WANG, 2019). Her teacher established a relationship that displayed support, as is evident through this descriptor of her teacher using the word *compassionate*.

The impact of building relationships is very strong in *Barbara's* classroom. It caters to a sense of belonging (MATTHEWS, 2020). Matthews (2020) states that for marginalized children of color, teacher care may take on heightened significance. Developing teacher-student relationships is vital for the success of Black students because it can provide an additional motive, and positive aspect to their learning environment. Both the teacher and students share the same sentiments of compassion and care for one another. *Barbara* displays this care by implementing a consistent routine in her classroom. It communicates compassion for students' success.

Jamaal: And it's because it is because you've built this routine with them, right? Like this, this didn't just happen overnight. You're saying that this has been gradual and doesn't really even sound like it's just about mathematics either. Like it's also about building a relationship with them, making them understand that they're, they're capable. Doesn't matter if you're, if you're in this school district, right. May not be the most wealthiest school district, but you're capable. You're smart. You're intelligent. As long as you're putting in the effort, you're going to be able to be successful.

Barbara: Yes, exactly. It's really about building those relationships, not just speaking of math, but just in general. That's the best part. I love doing that just in general.

Jamaal: And I can tell, I can just, I can tell that it's a, it's a powerful relationship between you and your students and it's, it goes both ways because you're smiling just as large when you're talking about the kids just as they do when they're talking about you.

Barbara: So, oh my God. They're so great. It's a beautiful thing. Yeah. It's a beautiful thing to see. Like it it's making, it's making me smile. Like it just, yeah. They're so, oh my God. It just, that is great. Yeah. It's such a blessing. They're really, they're really so great. Like, you can walk, like you can walk into my class at any given time and like, it's just like the environment, like, and everybody says it.

The influence that this educator had on her in mathematics motivated her in her practice with her own students. Many of the students from this teacher's class praised the different characteristics of the classroom in a positive way, and the way it influenced their learning and motivation. Some of these characteristics were: *aroma, organization, rigor and support, cleanliness, and belief.*

A focal characteristic that appears with the other elements of a positive mathematics learning environment is the organization of the site. *Barbara* goes on to elaborate about the importance of the organization of space in different ways.

Barbara: They're like, oh my God. Like the environment in here, like they just like, they love it. One of my things is organization. Like, I, I always tell 'em I have a little OCD, so I need things to be organized. You know, a clean room is a happy room and they get me like they know when it's time to like go, they cannot leave things unorganized. Like the floor has to be swept. Like they know, and it's not like I'm telling them you need to do this, but they just know like they get me, they know. You know, and that, that relationship with them, that since September, it's just, it's just great. And I'm, I'm so proud of all of them. Like all the ones that I recommended for the interview. I'm like, yes. Yes. so proud of them.

Jamaal: So, it's just welcoming. Has it always been like this? Has it always been like this in your classroom?

Barbara: Always. It's always been like that. And even this year doing like the interactive notebooks with them, you know, just they're literally on autopilot with the notebooks. They know what to do. They know where to open to. They know, they know a table of contents has to be updated daily. Like they already know that and they know it has to be organized. They know everything has to be in its place. And I always tell them everything belongs in its place. We need to keep everything organized. But I feel as though that fosters an environment that is welcoming, like they like that. Like they know that they're being welcomed into the classroom. I have Glade plugins in the wall and the room smells nice. [...] but it just fosters like that type of environment. And they love it. They absolutely love that everything is clean. They love that things are organized, that if they need to find something in the classroom, they don't have to like

rummage through things they know right. Where it is. So, yeah, it's that type of environment.

This organized, clean, and inviting type of environment is inviting for students and invokes the feeling of being welcomed. It allows students to focus on the subject as *Barbara* points out in reference to their notebooks. The organization of the classroom seems to take away this layer of worry or stress from the atmosphere which permits students to benefit from the relationship building in the classroom and allows mathematics connections to take place.

Through this example, it can be inferred that there is a sense of understanding from the teacher of student needs, as well as high expectations, and most certainly a sense of compassion.

10.3 Depleted learning environments

An observation I made in some of the math meetings I led is that teachers had lost their belief in the abilities of their students. Their hope in student potential had been depleted. When I began my work as a coach in Newark, I also needed time to learn my position; this required patience with self, and some guidance from other professionals that worked in the field or worked in mathematics education in different capacities. Stinson, Bidwell, and Powell (2012) claim that becoming a teacher (the same can be said for a coach) is a process which is never finalized or fixed, but rather it is a fluid process of continuous critical examination of one's self and their students, in which old ways of thinking and acting are disrupted and transformed into new ways of thinking and acting. I concur that, in order to progress, the elimination of past thought processes, awareness, or critical reflection is necessary.

Developing an environment that promotes reflection requires a culture of like-minded individuals, committed to growth and fruition of knowledge. Without the culture, or at least a model or two, to guide a collective mission of learning forward, it is difficult to disrupt negative narratives about Black students in education. Staying cognizant of the school I coached for, the majority of students were Black.

To create change for the school where I coached, I suggested presenting students with more open-ended problems that involved everyday activities, such as making purchases, measuring living spaces, gardening, and other things that students were aware of. During my rollout of this suggested activity, a few teachers voiced their disapproval and doubt about student potential. Something that was very concerning to me was a comment I continued to hear from teachers across

grade levels, “The kids can’t do this. I’m telling you; I have been teaching and doing this for years, these (Black) kids are not going to be able to do this.” What truly bothered me about this was the conviction in a teacher’s voice when she said this, and their disinterest in trying something new, to possibly see if this would help the students’ understanding or challenge the student in new ways that may pique their interest.

This type of mindset can be a poisonous trend among teachers and learners, contribute to lower expectations, possibly creating *destructive* learning environments because it perpetuates the deficit ideologies that are wrongfully tagged to Black students. Cokley (2023)⁴⁴ claims that the dominant narrative surrounding Black students is characterized by deficit thinking, and that this mindset focuses on presumed reactive racial identity that is believed to negatively impact achievement.

Overall, the doubt in African American learners can prove to be ineffective for learning. Borman (2004) conducted a study in a school with poor minority students and found that effectiveness in learning environments is created by strong leadership, support, clear goals, and a staff composed of individuals who share the same values and beliefs. A common theme found among the research participants was “Staff members maintain high standards.” This describes a *rich* learning environment, similar to what *Barbara* strives towards and shows appreciation for in her school. She states:

Barbara: My experience in Newark has been fine. I feel as though I'm very blessed to have people that are supportive, especially admin and our math coach. I'm definitely very blessed in that manner. I can't really complain. Last year there was a lot of like struggling through the material and the curriculum, because I didn't know it. But this year I'm like, oh, I know it. I know this, I already know this. I know what's next. I know the next unit. It's good, but I will say that having a team in place to support.

She attests to the importance of having support in both her learning as an educator and in the school in general. Teamwork and unity allow for the learning environment to improve and flourish.

⁴⁴ See (DIVISION OF HEALTH, 2023)

10.4 Accumulation of learning about learning environments

Learning environments need to involve aspects that are in relation to student success such as rigor, safety to explore and make mistakes (BOALER; ANDERSON, 2018; OSBORNE; JONES, 2011; OSBORNE; KELLOW; JONES, 2007; VARELAS; MARTIN; KANE, 2012). There is much literature in the field of mathematics education about such aspects, but when it comes to the classrooms in urban areas such as Newark, NJ, the practice seems to be less than what is expressed in said literature where all of the solutions may be revealed, or procedurally discussed. Black students in school districts such as Newark, where they are the majority, do not have access to robust relationships with mathematics and cannot develop critical and meaningful attitudes of mathematics; unfortunately, neither can many of their educators.

Learning sites and classroom environments include more than just academic qualities. They involve sociological actions and interactions within the *community* of the school, communities within the classroom, as well as outside of the classroom. People need to develop and maintain satisfying and meaningful narratives related to a community (VARELAS; MARTIN; KANE, 2012). Varelas, Martin, and Kane (2012) utilize a pedagogical framework, content learning (CL) and identity construction (IC). They claim that community is vital toward the contribution of knowledge and identity formation in regards to mathematics. Children learn outside of the classroom as well as inside, and these lessons can be connected. The amount of time or opportunities students have with these experiences can determine how influential these lessons are in their mathematics learning.

The communities that students participate in determine the knowledge they are exposed to, and formations of their own knowledge to share within these groups. These connections that are created can also represent disconnections that occur as consequences. Possible disconnections that can become evident are students lacking opportunities to connect to mathematics in their social realities, or insignificant moments to build and elaborate on these connections in academic spaces. These communities must be safe, inviting, and intriguing physical spaces and atmospheres. They need to be conducive to interconnect with others in the sense that all members in the community feel free to speak and be heard.

Their learning environment involves *dialogue*. The ways in which they can communicate their knowledge and how their thinking is received by others can be dictated by the communities

they participate in. Faustino and Skovsmose (2020) discuss the action of dialogue through dialogical and non-dialogical acts⁴⁵. I focus on one definition they use for dialogue, which is maintaining equality. This is essential to keep in mind when engaging in these dialogical acts with Black students in their different learning communities; the same goes for engaging non-dialogically. Faustino and Skovsmose state that when unpacking what is included in dialogic and non-dialogic acts, one needs to address issues of power, authority and position.

This is also dependent upon the amount of dialogue permitted, how dialogue is facilitated in the environment, and if the conversation is indeed equitable. In this sense, everyone may not speak for the exact same amount of time but all participants in the community have the autonomy and safety to contribute. The dialogue needs to allow students to incorporate their identities and interests along with mathematics in a possibly infused and interconnected way.

The conversations and ability to verbalize thoughts and possibilities are contributions to opportunities for students to construct and continuously develop their identities. They can serve as imagination pools, and conceptions from these talks can be carried out and possibly expanded into other moments of their lives, individually or as parts of a group.

Learning environments are *open*, interesting, and relevant, allowing students to learn in a variety of ways. Evans and Boucher (2015) argue that by providing meaningful choice in the context of classroom activities, teachers can support students' autonomy. Teachers do not always have full autonomy and can unfortunately become reduced to facilitators or task monitors, leading students through procedural exercises. Learning environments in schools can be seemingly selfish and one-sided, as in only being preoccupied with a pre-imposed curriculum or lesson plan, preparing students to pass assessments to access the next grade level, or to partition students into learning groups based on assessment results (for example, low-performing, middle-performing (i.e. on the cusp), and high-performing students). These types of learning environments can potentially connect back to *obsession with speed* in mathematics and the poor influence it may have on their learning trajectories.

Developing closed manners of thinking in mathematics may diminish the openness, meaningfulness, diversity, and imaginative forms of conception creation. The absence of these

⁴⁵ See (FAUSTINO; SKOVSMOSE, 2020)

aspects in the classroom may create an absence of motivation for students to learn mathematics and develop the sense of importance it can have in one's life. If one is unable to perceive the importance of the subject, the perception of meaning is lost as well.

Students in this research study shared experiences of *meaningful learning* that happened more often outside of the classroom than inside, highlighting the importance of providing more *real-world applications* and connections to motivate mathematics learning. “[T]he development of reasoned, coordinated, coherent, and meaningful ways of seeing one's self within communities.” (VARELAS; MARTIN; KANE, 2012). Embracing the connections between the knowledge students develop in their varying communities may allow for a richer academic space in schools. Learning environments in school are concerned with testing, which is not relevant to student interest or to real world experiences that they will face. This can create a disconnect with their learning environments and disconnect in their mathematical identities.

Learning environments are cumulative spaces where knowledge is produced and communicated in various ways. It not only depends on the dialogue conducted and facilitated, but the manner in which it can be carried out, and whether there is freedom for all to contribute to these conversations. An element of belief needs to be present and evident for members in the learning community.

11. Black Students' Foregrounds: Evolutions, (De)formations, and Connections in Mathematical Identities

“[I]dentity is always a question of producing in the future an account of the past, that is to say it is always about narrative, the stories which cultures tell themselves about who they are and where they came from.” – (Hall, 1995, p.5)

The above quote from Hall applies to the formation of mathematical identities and foregrounds. The backgrounds that all learners have contribute to the constructions of their identities and foregrounds. To understand the foregrounds of African American learners, it is necessary to observe and acknowledge their past and their narratives.

Environments and experiences shape who we are and who we become. Of course, along the way we learn to make decisions and we can come to make choices that will grant us beautiful opportunities and perspectives on the world; alternatively, we could be led to make determinations that are misleading or harmful. The experiences you have as a child and as a student stick with you, and they can stay with you for a very long time. They come to make up our internal being and the way we identify with the world, thus the way we make meaning of our worlds (Poole, 2010). Experiences through our environments determine how we begin to perceive and engage with other people, and how we manage and resolve our problems. In this sense, these experiences also influence how we come to see our future possibilities.

Experiences occur in our present and in our backgrounds. Backgrounds were discussed along with foregrounds and mathematical identities in Chapter 5. To deepen the discussion around the aspects of foregrounds, backgrounds, and mathematical identities, the perceptions of mathematics, success, and obstructions were discussed. In this context, these aspects are explained in terms of the perspectives of Black students and their teachers.

Growing evidence shows that African American children's mathematical identities are strong predictors of their mathematical success or failure and that teachers' classroom practices and beliefs can dramatically shape these identities - not just in the short term but also over the whole life span (Martin, 2009a).

Foregrounds consider ways of thinking that derive from environments that we live and learn in, which possibly influence our choices for the future (Skovsmose, 2012, 2014). It includes all possibilities, and “Of course, foregrounds include wishes, necessities and desires.”⁴⁶ (Filho, 2014). In a theoretical sense, foregrounds involve the level of importance placed on mathematics in their lives in relation to their present and future.

Foregrounds are complex constructs of our experiences, they are in no way simple and require our explorations to be conceptualized (Skovsmose, 2014). Within the foregrounds are the thoughts and propensities of success, hopes and dreams, doubts and fears, importance of mathematics in their lives, imaginations about their futures, influences from their communities, and the relation of their interests to their realities. There is much that goes into one’s foregrounds; in this chapter I will remain focused on the interconnected relationships for Black students between mathematical identities, backgrounds, how they view their environments, how this may influence their mathematics experiences, and perspectives of their futures. I will also analyze the influences of their teachers’ experiences and backgrounds on their foregrounds and mathematical identities.

11.1 Connecting backgrounds to the foregrounds

Do Black students see mathematics education as being essential to their survival or to their ability to thrive in their communities? Their daily activities may communicate the contrary, where worrying about one’s safety may be of greater concern, and mathematics may not be paramount in their lives (Martin, 2012). The importance of mathematics is definitely present, but its level of pertinence in the present and future is varied depending on the opportunities they have in relation to mathematics.

Skovsmose et al. (2018) state that:

“A decision about being involved in the mathematical tasks, or not, is not simply the result of a conscious individual choice, but rather a decision that is strongly associated with the intricate relationship between the student, the teacher, and the context for learning in the social-political-cultural environment.” – (p. 98)

⁴⁶ Translated by the author.

Relationships to mathematics are greatly interconnected with backgrounds and foregrounds, and will affect the way one identifies with mathematics. The histories, circumstances, desires, or dreams that individuals have stem from their backgrounds and grow into their identities and foregrounds. For Black students, this has proven over time and through history to limit and strangle their relationship with mathematics, as they face racial and systemic obstacles that stifle their development (Davis, 2022; Martin, 2009b; Valoyes-Chávez & Martin, 2016).

In terms of foregrounds, the histories of Black students can greatly affect what they come to dream about or aspire to, as their possible experiences may be limited. African American histories are steeped in systemic racist conditions that often present obstacles to Black students' success in mathematics (Carter, 2022; Division of Health, 2023). It can then limit future opportunities in relation to mathematics, or one's relationship with mathematics.

A connection that Carter (2022) makes to the current systemic racist circumstances is policies such as Servicemen's Readjustment Act of 1944, also known as the GI Bill. The GI Bill provided millions of war veterans with advantages and benefits, such as access to low-interest mortgages, stipends covering tuition, and expenses paid for veterans attending college or trade schools. Unfortunately, for Black and Latino veterans, the rewards of GI Bill were unreachable during this period of racialization and discrimination.

This is an important example to consider because this occurrence prevented African American veterans from accessing universities due to segregation. So, the effects of poverty were seemingly two-fold, as they were refused by educational institutions (Thain, 2024) and were also victims of collusion through the federal government by means of housing discrimination (Roisman, 1995). Actions such as these have contributed to deformations of Black success and opportunity.

Up until this point I have discussed the different aspects of identity, such as the ways we identify racially and the ways we identify with mathematics, the make-up of our foregrounds and backgrounds, learning environments, as well as the notion of moving through mathematics with an obsession with speed, and how these theoretical notions may be influenced by one's environment.

In this chapter, I will connect the ways in which experiences and environments can influence the foregrounds for Black students. To do this, I will discuss the foregrounds that may be imposed on them from their city environment, and the differences in foregrounds for students in different contexts that have been discussed over the years. Throughout, I will refer to statements from the interview participants. Finally, I will bring some of my own experiences in, to further consider the connections between mathematical identities and foregrounds.

11.2 Foregrounds in Newark

To examine foregrounds, it is necessary to observe the backgrounds, and the present situation. Part of the present circumstances for Black students in Newark are their surroundings, therefore it is important to explore the history and context in which they live, and moreover, the differences that may exist for them in their neighborhoods.

The city of Newark, although not a very large city, is incredibly important. It is an interstate and international transportation hub, home to multiple universities and hospitals, has a rich history, and the demographic has grown more diverse in the passing years. It is very close to New York City, though not as well known, and it has various cultural locations and activities to participate in year-round. The city has grown over the past few decades and has become a recent site of gentrification due to its proximity to New York and the presence of necessities in a metropolitan city.

The gentrification has been slowed by the mayor, Ras Baraka, through the creation of the Equitable Growth Advisory Commission⁴⁷, to provide more equitable opportunities for ownership for the present citizens in Newark (Morel et al., 2021). While there is evidence that the city has not undergone gentrification as quickly as nearby cities such as Jersey City or Hoboken, there have been new commercial and residential developments in Newark. Along with gentrification comes an increase in the cost of living.

There is a clear effort to provide equitable opportunities, but the percentage of people that own their homes is still low. In 2019, only 24% of Newark residents owned their homes, 39%

⁴⁷ See Morel et. al. (2021) for an in-depth explanation of the gentrification in Newark, NJ, the Equitable Growth Advisory Commission.

lower than the average of the state of New Jersey, and 40% lower than the national average; at the time, Blacks and Latinos made up the majority of the city population, 47% and 39% respectively (Neal et al., 2020).

Inequity in home ownership is interconnected with inequity in income. Inopportunity to buy a home is related to how much one can earn, as one may not be able to access housing loans without proof of sufficient income, even if the process of gentrification is stalled. One is unable to conceive the possibility of owning or building wealth, even if granted the time, without the resources⁴⁸. In the 2022 United States Census, the median income for Newark was \$46,460, and the amount of people living at or below the poverty line was 24.4%; meanwhile the national average is \$75,149 and 11.5%⁴⁹.

Inability to earn an above average wage stems from the level of education achieved, and therefore the number of options available for career and employment. The data from the 2022 Census shows that 77.7% of Newark residents had graduated from high school, and only 17% had a bachelor's degree or better; both are below the national average, where the percentage of high school graduation and undergraduate completion or higher is 89.1% and 34.3% respectively (Census, 2022). Lack of education can possibly push individuals towards crime as a means to improve their financial status. A depleted financial status can result in social exclusion (Thain, 2024). The attainment of education not only affects the possible income or options available, but also the rights that may come along with these possibilities, and the awareness and knowledge of privileges in their current or available circumstances.

In this sense, foregrounds are not just the opportunities and knowledge afforded to them, but also the opportunities and knowledge they are able to attain themselves. This can possibly be prevented and altered dependent upon the external structures in place, some of which can be racist and obstructive to significant progress. The perceptions of these realities are what contribute to forming foregrounds within the environment of Newark. Hence, for Black students in Newark, they can come to observe poverty and inequities in housing (Newman, 2004), as well as low expectations of education and careers, violence, crime, and a multitude of external influences of

⁴⁸ In 2022, the average cost of a house in the United States was \$442,600. Data from <https://fred.stlouisfed.org/series/MSPUS>

⁴⁹ Data used from the 2022 United States Census Bureau, <https://www.census.gov/quickfacts/fact/table/newarkcitynewjersey,US/PST045222>

what can be considered as a priority outside of education. Due to circumstances such as these, students' foregrounds could be ruined (Skovsmose et al., 2018).

The collective identity and foreground of Newark varies and depends on the neighborhood. The landscape of Newark has changed dramatically over the past decade, but some neighborhoods remain the same or have worsened due to continued poverty, crime, and violence; poverty and crime can become concentrated due to the process of gentrification (Newman, 2004). In a study by Hahn (2014), the crime rate in Newark was found to be three times higher than the national average.

Considering the theory of foregrounds, I draw attention to the notion of foregrounds in a borderland position by Skovsmose et. al. (2018). The authors describe borderland positions as a relational situation where individuals meet their social environment and come to terms with choices that diversity makes available to them. Therefore, they define everyone to be from a borderland position. They research the foregrounds of Brazilian students located in favelas in the capital of São Paulo, living in vulnerable situations, apart from the greater metropolitan areas of the city. The authors are interested in learning more about the relationship between the students' foregrounds, and if they may come to connect mathematics with their future possibilities.

Foregrounds can be defined as a person's interpretation of life opportunities in relation to what appears to be acceptable and available within the given socio-political context (Alrø et al., 2008; Skovsmose, 2018; Skovsmose et al., 2018; Valero, 2015). Looking at the environment of an 8th grade student, *Isabella*, she discusses her insight:

Jamaal: What area of Newark do you live in?

Isabella: The South Ward.

Jamaal: South Ward. Okay. Can you tell me a little bit about the South Ward? How is it over there?

Isabella: It kind of depends on the season really. Winter is kind of dull. And summer is kind of like the crime rate goes a little bit upward.

Isabella shares her own perspective of her community in Newark, and it reflects the data shared about the high rate of poverty translating to increased possible crime. Interested in the correlation between the environment and the affect it may have on learning and future opportunities (Varelas et al., 2012), I ask about the professional lives of others in her neighborhood. We go on to discuss the occupations of individuals in her neighborhood:

- Jamaal:* Okay. And the people in your neighborhood, what do people do in your neighborhood, like for work?
- Isabella:* I think most of them do like security jobs.
- Jamaal:* Okay. Do most people in your neighborhood go to college?
- Isabella:* I don't think so. No.

Isabella lives in a dangerous neighborhood, which is pretty calm during the winter but during the summer the crime rate goes up. Most people in her neighborhood work as security guards, and do not go to college. An environment such as this can lead one to aspirations of being a security guard, which can lead to satisfied lifestyle possibilities, depending on the individual and their desires. It can also lead to curiosity about the role mathematics may have in their future outlook, and its overall meaning or purpose.

One may also have motive to move away from environments such as these. They may not have the types of interactions which motivate or observe others in their neighborhoods that pique their interest. They could in fact become demotivated or motivated by what they see. *Omar* shares a brief reflection about his community:

- Jamaal:* Can you describe your community?
- Omar:* Retarded.
- Jamaal:* Retarded. What do you mean by that?
- Omar:* Because it'd be a whole bunch of, you know, people who be wildin out there.
- Jamaal:* Okay. You wanna say any more about that or you wanna leave it as that?
- Omar:* Just wildin. I wanna leave it right there.
- Jamaal:* Okay, no problem. Coming from where you come from, what are your hopes and dreams?
- Omar:* To not be like those people outside.
- Jamaal:* Okay. Can you say more about that? What would be more unlike those people outside?
- Omar:* Like probably finishing college and not being outside selling drugs.

Omar refers to his environment as *retarded*, and the people as *wildin out*. He is not motivated by the foregrounds of his socio-political context, as he is not inspired to be like the people he sees. During his interview he displayed emotions of frustration, fatigue, and possible a sense of shame of this environment, as he declined to go into further detail. I interpret his response of *retarded* as referring to the methods for decision making in his neighborhood being illogical, where wildin out types of actions may follow; wildin out can refer to many different things in

which the person committing these actions is doing so irrationally or without care (potentially signaling criminal behavior).

The foregrounds of his community, however, provides him with motivation to do the opposite of what his environment is showing him. Rather than give into the surrounding future aspirations that he is noticing, he prefers to be different and pursue other goals. *Omar* may not be completely committed to the idea of college yet, but he desires more than what is modeled for him right now.

Through observations such as these, one can see how social and environmental interactions may alter the ways in which students come to identify with academics and mathematics (Gonzalez et al., 2020) or construct their foregrounds (Skovsmose, 2014). If students have insignificant opportunities to engage with mathematics outside of school and their expectations in school are low, the precedence of mathematics may be lower as well. Academics also appears to be a means to improve their circumstances. Other external influences, such as the crime this student witnesses, can distract from success in academics.

Restrictions and low expectations of success in academic spaces can repel Black students from mathematics or sway them into resenting mathematics. However, through perspectives such as these, we can see that the conditions of social environments can persuade students into aspiring for higher education. Therefore, it is necessary to view these multiple directions of coming to form foregrounds and mathematical identities, to provide avenues for students who may or may not recognize the visual and embedded functions of mathematics.

Omar, for example, is motivated to go to college. In other analyses he also displayed a mindset for doing mathematics quickly. In his thinking, this is what makes a good mathematician. One may interpret that he is persuaded to do mathematics quickly because he wants to move away from his current situation, or it could be a result of the manner in which mathematics is presented and assessed in academic spaces. There are different interactions that students have that may determine their purpose of learning and goals they stride for.

In the following section I will discuss the varying foreground perspectives and ideals, to compare to the different ways in which foregrounds come to be formed, and how they may differ or reflect from foregrounds of Black students.

11.3 Multitude of foregrounds and mathematical identities

In this thesis, the focus is learning about the mathematics experiences of Black students and how these experiences may affect their way of thinking about future possibilities. The futures of many Black students are restricted because of their mathematical aptitude, which is typically measured on results of assessments that are unjust. Based on test scores and track records of mathematical ability which often display deficit narratives for Black students (Davis & Martin, 2018; Martin, 2009b; Sonnenschein & Galindo, 2015), students can be rejected from certain academic spaces and institutions, unless they are able to prove that they are capable on assessments.

Aside from this restriction, a cause of poor performance can be the inadequate experiences that students receive in their learning environments, which can result in a depleted foreground. Chapter 10 discusses the multitude of learning sites that may be possible. Within these learning locations are various scenarios that can leave students fulfilled or emptied of deep connections with mathematics and connections to future opportunities, potentially those involving mathematics.

Much of an individual's foreground is influenced by one's background, and all of us have a slightly different background. In a study by Alrø, Skovsmose, and Valero (2008) conducted interviews to learn about foregrounds in a multicultural context. They used a conceptual framework to outline a learning landscape based on nine dimensions⁵⁰. These dimensions are students': 1) foregrounds, 2) students' construction of identity, 3) teacher's perspectives, opinions and priorities of teaching, 4) the content of learning, 5) tools or resources for learning, 6) classroom interaction, 7) parents, 8) friends, 9) public discourses (in relation to politics). All these dimensions are interconnected; they are also self-standing dimensions that allow for perceptions of students' learning experiences.

The intent of their study was to gain insight into the experiences of an Iraqi student, Razia, and her learning experiences. Although their aim was to learn more about the experiences of a student who was foreign to her new learning environment, I see the correlation between this study

⁵⁰ For in-depth details of their learning landscape framework and definitions of the nine dimensions, see Alrø, H., Skovsmose, O., & Valero, P. (2008). Inter-Viewing Foregrounds: Students' Motives for Learning in a Multicultural Setting. In *Social Interactions in Multicultural Settings* (pp. 13-37). https://doi.org/10.1163/9789087907174_003

and the study of students in borderland positions, as Razia is perceiving what her future opportunities may present in her current life condition. Although the backgrounds of the students differ, there are many similarities to how one constructs their foreground.

Even if we come from a similar cultural background, the same community, or have resembling beliefs the construction of our background can be minimally or extremely different from someone else's; the foreground construction remains highly similar in regard to the interactions that may provide motive. The context and contents of one's foreground can come to have many differences. In any of these cases, there are possible similarities but most certainly differences in these constructs and therefore there are multiple ways in which foregrounds and identities can (de)form.

These infinite variations can determine the ways in which people prefer to learn, and their motives to learn (Skovsmose, 2023). These preferences and motives have the ability to invigorate students' foregrounds and mathematics learning. Attending to all these differences is not an action that is constantly occurring but can be an actual reality. Within every community and every mathematics classroom there can exist alternative ways in which students bring knowledge, bring their culture, backgrounds, identities, and perceptions into their learning spaces (Gholson & Wilkes, 2017). In this way, many different foregrounds can be possible for a student, depending on economic, political, culture, religious, and discursive factors (Skovsmose, 2023).

11.3.1 Thoughts of mathematics and foregrounds

Let us look at *Isabella*, for example, she discusses her opinion and relationship with mathematics:

Jamaal: What do you think about mathematics? What's your opinion of it?
Isabella: It's kind of like mixed emotions, you know? Sometimes it's like fun cause I know what I'm doing and then other times it's just like, why do I need to learn this? It's like, okay. Kind of confuses me.

For *Isabella*, mathematics is fun when she understands what is going on. This is when the mathematics can be communicated in her own way, as I interpret. *Isabella* is also describing a possible lack of utility for mathematics in her perception (Matthews, 2018), as she is not exactly

sure about the purpose for learning mathematics. She goes on to share her opinion of mathematics and how it may apply to her future; I inquire more about her previous statement:

- Jamaal:* And when you say that it's easy for you, like you know what you're doing, what area of math is that for you?
- Isabella:* Multiplication, working with variables, I'm good with variables. Um, okay. I think that's [it], like multiplication, division, and like variables.
- Jamaal:* Okay. And when you're saying that you don't really see the point of it, tell me a little bit more.
- Isabella:* Like right now we're doing geometry. This is like the most confusing subject I've done in math. There's like so many rules and like all these like terminologies that you gotta remember. It's kind of difficult.
- Jamaal:* Okay. And when you said that you don't really know what the purpose of it is, what do you want to do with your life? Like what do you want to do in the future?
- Isabella:* I want to do acting or future in fashion design. And mathematics doesn't really relate to that. I guess like when it comes to like percentages and stuff like that. That's probably good to know since I have to do like management sometimes and like money and like contracts. But other than that, I don't think so.

In the previous statements, there is evidence that *Isabella* observes the importance of mathematics but not the necessity for it in her future prospects. However, there may be opportunities for her to bring more of her interests into her academic spaces, as there is most certainly a relationship that exists between her interest in fashion design and geometry, and her understanding of area and the different designs that exist within the world of geometry. The experiences that she describes in doing geometry are only based on procedural learning, focusing on memory of terms, with no real connection to her interests.

A possible oversight is the interrelationship between the culture of personal and academic in this scenario, or lack thereof, and the language of the two worlds does not match or overlap (Iseke-Barnes, 2000; Lerman, 2001). In other words, a place where the interest of the student is personal, yet valuable, and the necessary memorization of geometric terms and formalities to demonstrate mastery do not overlap. There are differences, but opportunities to link and coexist.

As Alrø, Skovsmose, and Valero (2008) suggest, these cultural differences are constructed through individual and collective groupings, through identities and interactions. The ways in which these individual and collective interactions are embraced is dependent on the current activity and conditions of the environment. The current activity is what students experience in and outside of

mathematics classrooms, which includes what they experience in their neighborhoods. Conditions of the environment involve these same spaces, mathematics classrooms and communities, as well as what activities are carried out, how these activities are facilitated, and ensuing interest based on individual and collective identities and foregrounds.

Thoughts and feelings around mathematics can also determine how students may come to perceive connections between mathematics and their futures. *Isabella* not being an enthused mathematics learner may have dissuaded her from connecting many of her future goals or possibilities with mathematics. Another student, Robert, is presented with the same question in his thoughts about mathematics; he describes his feelings about mathematics:

- Robert:* Nervous.
Jamaal: Nervous?
Robert: Yeah.
Jamaal: Okay. What else?
Robert: Hmm. Pretty much mixed feelings. Sometimes it be a little hard, easy, but always find a way to get through it.
Jamaal: Okay. So, using, determination or persistence?
Robert: Yes.
Jamaal: Okay. And then when you say mixed, can you throw some of these mixed feelings at me. What would you say some of these mixed feelings are?
Robert: Um, happy, sad, mad, um, nervous. Courageous, curious, and a lot of determination towards fixing the problems.
Jamaal: Okay, so, Hmm. I'm gonna stick with these emotions of curious, happy, and mad. What makes you curious about mathematics?
Robert: A lot of new stuff. Multiplying decimals, dividing, wondering when was this ever possible?
Jamaal: Okay. When was this ever possible? Like what do you mean?
Robert: Hmm. It's like when we start the lesson, it's like impossible to do, but as the teacher explains, more understanding comes into play.
Jamaal: Okay. And you said happy. What, what makes you happy about mathematics?
Robert: Okay, um, when. I get the answer correct or able to help somebody that doesn't understand. Just brings joy.
Jamaal: Okay, I understand that one. I can identify with that. And mad. What makes you mad about mathematics?
Robert: How do I say this If I get something wrong, like wondering how I got it incorrect? I did everything correct, but probably messed one thing up.
Jamaal: Like if you mess a set of steps up or if you misunderstand something.
Robert: Okay. I like the honesty. So, do you like mathematics?
Robert: Yes, sure. One of my favorite subjects.
Jamaal: Oh, okay. Nice. Why?

Robert: You find out a lot of interesting things with math that involve the real world. Same thing with science in but math, it's an everyday thing. Money. Mm. Buying something. You're in debt. Anything that involves math could be used.

Robert shares a flowing river of different emotions when he engages with mathematics, from feeling nervous, happy, sad, determined, curious, to courageous. Ultimately this leads to the point that he is interested in mathematics, and that it is one of his favorite subjects. *Robert's* awareness of all of these emotions in relation to his mathematics learning may allow him to understand the flexibility of interactions he may encounter. That is, by having the space to feel all of these emotions, he can make a more informed decision of whether he likes mathematics, if mathematics has a purpose, and if it is indeed important for his future possibilities.

Below, *Robert* shares how mathematics may connect to his future goals:

Jamaal: Can mathematics help you accomplish your goals in the future?

Robert: Yes, it very much can.

Jamaal: Okay. How so?

Robert: Like I said, you use it in real world. Um, you can make it far in life knowing a lot of things about math. Because in some states in life, if you don't, if you're not good at math, you won't make it as far and you don't wanna just give up cause your life could go downhill pretty quick.

Robert displays an understanding of the consequences of not doing well in mathematics. Assessments are heavily prioritized in schools, and although *Robert* does not explicitly mention testing, students are consistently reminded about the importance of doing well on standardized tests. However, even if it is a shallow or deep understanding, he recognizes that mathematics is used in real life, and that one has the opportunity to make it far if they know mathematics. These recognitions can allow one to understand their sociopolitical environments.

11.3.2 Connecting relationships and foregrounds

Embracing the culture of the environment and developing an appreciation for it can positively influence the mathematical identities for students and possibly enrich their foregrounds, as it demonstrates validity of ability and potential. *Barbara* shares her love for her own environment and for her students, and how it influences her teaching practice:

Barbara: I went to an urban school district and I excelled just fine. And I feel like if students just have that consistency with all educators that they will excel just as well. And they have as much opportunity as any other student in any other district. When I worked at St Benedict's, I would always tell the students, it doesn't matter, cause we were right in the center of Newark, Martin Luther King Boulevard. I just, I fell in love with the city. I fell in love with the culture.

The teacher is connecting her background and identity with her current experiences and activities. She understands the importance of consistency and her role in valuing the conditions and circumstances of the current environment. She continues to share a story of the importance of validating students' potential as she observes students doubting their own ability:

Barbara: I bump into students that I had, and I'm like, I'm sorry, I don't remember your name, but they're like, oh, I'm, I'm a physical therapist. You know, because they doubt themselves, you know, when they're in the city of Newark and they're, you know, walking to go to school, you know, they doubt themselves. Well, you know, I'm not in this district, so I can't do anything. Well, you can. And I always tell students, I'm like, you always have to remind yourself that education is the most powerful weapon that you can have against the world.

Barbara reminds her students of the importance of their education and acknowledges their doubts, what they are, and where they are coming from. During the moment she shares "You know, because they doubt themselves, you know, when they're in the city of Newark and they're, you know, walking to go to school, you know, they doubt themselves", she gives a gesture as if to imply that I know why they would doubt themselves walking around in the city of Newark because of the level of poverty that is evident, and there is such a low level of representation of individuals who are highly educated who have cultural or racial identities similar to their own.

The environment around the school where I coached can give students reason for doubt: surrounding streets littered with trash, impoverished and abandoned homes, alcohol and drug users on the sidewalks outside of the school after dismissal, and consistent actions of crime in the community. These are all common sights for students attending the school and may lead to depressed identities when it comes to academics, possibly depleting its importance for their respective foregrounds.

In this way, identities and foregrounds for community members can be influenced and changed, or they can be malnourished. In either scenario a change is occurring, and it can either

be motivating to grow or become a hindrance to transformative change and new possibilities, resisting and blocking alternative ways of being. This depends upon the individual and their motives to learn based on their identity and their foreground.

The influences of the community on cultural identities can affect the motives and dispositions for the importance of learning mathematics. In a study conducted by Filho (2014), students are interviewed to understand how their purpose and motives are formed withing their foregrounds and learning of mathematics. Filho interviewed students from socially excluded backgrounds and asked them questions in regard to their reasons for learning mathematics. He determines that there is both an internalist and externalist nature for learning mathematics.

An internalist, meaning learning mathematics for the purposes of doing mathematics, such as in a strict academic way, and an externalist, meaning learning mathematics for the purposes of social context (such as political or cultural purposes), for example, in an ethnomathematical way. He also determines that it is possible to have thoughts of learning mathematics which are not pulled strongly toward either an internalist or externalist nature for learning mathematics.

From some of the responses and the conclusion of the study by Filho (2014), it appears that the purposes for one to learn mathematics are influenced by the environments in which they learn, and the backgrounds that contribute to the formation of their foregrounds and mathematics identities. Similar to the students in this study, they view learning mathematics as useful for varying purposes, which can be framed as internalist, externalist, or passivist. In this sense, I do not refer to a passivist as unable to respond or act; there is a full ability to act, and they recognize that there is a purpose to learning, but it may not be necessarily strong for them. This motive to learn may only be in relation to the science of mathematics and the ways in which is presented.

In the case of *Isabella*, she does not see the purpose in learning mathematics for her future. Based on the framework raised by Filho, one could view Isabella to have an internalist view of mathematics, and one can perceive that she has a type of passivist view of mathematics. In contrast, one may view a student like *Robert* to lean more toward an externalist type of student who connects their emotions and understanding of the real-world application of mathematics. He may not be fully aware of how just yet but recognizes that there are connections.

11.4 My experiences and foregrounds

From the time I was in 5th grade, I realized that I had a talent for teaching; in particular, I enjoyed guiding others through mathematics. One reason I became a teacher was to aid other students who looked like me to master mathematics and avoid the fear and evasion that is often associated with learning and doing mathematics.

I was often viewed as being smart because I knew the steps, procedures, rules, and concepts of how operations and relationships worked between numbers. I always wondered to myself why others didn't feel that same confidence in themselves to do well in mathematics. Through my journey in this research, I now notice that many, if not all, have a mastery of mathematics in their own way. Perhaps it does not always align with the mathematics that is communicated in a typical school curriculum.

Academic materials have a great influence on how students come to engage with mathematics and develop their own meanings for its purpose. During the analysis of the study, conversations with the participants and other researchers, I have also noticed that learning must be safe to take place in all spaces. The connections that are possible between formal academic and sociocultural environments allows for profound opportunities for thought, and greater chances that students will discover valuable meaning in mathematics and other subject areas.

Developing an awareness of students' surroundings and their remarks about of these surroundings allows educators and community members to understand the learning motives and possible future aspirations that students formulate.

The experiences I had in my learning differed from others in my schools. Although I attended the same school as many in my community, my experiences also contrasted from others in my community. My education stemmed from my experiences at home, my mother prioritized education. She would preach it, have me practice at home and in libraries, enroll in summer programs, and supplemental academic activities. She encouraged activities after school and over the weekend. This allowed me to learn different perspectives. I spent time outside with people from various backgrounds. Similar to *Omar*, there were many in my neighborhood who were also *wildin out*. And, like *Omar*, I learned from those experiences that I had dreams of doing more.

Although, during my youth, I learned my community culture and developed relationships in my environment, this helped me in my success as well. There are countless lessons that I learned in my community which helped me relate to mathematics - for example, thinking about statistics or angles through the perspective of playing football, or percentages considering the amount of weight for exercises at the gym. Experiences such as connecting my interests to my mathematics learning led to mastery of mathematics in academic spaces and a comfort with the formal language and practice of mathematics, because I could connect to my outside world. This was not intentionally done by my teachers (or not by many of them). But these are actions that can be taken for future Black students. However, one limitation is that it did not necessarily open my mind to the deep interconnected workings of mathematics in everyday possibilities, such as algorithms used for automated devices or programs, particularly in ways where mathematics could be applied to my daily activities and learning to contribute to my collective identities (Lave, 2019), or my foreground construction.

Mathematics has a sole purpose in schools and formal locations: it continues to be this entity that appears to be separated from many people and can only be accessed by few. The connections that learners and educators make with mathematics culturally, socio-politically, and personally may allow us to create better learning opportunities for Black students and many others, if we allow these connections to exist.

PART IV – CLOSING REMARKS

This part of the dissertation contains my final reflections from my research journey, knowledge shared in the text, possible connections that may exist from the analysis, and future hopes.

12. Reflections and Considerations

The importance of discussing how students feel towards the subject of mathematics is integral to understanding how students may relate to or view the subject area. Black students have various contributors to their identities. This can impact the way that they come to see their future possibilities.

In this last chapter, I will reflect on the entirety of this dissertation. The process of producing this thesis was an immense mental weight for me. Embarking on intense research and encountering so much literature was both thrilling and overwhelming. However, I am happy to have persevered through this development in my academic career. I am a better man, educator, and professional because of it. Below I discuss my research journey and the future possibilities that could extend from this study.

12.1 Starting point

This research began in the United States and is coming to its final stage in Brazil. There have been challenges in completing the study as the doctoral study commenced just months after the Covid 19 pandemic struck the globe. This worldwide change altered the lives of billions of people, pushing everyone into social shutdown.

During this time, I was working as a mathematics coach in a public school, and I happened to meet Dr. Arthur Powell in a professional development opportunity to learn about teaching fractions conceptually, through the use of a manipulative known as Cuisenaire Rods. I tried to convince my colleagues at the school to enroll in the program with me, but unfortunately, they were not motivated to participate.

The chance to participate in this developmental training with Dr. Powell allowed me to engage with other mathematics coaches in the city of Newark in a completely different environment. I had the time and space to get to know other coaches, build connections, relationships, and deepen my mathematical understanding. As with anything, the project came to an end, but the experiences I had were meaningful.

Dr. Powell persuaded me into thinking about pursuing further education and asked if I had ever considered studying for a doctoral degree. In an affirmative and confident tone, I said no, and that I was not interested. I had no desire to return to school or to study. He invited me to think about it more deeply, and needless to say I decided to go for it.

Before I knew it, I was a new post-graduate student at Universidade Estadual Paulista "Júlio de Mesquita Filho"⁵¹, in PPGEM, under the advisement of Dr. Ole Skovsmose. My first interaction with my new orientador was online along with his wife, Miriam Skovsmose. In the weeks to come, I then met some of my colleagues of the Épura research group. The first meeting was an awful experience as far as trying to understand or follow a conversation in Portuguese. But, at the same time, it was intriguing to be a part of a group speaking about education in a focused and passionate way.

I reflect on all of these experiences because they have all coordinated to bring me to this point. These moments are part of my recollections now, part of my background. However, four years ago these moments were contributing to movements and evolutions in my own foregrounds, changes, and growth of my identities. My experiences have contributed largely to this study and my learning and have given me new perspectives on where I can continue to push this work, further expanding my foreground and identity, as my background continues to grow with all of the gained experiences.

In the following sections I will summarize the theories, methodologies, and analysis that continue to provide motives for my own reflection.

12.2 A look at the theoretical (back)ground

When I initially proposed this project, I intended to study the formation of mathematical identities of Black students. This topic was very important for me based on my own experiences and thinking about the relationship I had with mathematics, and the relationship I witness of old friends and Black students when it comes to mathematics. Over time I had contact with more professors and researchers, understanding the theory of mathematical identities better and discovering more of the work that had already been done in the field. There have not been many

⁵¹ Translation in English: São Paulo State University

studies with Black students in the middle school years, but there was certainly no work that examined the mathematical identities and foregrounds of Black students.

The connection between mathematical identities and foregrounds is a valuable theoretical perspective to use when understanding or observing the experiences of Black students. Viewing identities and foregrounds requires us to acknowledge the backgrounds of students. Beginning with the backgrounds of Black students can immediately open up spaces for them to feel welcomed, or as Matthews (2020) states, a sense of belonging.

The utilization of backgrounds makes Black students visible in a multitude of ways as much composes the backgrounds. Within one's background is their perceptions, preferences, identities, cultures, and interests. There is possibly more that can be discovered and explored in the backgrounds. Therefore, it was imperative to this study to consider the backgrounds that students grow from, as this can influence how they come to understand and dream.

Mathematical identities and foregrounds are still two relatively new concepts, and there is still much to learn about them to benefit students in the classroom and beyond when it comes to mathematics education. Mathematical identities are intertwined with both foregrounds and backgrounds. The ways in which Black students come to think about their abilities in mathematics, including the ways they perceive themselves and observe how others may view them, can be affected by the backgrounds or foregrounds; and possibly by both.

Understanding the interconnectivity between these theories was an important notion to comprehend. I appreciate the advice from advisors and professors at UNESP and contact with other researchers at mathematics education conferences in Brazil. These interactions gave me space to share my ideas and receive feedback on the possibilities that exist, even to remark that the work I am doing seeks to address the same problems in Brazil that I have noticed in my experiences in the United States.

Foregrounds consider the social context people are born into, as well as the perspective and interpretations of the context which a person is born into (Skovsmose, 2014). Foregrounds are not in any way simple; they are constructs which are changing all the time as one moves through their experiences. Similar to the theory of mathematical identities, there is an aspect of perception and self-perception. However, they are different in the sense that mathematical identities are solely

concerned with one's relationship to mathematics; foregrounds, on the other hand, are a theory that can be applied in alternative modes to explore the intentions of an individual and possibly what influences an individual to pursue an action.

Due to the social nature of these theories, the research called for a qualitative investigation. The study produced data through the construction of artifacts, but principally through semi-structured interviews to gain insights about their thoughts, produce knowledge, and voice the stories of the participants (Denzin & Lincoln, 2005; Schensul & LeCompte, 2013). It is very difficult to define any of these concepts one way or another. Determined to uncover some possibilities a scientific inquiry was necessary. The research was driven by the following questions: how do Black students experience their foregrounds? In particular, what is the relationship between the mathematical identities of Black students and the formation of their foregrounds?

Aiming to provide some insight into these questions, these theories were researched and connected with other theories and context, such as racism and mathematics education in the city of Newark.

12.3 Backgrounds growing into foregrounds

The dissertation begins with a summation of my experiences before starting my doctoral study. There, I also give a brief about why this research is important to me, and my personal connection to learning more about this topic. After the introduction, the thesis moves through four sections, laying out a path which aims to uncover just a bit of understanding of the connection between the foregrounds and mathematical identities of Black students.

Part I sets the preparation for the journey into the research, providing a theoretical foundation, discussing backgrounds, foregrounds, and mathematical identities in a socio-political, socio-cultural perspective in the context of mathematics education for Black students. Chapter 2 addresses the mathematics education circumstances in Newark and discusses some of the foundations on which the public school system was built. There are similarities between some of the mission statements created by the administration of the founding public schools and the current public school system. But many struggles exist, and it is shown through the author's observations, assessment scores (although proven to be biased), and data in this study. Chapter 3 considers

mathematical identities; drawing from other researchers in the field, it provides a better theoretical understanding of mathematical identity. Chapter 4 discusses racism, and the subtle effects it has on education systems. There are remnants of old racist systems, and there are still leftover issues from times of segregation and blatant discrimination. Chapter 5 addresses the theories of backgrounds, identities, and foregrounds, and what the connection between these theories can consider.

Part II provides insight into the methodological procedures. Understanding identities or how one observes their future requires narrative. Chapter 6 includes the procedures, phases of the study, analysis, and a preview of the themes that arose, along with reasons why the methods were selected. Chapter 7 presents the interview participants; it serves as a summary of for the data that was used from each participant in the analysis.

Part III brings the research path into the light of the interpretations made from the data collection; each chapter takes on a distinctive theme. Chapter 8 discusses race and racial perceptions: students and teachers share their experiences with racism, or moments where they may not be the target of racial attack but recognize that it is racism. This is crossed with mathematics education, as some interviewees mention the connection they notice when considering Black learners and mathematics.

Chapter 9 explores *speed obsession* and mathematical identities, a concept that I have not found much reference to in the field of research. The data revealed that there are some students who prioritize doing mathematics fast, and this is indeed what makes someone a good mathematician. One can come to see that this may affect how students come to think about mathematics in their futures, if speed becomes the main characteristic of a *good* mathematician.

Chapter 10 discusses learning environments and how one may position mathematics. Students share interesting experiences that they have had in learning mathematics, and how they are learning mathematics. Some of these occurrences happen outside of the classroom, and it seems to pique their interest the most. In the classroom, students share opportunities to learn mathematics in topics that are related to socio-political dynamics. In these experiences, inside and outside the classroom, students are displaying opportunities to empower their foregrounds when it comes to mathematics.

Chapter 11 explores the possible evolutions and deformations of Black students' foregrounds. This chapter sheds light on the foregrounds of the city, such as the history of the city, how it has impacted its present state, possibilities of crime or poverty, and the effects it may have on students. After this perspective, the chapter explores how students feel about mathematics and what connections they see, if any, with their futures.

Overall, the analysis chapters have their own distinct theme, but they are all interconnected. One can see the racialized forms of experiences in mathematics, such as being tested constantly or primarily taught through procedural worksheets (Davis, 2022), as contributing to Black students' motives or learned preference for doing mathematics. In other words, there might be a connection between the learning environments students encounter and the way in which one comes to view their future in relation to anything mathematical.

12.4 Foregrounding identities

There are many more interconnected relationships between the themes that arose during the analysis. This study sought to gain understanding about the theories of mathematical identities and foregrounds of Black students. The themes themselves gain initial insight on how to attend to these two theories for African American learners and have the potential to shed light on ways to assist other students as well.

Understanding of the correlation between mathematical identities and foregrounds was gained. One can see that some Black students have future aspirations in relation to mathematics, and some do not. Some students are enthused mathematics learners; others may not be. Some students had a low level of interest in math. Commonalities among all of these students include that they recognize the importance of mathematics; for a few students there seems to be slightly more recognition, but they all notice.

This raises a question about exactly why they find it to be so important. There was not enough evidence in this study to give a particular reason. However, the respect they give to mathematics as an important subject is observed. In relation to respect of mathematics, many students do not reveal an in-depth understanding of mathematics. A few participants used phrases from algebra or explained a concept; many kept the language of mathematics basic and short (i.e.

addition, multiplication). This could have been a result of responses to the structured interview questions.

This leads me to the speed obsession that students have. There is some sociological reason as to why this happening. It is important to explore more as it can affect the ways in which students interact with mathematics. While one should have some speed with numbers and certain calculations, prioritizing doing mathematics quickly may prove to be dangerous for students' mathematical development.

Speed obsession seems to stem from either constant testing or procedural curricular resources that do not provide deep cognitive challenges - possibly from a socio-cultural standpoint, learned from communities and social environments to do, move, and think quickly so that one has a better opportunity to succeed.

Learning environments are important for Black students. There are schools in Newark that do not provide the best sites for education (i.e. poorly trained or supported teachers, lack of strong leadership, lack of quality resources). Also important is the lack of connection students have the chance to make with their social lives outside of school and their academic mathematics education. Varelas, Martin, and Kane (2012) state the importance of incorporating the community into the learning environment for students. In the data, students much prefer to discuss the mathematics outside of school, more often than they mention the mathematics offered in school. This also affects their motives to learn, and as a result affects their foregrounds (Skovsmose et al., 2018).

The analysis of the foregrounds of Black students emphasized the remnants of racial experiences endured in the city of Newark. The conditions some of the students mentioned, along with the data that can be found about some areas of the city and the author's experience at a school in an impoverished neighborhood reveal the inequitable conditions many Black students and their families are faced with.

An interesting observation was the motivation it provided some students. They extracted motive from their circumstances to do well in mathematics, and overall, academically, to gain opportunities to go to university and escape their conditions. This motive needs to be harnessed and embraced with mathematics that will challenge them and provide real opportunities to progress and achieve their future goals.

There are indeed more avenues of exploration and inquiry to seek out beyond this study. One analysis chapter could evolve into an in-depth project to further understand the phenomena occurring for Black students. The hope is that this work gives motivation and influence for young scholars to continue to push their limits and learn, especially for those who may share the same ancestry as I do.

Children and young people are capable of more than what we give them credit for. This world and generation of students is drastically different compared to even just ten years ago. Access to information is incredibly easy. How can we build awareness for students to make informed decisions through mathematics education? How can we do the same in consideration of their futures? Quality education can provide them with options, and with more options individuals can hopefully come to have a life they find to be happy and fulfilling.

A proud accomplishment of this study was to provide students the space to share their experiences and feelings about mathematics. In reflections post interview, students often shared gratitude for the opportunity to share their thoughts and emotions in relation to learning mathematics. They expressed that they had not thought about what that may mean for them, or that similar questions had never been presented to them before.

Conducting this research was life altering because it allowed for deep reflection on my own identities and foregrounds. I am truly thankful for the opportunity, for your time, and attention.

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14. Appendix

14.1 Interview Protocol

Interview Protocol (Version 1)

Semi-Structured Interview about Mathematical Identity and Foregrounds

Topic

Mathematical Identity and Foregrounds for African American Students

Research Question

What experiences shape Black students' mathematical identity and foregrounds?

Introduction

Good afternoon. My name is Jamaal Ince. I am a Math Coach for Newark Public Schools and doctoral student at UNESP (Sao Paulo State University) in Rio Claro, Brazil. What is your name? Thank you for meeting with me. How do you spell your first name? How do you spell your last name?

I would like to inform you that your participation in this interview is voluntary. It is your choice if you would like to continue or not. You can take a break or stop at any point, just let me know.

Purpose

This afternoon I will ask you a series of questions for about 30 minutes. The purpose of this interview is to understand how one identifies with mathematics. I am interested to hear how you identify with mathematics, and how it influences your thinking of your own ability and confidence in mathematics.

I value your thoughts, so I will record our interview today. To ensure you are comfortable during our interview, this can either be a voice or a video recording. I will study the recording and your responses to gain a deeper understanding.

Pseudonym

Because I may share this recording with other researchers that you do not know, you and I will create fake names. My pseudonym will be Mr. Lock.

What pseudonym would you like to use? [Student gives their pseudonym] Ok great, let's remember to use these names during the interview.

Questions-based Interview

Ok, [participant pseudonym]. Let's begin. I have 14(pending) questions that I would like you to respond to as openly and honest as possible. We will go through each question one by

one; we will move to the next question after you have completely finished your response. There may be stretch questions in between scripted questions that I will ask to further understand your responses. [Alert participant that you will begin to record] Let's begin.

Definition of Mathematical Identity

[Beliefs in one's own ability in mathematics. This can be expressed through beliefs, attitude, values, emotions, and personal outlooks that revolve around the subject of mathematics.]

Personal Perception

1. How would you define mathematical identity?
2. How do you identify with mathematics?
3. What emotions do you experience when you think of mathematics?
4. How would you describe your experiences in mathematics:
 - a. In elementary school?
 - b. In middle school?
 - c. In high school?
5. What do you consider to be success in mathematics?
6. What do you consider to be the importance of mathematics?
7. What past experiences influence your thinking for the last question?
8. How confident are you in your mathematical abilities?
9. From your perspective, how can mathematics provide more opportunities in your future?

Personal Experience

10. How are the discussions in your mathematics class related to your everyday life?
11. If any, what are the experiences in school that attract you to mathematics?
12. If any, what are the experiences in school that repel you from mathematics?
13. If any, what are the experiences outside of school that attract you to mathematics?
14. If any, what are the experiences outside of school that repel you from mathematics?
15. What connections do you see between your racial identity and your interest and performance in mathematics?
16. What connections do you see between other racial identities and their interest and performance in mathematics?
17. If you needed support in mathematics, who would you ask for help?

Success and Future outlook

18. What is your definition of success?
19. What are the possibilities that you imagine for yourself in the future?
20. Of these possibilities, which of them are most realistic to you?
21. Which of them seem unobtainable (unreachable)?
22. What are the obstacles that you imagine for yourself in the future?
23. Of these obstacles, which will prevent you from reaching your dreams?
24. What are your future goals and aspirations?
25. What prevents you from achieving your goals or aspirations?

26. How are you capable of achieving these goals?
27. How are you incapable of achieving these goals?
28. What experiences give you the confidence to achieve these goals or dreams?
29. What experiences make you feel that you cannot achieve these goals or dreams?

Closing

Thank you for taking time to participate in this interview. Your contribution is greatly appreciated. Are there any comments that you would like to add? Do you have any questions for me? We are finished with our interview. Once again, thank you for your participation.

Interview Protocol (Version 2)

Semi-Structured Interview about Mathematical Identity and Foregrounds

Topic

Mathematical Identity and Foregrounds for African American Students

Research Question

How can we guide students to build their mathematical identity and confidence in mathematics classrooms in the city of Newark, New Jersey?

Introduction

Good afternoon. My name is Jamaal Ince. I am a doctoral student at UNESP (Sao Paulo State University) in Rio Claro, Brazil. What is your name? Thank you for meeting with me. How do you spell your first name? How do you spell your last name?

I would like to inform you that your participation in this interview is voluntary. It is your choice if you would like to continue or not. You can take a break or stop at any point, just let me know.

Purpose

This afternoon I will ask you a series of questions for about 30 minutes. The purpose of this interview is to understand how one identifies with mathematics. I am interested to hear how you identify with mathematics, and how it influences your thinking of your own ability and confidence in mathematics.

I value your thoughts, so I will record our interview today. To ensure you are comfortable during our interview, this can either be a voice or a video recording. I will study the recording and your responses to gain a deeper understanding.

Pseudonym

Because I may share this recording with other researchers that you do not know, you and I will create fake names. My pseudonym will be Mr. Lock.

What pseudonym would you like to use? [Student gives their pseudonym] Ok great, let's remember to use these names during the interview.

Questions-based Interview

Ok, [participant pseudonym]. Let's begin. I have 14(pending) questions that I would like you to respond to as openly and honest as possible. We will go through each question one by one; we will move to the next question after you have completely finished your response. There may be stretch questions in between scripted questions that I will ask to further understand your responses. [Alert participant that you will begin to record] Let's begin.

Definition of Mathematical Identity

[Beliefs in one's own ability in mathematics. This can be expressed through beliefs, attitude, values, emotions, and personal outlooks that revolve around the subject of mathematics.]

Personal Perception

1. How would you define mathematics? Please tell me more about what you think about mathematics. This is for me to define more how they identify with the subject.
2. How do you see mathematics?
3. How do you do mathematics?
4. How do you prefer to learn mathematics?
5. How do you identify with mathematics?
6. What emotions do you experience when you think of mathematics?
7. How would you describe your experiences in learning mathematics in and out of school?
8. How do you feel about the way you learn mathematics in school?
9. What do you consider to be success in mathematics?
10. What do you consider to be the importance of mathematics?
11. How confident are you in your mathematical abilities?
12. From your perspective, how can mathematics provide more opportunities in your future?

Personal Experience

13. How are the lessons or discussions in your mathematics class related to your everyday life?
14. What do you find to be interesting about mathematics?
15. What connections do you see between your racial identity and your interest and performance in mathematics?
16. What connections do you see between other racial identities and their interest and performance in mathematics?
17. If you needed support in mathematics, who would you ask for help?

Success and Future outlook

18. What is your definition of success?
19. What are the possibilities that you imagine for yourself in the future?
20. Do your future plans involve mathematics?
21. Of these possibilities in the future, which of them are most realistic to you?
22. Which of them seem unobtainable (unreachable)?
23. How are you capable of achieving these goals?
24. How are you incapable of achieving these goals?
25. What experiences give you the confidence to achieve these goals or dreams?
26. What experiences make you feel that you cannot achieve these goals or dreams?

Interview Protocol (Version 3)

Semi-Structured Interview about Mathematical Identity and Foregrounds

Topic

Mathematical Identity and Foregrounds for African American Students

Research Question

How do black students construct their foregrounds? Particularly what is the relationship between mathematics identity of black students within the formation of their foregrounds?

Introduction

Good afternoon. My name is Jamaal Ince. I am a doctoral student at UNESP (Sao Paulo State University) in Rio Claro, Brazil. Thank you for meeting with me.

I would like to inform you that your participation in this interview is voluntary. It is your choice if you would like to continue or not. You can take a break or stop at any point, just let me know.

Purpose

This afternoon I will ask you a series of questions. The purpose of this interview is to understand how one identifies with mathematics and how your foreground may influence your identity. I am interested to hear how you identify with mathematics, and how it influences your thinking of your own ability and confidence in mathematics.

I value your thoughts, so I will record our interview today. I will study the recording and your responses to gain a deeper understanding.

Pseudonym

Because I may share this recording with other researchers that you do not know, you will create a fake name.

What pseudonym would you like to use? [Student gives their pseudonym] Ok great, let's remember to use these names during the interview.

Questions-based Interview

Ok, [participant pseudonym]. Let's begin. I would like you to respond to each question as openly and honest as possible. We will go through each question one by one; we will move to the next question after you have finished your response. There may be stretch questions in between scripted questions that I will ask to further understand your responses. [Alert participant that you will begin to record] Let's begin.

Definition of Mathematical Identity

[Beliefs in one's own ability in mathematics. This can be expressed through beliefs, attitude, values, emotions, and personal outlooks that revolve around the subject of mathematics.]

Interview Questions

Personal Perception

16. Name and grade.
17. How do you identify racially?
18. Where did you grow up?
19. Describe your community.
20. What are your hopes and dreams?
21. Draw/describe a mathematician.
22. What do you think about mathematics?
23. Do you like mathematics?
24. What do you like/dislike about mathematics?

Personal Experience

25. Can you bring yourself into mathematics?
26. What about yourself do you relate to mathematics?

Success and Future outlook

27. What do you aspire to be or have in the future?
28. Can mathematics help you accomplish your aspirations in the future?
29. Can you be a mathematician?
30. What makes you think so/what makes you think not?