4-30-2024

Let Our Voices Be Heard: A Youth Participatory Action Research Project Incorporating Black History and Culture into Informal Science Curricula

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Recommended Citation

Smith, Torressa N., "Let Our Voices Be Heard: A Youth Participatory Action Research Project Incorporating Black History and Culture into Informal Science Curricula." Dissertation, Georgia State University, 2024.
doi: https://doi.org/10.57709/36954507

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This dissertation, LET OUR VOICES BE HEARD: A YOUTH PARTICIPATORY ACTION RESEARCH PROJECT INCORPORATING BLACK HISTORY AND CULTURE INTO INFORMAL SCIENCE CURRICULA, by TORRESSA N. SMITH, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Education, in the College of Education & Human Development, Georgia State University.

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LET OUR VOICES BE HEARD: A YOUTH PARTICIPATORY ACTION RESEARCH PROJECT INCORPORATING BLACK HISTORY AND CULTURE INTO INFORMAL SCIENCE CURRICULA

by

TORRESSA N. SMITH

Under the Direction of Dr. Natalie S. King

ABSTRACT

This Youth Participatory Action Research (YPAR; Cammarota & Fine, 2008) study was designed to include youth as co-researchers to uplift their voices during the research process and showcase ways to incorporate Black culture and history into science curricula. This study applied elements of culturally relevant pedagogy (CRP) for children to 1) experience academic success, 2) maintain their cultural competence to develop positive ethnic and social identities, and 3) build sociopolitical consciousness to heighten awareness of inequities of underrepresentation within the science curricula (Ladson-Billings & Tate, 1995). Data were collected through questionnaires, cogenerative dialogues, student reflections, lesson plans, student artifacts, and a culminating focus group interview. The use of thematic narrative data analysis facilitated the portrayal of the researchers' experiences through storytelling. Findings revealed the power of cultivating out-of-school learning spaces like the after-school program to alleviate barriers such as time constraints, rigid curriculum pacing guides, and inflexibility in the learning process. Findings indicated that when youth were afforded opportunities to provide input in what they learned and autonomy in how they demonstrated that learning, there was an appreciation for the

process and evidence of joy in the creations they produced. As a researcher and facilitator, the ability for youth voices to be heard within this study allowed me to leverage their cultures and interests in my pedagogical approach. Implications indicate a need to diversify the teaching workforce, include student voices in curricular decisions, and incorporate the histories and identities of Black people in science. YPAR has the potential to support positive youth development because it provides a rich space to engage in the research process and improve their schools and communities.

INDEX WORDS: Youth Participatory Action Research (YPAR), Black culture and history, Culturally Relevant Pedagogy (CRP), Science Education, Cogenerative Dialogues

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TORRESSA N. SMITH

A Dissertation

Presented in Partial Fulfillment of Requirements for the

Degree of

Doctor of Education

in

Curriculum and Instruction

in

Middle and Secondary Education

in

the College of Education & Human Development

Georgia State University

Atlanta, GA
2024

DEDICATION

To Justin, Ryan, and Bryce,

Thank you for giving me the space and time to express myself in this work. You are “My Why” for the work I do. I love you and thank you.

Thank you to my family for your continuous support throughout the years. I can never repay you for your time, love, support, hugs, laughs, and, most importantly, your encouraging words to keep me going. I Love You.

ACKNOWLEDGMENTS

First and foremost, I would like to give honor to God; without His unwavering love and support, I would not be at this moment today. “He does exceedingly and abundantly above all that we can ask.” Ephesians 3:20 KJV, and for this, I give Him praise.

To my first supporters, Mom and Daddy - thank you for EVERYTHING. Thank you for the weekend babysitting so I could write, sleep, or have a mental break. Thank you for the push and for not allowing me to quit so many times. I can never repay you, and I know what you would say anyway…You don’t have to repay me; just finish what you started.

To my wonderful husband, Justin - I love you and owe you so many free weekends to enjoy watching the games you missed while entertaining our sons while I was writing or taking a break. You may have only complained once, maybe twice, but you stood beside me or slept on the couch as I worked to let me know that you supported me along my educational journey. You understood how important this work was to me, and you always offered to read a paper, run to the copier, or just listen to me read and share my thoughts. From the bottom of my heart, I appreciate you. Thank you.

To Bryce and Ryan - You did not know what “Mommy has homework” meant. You two continued to make our house as lively as ever. I sometimes missed special moments because I had to work, but I knew I could not skip too many, for you two were growing up so fast. I am glad I had the opportunity to watch you grow as I worked because it made this work much more

meaningful, as I want your voices to be heard in a world that may try to silence them. You are destined for greatness, so use your words to help you lead the way. I love you more than you love me. Love, Mommy.

To my Angel Babies - You are forever in my heart.

To Shannon and Jonathon - Thank you for always calling to check on me to make sure that I am writing and mentally okay or to tell me the latest gossip to put a smile on my face. Thank you, T-T, for the free babysitting services I owe you. I did this for us. You should know that anything is possible at any age if you are determined. Continue to want more for yourself and go for your goals and dreams; nothing is impossible.

To Bailey - You are the ultimate work companion. You would stay up with me as long as possible, and I thank you for watching over me late at night.

To my Ancestors, you instilled in me high goals from a very young age. You always told me I could do anything and even become a doctor. I am my Ancestors' wildest dreams. I hope I made you proud.

To my Chair, Dr. Natalie King - Thank you. To the only person who will give you a push up a mountain to explain this doctoral journey, as it is not easy, then make you write once you get to the top…it is you. My mom's favorite saying is, "You better do what Dr. King has told you to do." You know your scholar's potential better than we know our own. You are the one person

who can call, and my heart drops because I am nervous about the task, but I know it will lead to great rewards, as seen here. Thank you for the cheers and tears we shared.

To my Committee Members, Dr. Partick Enderle and Dr. Reneé Schwartz, Thank you for pushing me and making me think outside the box. Thank you for your feedback along this journey.

To my family and friends - Thank you for understanding, as I may have missed your wedding, baby shower, birthday party, or gathering. I hope you understand the dedication I had to make for this work to come together. I am ready to hang out again. Where are we off to next?

To my work family - Thank you for your support over the years. I can honestly say that you have loved and supported me through my ups and downs along this journey. Thank you for being a soundboard, a shoulder to cry on, or a cheerleader in passing.

To the STEAM Team, thank you for your voice, passion, hard work, and creativity. I hope you continue to let your voices be heard and your lights shine wherever you go.

To Cohort 2019 - It was a pleasure to share our evenings, dinners, memories, laughter, sorrows, and much more together. We will always be a GSU family.

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CHAPTER 1: INTRODUCTION

Every story has a beginning, and that is also true about science. There are untold stories of Egyptians gazing into the sky, seeing that there is more to the night sky than just twinkles, but a pattern to develop maps known as constellations (Woods, 1998). As Egyptians continued to enhance their knowledge of astronomy, creating waterway navigation systems were later used for trading among other countries. The development of the number system produced one of the world's seven wonders, the Egyptian Pyramids, based on formulas and calculations. Medical techniques were paramount during their time and beyond to heal illnesses among populations, such as malaria, the creation of vaccines, and the use of an array of plants used for medicinal purposes still used today (Blatch, 2013; Van Sertima, 1991). Without ancient Africans' knowledge and skills, none of these scientific methods would be at the forefront of science education today.

Fast-forwarding to today, the thought of mainstream inventions and the inventors, such as the car invented by Karl Benz (Sheldon, 2021) and the refrigerator designed by Jacob Perkins (Hertzmann, 2016), both created by white males; we might automatically tie those inventions as life-altering.

The automobile allows people to travel vast distances comfortably and drastically reduces the time to go from Georgia to Texas. For example, the refrigerator enables many people to store food longer without spoiling. It is almost taken for granted or forgotten that without inventions like the automatic gear shift invented by a Black scientist, Richard Spikes (Wilson & Wilson, 2003), a trip that typically takes a couple of days would take weeks. Since we would have to travel at the same speed from Georgia to Texas, consider food storage and its availability in

stores. If it were not for the refrigerated freight trucks invented by a Black scientist, Frederick Jones (Davison, 2013), that made transporting food over long distances possible, food would spoil faster.

Why is so little known about these and other inventions Black scientists and inventors created? Restrictions provided obstacles for Blacks to obtain patents due to certain restrictions. Stories of the past have continued to show a pattern in which stories are told, revealed, and concealed (Bell, 2010). The untold stories are based on who had access to tell stories and what is shared through storytelling. A Black person had to be either free, born into freedom, or purchased their independence, which limited the ability to gain ownership of what they created because the law stated that they could not own property if they were enslaved (Van Sertima, 1991).

Why is it very seldom that Black youth know their history? History is made entirely of stories passed down from generation to generation. The separation of Africans from their families made it difficult to pass down these stories as they were torn apart, brought to America, and enslaved. Folklores, the stories of African cultures, were based on the storytellers' interpretations and what they saw. Therefore, only parts of the stories have been told to the next generation (Musher, 2001).

Now is a better time than any to recognize Black scientists and inventors for their contributions to STEM improvements that are not publicly mainstream but still invaluable. Having students know how science is derived and the accomplishments of these Black scientists and inventors can have the potential to create a sense of belonging to the science world, as these contributions have made a tremendous impact in the world we live in today.

Problem

The science curriculum focuses on the content; it does not showcase the triumphs of Black scientists and inventors in the STEM field. Students typically learn about foundational scientists such as Albert Einstein, Isaac Newton, and Neil Bohr, all white males. Looking at the curriculum, which students see as relevant, does not showcase them acknowledging contributions that Black scientists and inventors have made. The usual thought is that Black students will learn about their history and culture during Black History Month; however, the accomplishments and contributions of several Black scientists and inventors are rarely addressed during February, much less during the entire school year. The science curriculum and textbook resources' representation of scientists does not adequately represent the students' demographics in science classrooms (Brown, 2017; Kendi, 2019; Sleeter, 2007).

Brown (2017) noticed limited use of cultural integration within the classrooms. Parents and students have been pushed away from the science curriculum due to the lack of understanding of content knowledge. Brown also noticed that students did not understand the scientific discourse since culture was absent in the science curriculum. Lacking content discourse was a problem since it meant communicating knowledge of the information taught in the classroom.

Sleeter (2011) mentioned how teachers lack expectations for Black and Brown students, which ultimately transferred to teaching them on lower levels and placing them in lower-achieving classes. Therefore, narrowing achievement gaps would alter based on how teachers view their students and incorporate culture to make connections for students to learn and grow academically.

So, how can students learn, and teachers teach the science curriculum when white males make up seventy-seven percent of scientists represented in textbooks, creating a disproportionate

representation of a diverse science curriculum? Black students should have the opportunity to learn about their heritage, similarly to their White counterparts (Howard, 2003). Therefore, the science curriculum must be altered to represent a more diverse science scholar population (National Science Foundation, 2007). This notion comes as the numbers are at a low for Black scientists and inventors present within STEM, showing minorities are underrepresented in this area. With less than ten percent representation in a science text, this limits how students visualize what success can look like in Black students who might express interest and are offered experiences within STEM fields (NSF, 2007). Garrison's (2013) research showcased how Black students matriculated through school and started their interest in a science field. Later, students' interest began to decrease, leaving the study of science at an early age.

Conceptual Framework

As an educational researcher, thinking about how to make the classroom more inclusive for Black students within American schools required me to incorporate tenets of culturally relevant pedagogy (CRP; Ladson-Billings & Tate, 1995) and put this theory in conversation with critical race theory (CRT; Delgado & Stefancic, 2001). I specifically leverage three CRT tenets in this work to center race, elevate stories, and discuss the ownership of education as property.

Culturally Relevant Pedagogy (CRP)

Shannon and Bylsma (2002) studied students from Washington state, where they noticed achievement gaps between white students and Black students from affluent and improvised areas. They realized that Black students would have to speed up their achievement to close the achievement gap between students. The problem with achievement gaps is that students are not on equal playing fields with the same equipment. Research talks about closing achievement gaps by over-testing students or lowering the requirements for different ethnic groups, believing this

would boost confidence levels in testing or performance (Stiggins & Chappuis, 2005). However, these methods will not benefit students with minimal skills after leaving school due to reducing the numerical values to lessen the achievement gap.

Instead of altering numbers to benefit data, Ladson-Billings (1995) stated that it is essential to design a curriculum and develop pedagogy geared toward Black students' cultures that will allow them to thrive like their White counterparts. She proposed CRP as a mechanism to make the curriculum more accessible for students so that they could experience academic success. CRP focuses on "inserting education into the culture" (CRP; Ladson-Billings, 1995, p. 159), and educators must be willing to adjust to more equitable learning opportunities for minority students. A constant lack of CRP implementation in schools creates missed opportunities for students to learn and grow. According to research, achievement gaps are based on students' performances, making students more accountable for their learning (Lee & Orfield, 2006; Stiggins & Chappuis, 2005). Students learn by doing what interests and pertains to them; as educators, we consider real-world connections. Students then can see and apply concepts from their cultural lens and use them as a reference point for achievement (Shannon and Bylsma, 2002).

CRP consists of three tenets which focus on understanding one's culture while teaching practices are centered around equity and justice (Ladson-Billings, 2014). Students must be conscious of their social identities and societal positions and navigate being active participants in "democracy" (Ladson-Billings, 1995, p. 160). Students come to school with different intersectionality and are unique in how they experience, develop, and achieve through their identity (Collins & Bilge, 2020).

The first tenet of CRP ensures that students learn and achieve academically. “Academic success” (Ladson-Billings, 1995, p. 160), as one can negotiate their learning space and value the abilities they bring into this space. Ensuring that students understand their culture through various learning avenues can range from language usage, presentations from community members, or cultural food to enhance their competence in understanding value. Teachers can be stewards of welcoming the opportunity to create a more diverse learning environment. Ladson-Billings and Tate (1995) identified that good teaching comes when pedagogy strategies are foundational to students’ academic success. Understanding the knowledge that students enter at the beginning of the year and seeing students’ academic growth in education by the end of the year can show if they have a greater understanding of the content. However, learning the content alone does not mean students genuinely connect to the subject. Therefore, catering to students’ needs through their interests, culture, and community can strengthen students’ academic achievement in science education.

The second tenet of CRP pushes teachers to teach with cultural competence for their student population, meaning for this study to incorporate Black history and culture into the curriculum is a door opener to create opportunities where students can see their culture as “a vehicle for learning” (Ladson-Billings, 1995, p. 161). Teachers who understand how students learn and what obstacles they might face can reduce learning challenges by catering to students' needs to ensure they achieve academically. This CRP phase allows the cultural aspect to take center stage in the learning process through “cultural competence” teaching (Ladson-Billings, 1995, p. 160). There must be a critical look at what is lacking in education for some students and what is offered for others. Achievement gaps have been the staple for explaining the performance of Black students. Therefore, looking at methods to create opportunities for students

to achieve should be at the forefront for teachers as they gain insight into students within their classes.

The third tenet of CRP opens students' and teachers' eyes to be critically aware of the mandated outlined curriculum and what is missing from the content. Students and teachers can collaborate as an educational community as sociopolitical consciousness heightens to determine how to incorporate Black culture into education. Blending culture can shine a new light on the contributions of Black scientists, past and present while discussing the inequities in education and their communities and determining ways to solve this problem because there is a tremendous sociopolitical view of representation and who matters in various spaces within the past two years. For students to navigate where they belong in a learning space should not be a hurdle for learning to occur but a way to embrace learning year after year.

Suppose teachers are attentive and students notice the unequal access to resources, class, and opportunities. In that case, CRP teaches students to be critically conscious (Ladson-Billings, 1995) and figure out ways to change the narrative of what society has written. Freire (2000) described the oppressed and how they must decide to stay oppressed or liberate themselves. The work it takes to dismantle what has always been the norm for a group can be hard to fathom, anything different from trying to endure society's struggle.

Ladson-Billings (2014) consistently focused on the criteria for CRP. Gay (2002) described the inadequate preparation of teachers for the students they serve by not knowing who their students are, and their culture already shows the lack of CRP that takes place once students enter through the door. The thought that students are ineducable shows the importance of critically reflecting on teaching styles to showcase that a one-size-fits-all teaching model does not work in today's schools. Howard (2003) mentioned how teachers should reflect critically on

their pedagogy style. The use of the same lesson plans each year is altered based on students' needs, interests, and ability levels; therefore, revamping the curriculum to adjust to students' cultures should fit and become standard practice when cultivating lessons for the classroom.

CRP is suitable for this study. As classrooms become more diverse, students' cultural capital should play an intricate role in teachers' delivery of instruction through culturally relevant pedagogy. Embracing and nurturing their identities in science, strengthening literacy and discourse content knowledge can improve how minority students perceive science to continue to embark on studies in science education. Altering classroom teaching styles and curriculum alignment to students can open doors and allow students to expand what they know and make it so that minority students can succeed in the classroom and beyond. These frameworks' primary goal leads to Ladson-Billings (2014) of teachers providing CRP with focused lessons that gear teachers to think about their social responsibilities of promoting equity inside and outside the classroom.

Critical Race Theory

Delgado and Stefancic (2001) described "the critical race theory (CRT) movement as a collection of activists and scholars interested in studying and transforming the relationship among race, racism, and power" (2001, p. 2). There are five tenets of CRT in education that are structured around the notion that 1) racism continues to exist, 2) Whiteness as property, 3) counter-storytelling, 4) interest conversion, and 5) critique of liberalism. The first tenet states that racism continues to exist in the United States. Based on the structure of the present-day curriculum, this notion stands to live from the lack of representation of Black individuals within content materials. One's race continues to be a factor in inequitable education for over one hundred years. White and Black students could not learn in the same building based on the color

of their skin, not until after a landmark case, the *Brown v. Board of Education*, overturned inequities in education and ruled for the integration of schools (Love, 2019). However, there is still a substantial racial divide within our school systems (Ladson-Billings & Tate, 1995). The superiority of white students in having resources, materials, and better structural buildings was a means to hinder the advancement of Black students in education. Education processes that stimulate the oppressor "depresses and crushes simultaneously the spark of genius in the Negro by making him feel that his race does not amount to much and never will measure up to other peoples' standards" (Woodson, 2006, p. 5). Pinar (1993) also describes Blacks' gaps and exclusions in curriculum resources. It is a denial for Blacks to receive an education if the representation is missing and continues to be excluded from education resources.

CRT's second tenet is that property rights do not equal human rights. Property value equates to an elevated opportunity to progress in education. Delgado and Stefancic (2001) continued to investigate what racism is in CRT and how it affects the class, welfare, and poverty of Black people. Cities have utilized different tactics to separate Black people from white people, even when developing towns and building infrastructures like highways to be a permanent divider of neighborhoods. Bell (2009) described property lines drawn to distinguish between the haves clearly and have-nots, but more so, Black and white. Rousseau Anderson (2019) explained how racism is a structural aspect, and the "allocation of material resources" (p. 21) is a way to understand the racially divided lines in education. The identification that property is a treasure to showcase superiority means one must have a property to be amongst the dominant group. Crossing into spaces that are not welcoming due to race presents obstacles to understanding one's positionality in different areas.

The third tenet of counter-storytelling allows for the voices that have been concealed by the majority group to be heard. Experiences through counter-stories allow for stories to be heard; “critical race theorists deploy stories and narratives as a means of building cohesion within minority groups and shattering the mindset created by the stories of the dominant group” (Delgado & Stefancic, 2001, p. 91). The lack of representation within the curriculum is due to the lack of information that is known. (Bell, 2010)

The fourth tenet of interest convergence suggests that everyone's interests are aligned. In education, the notion is that if the resources are mainstream and the curriculum content is the same, then that is equal education; however, that is not equitable education. If only one interest is being addressed, the interest of others is pushed to the side, and cultural and racial injustices are taking place. Interest convergence works for the dominant interest, “people believe what benefits them” (Delgado & Stefancic, 2001, p. 41) to be placed at the forefront of the policies that are created.

The fifth tenet of the critique of liberalism describes how affirmative action, color-blindness, and merit principle are supposed to create equity in spaces. Some scholars believe that it just creates a space that is objective to whose truth is being heard. (Delgado & Stefancic, 2001).

I decided to highlight only three of the five tenets that align to my study at this moment and omit discussing interest convergence and the critique of liberalism at this time. The interest of incorporating Black culture and history into the science curricula is not currently on the forefront of the curricula agenda in the science community, which is the fourth tenet, interest convergence. There is a possibility that interest will gain once the science community can see the impact that representation for Black students can have in STEM fields (Lee et al., 2022).

When thinking about the critique of liberalism, middle-class whites and middle-class Black students do not move at the same rate due to the placement of students in classes, classes offered, and inadequate instruction provided to students due to low teacher performance or high teacher turnover rate (Darling-Hammonds, 2010; Ladson-Billings & Tate, 1995). Predominantly Black schools do not represent the essence of equitable education classes, with classes in place such as remedial classes, special education, and co-taught classrooms that are overcrowded and basic level courses (Darling-Hammond, 2010). Creating equal learning opportunities for Black students can bridge the gap for learning advancements. Comparison of content course opportunities is deeply rooted in a student's location. Suppose a student lives in an affluent area, and there is a wide range of course selections and accelerated, advanced placement courses to prepare for a career in the STEM field. In contrast, the introductory requirement courses offered to students in urban areas lack the exposure students receive to curriculum content within their neighborhood schools, showing injustices in the curriculum (Ladson-Billings & Tate, 1995). Figure 1 showcases the alignment of both frameworks together and their place within this research.

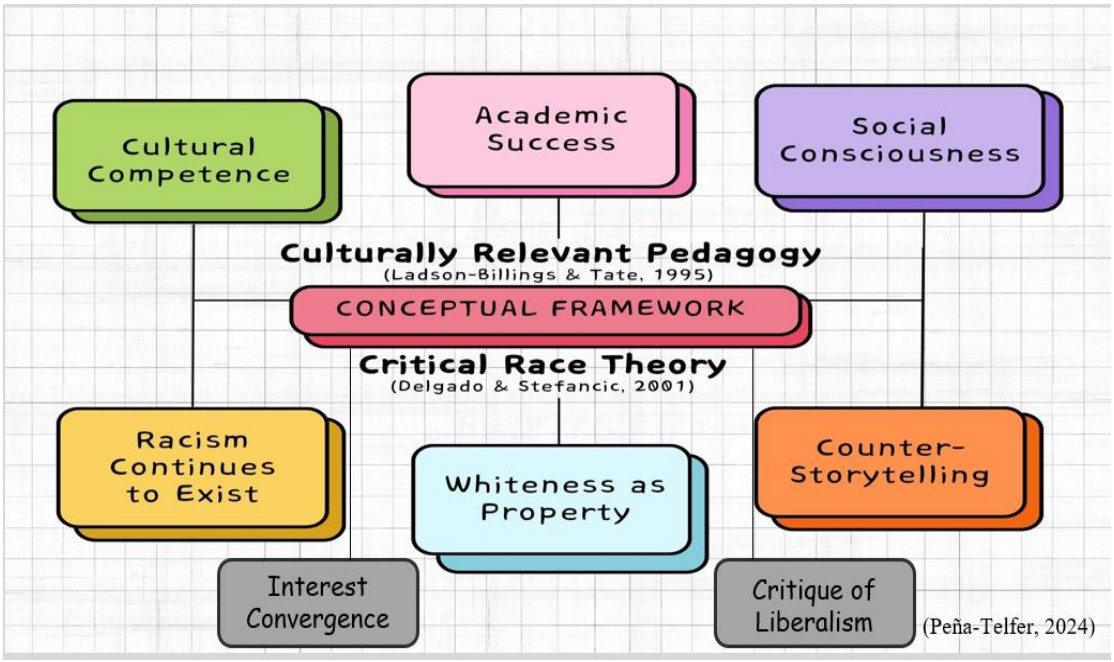

Figure 1: Conceptual Framework Map

Stories Told

Stories told are those that we come to know and believe. Examining different storytelling methods can allow understanding what is known and shared in society. Stock stories are stories that repeat throughout history from the dominant group. Stock stories have labeled Black students as inferior. The dominant group of whites telling the story has led to many pessimistic views on why Black and white students should not be placed in the same educational facility together. With these stories told, research (Tushnet, 2009) has shown that busing, implementation of magnet schools, and courses offered in school have been a tactic to have white students join Black students in the same schools.

Concealed stories are those that hide the stories of the inferior group. The concealed stories of Black educators and organizers showcased the fears of lynching and the struggles of implementing change in education. These stories hid the objectives of protest that came with the initiative to reform education in government through the documents kept by the National

Association for the Advancement of Colored People and the Georgia Teachers and Education Association (Siddle Walker, 2013).

However, CRT created a space where stories can be transformative to groups oppressed using counter-stories as narratives. Counter-storytelling tells a story that is not always pretty; it opens up about what the stock story has covered up and makes it seem true to reality. In this research, the ability to hear the voices of the youth and how they view, learn, and negotiate their space in science provided a great lens on the importance of diversity within the science curriculum. CRP and CRT collectively show the inequities that still exist in education. Material content does not show diversity and shows how racism continues to exist through the stories from a Western viewpoint. This study shared the lived experiences of six youth co-researchers who, when given a space to learn, shared the knowledge they brought to the learning space.

Purpose of the Study

This study aimed to show what we know about the problem of inequitable representation that exists in the science curriculum. Closing the inequities in science education from the lack of cultural representation means creating a space where science discourse can be taught and communicated from the researcher to the youth co-researchers. Cultural background knowledge is present more than just on occasion, and the youth are socio-conscious about the missing pieces in education. This study hopes to increase the awareness of Black culture's scientific contributions and showcase its space in science education.

Research Question

1. When given the opportunity to incorporate Black culture and history into informal science curricula, what can middle school students showcase about the contributions of Black scientists and inventors?

2. In what ways can Youth Participatory Action Research (YPAR) support the implementation of Culturally Relevant Pedagogy (CRP) in an after-school science club?

Discussion of Research Questions

The first research questions explored what students can learn in an after-school club when lessons are created and implemented to showcase the representation of more Black scientists and inventors than what the textbooks and curriculum showcase. The exposure to Black scientists and inventors from the past, present, and within the community presents science's potential beyond the classroom.

The second research question utilizes YPAR to collaborate with students as co-researchers while creating a learning environment that encourages them to be active participants and demonstrate agency during teaching and learning. Often, youth need the opportunity to share what or who they want to learn about, and this research study allowed guidance in understanding the science curriculum their way with guidance.

Significance of the Study

This study aimed to infuse dialogue about Black excellence within our history and community more than once a year. This study is pivotal in incorporating culture into the science curriculum more than once a year (Holly, 2021). Youth could integrate past and present scientists and inventors to science standards, increasing their discourse and knowledge of the content. The ability of youth to be researchers and guide their learning can jump-start the classroom to be a collaborative place to learn and grow students. Students should be able to take what they know and make meaningful connections to their world.

Using CRP helped bring awareness through cultural integration (Boutte & Hill, 2006). Students became aware of the social aspect of learning in their community as they centered their learning on their cultural background.

Considerations

Leedy and Ormrod (2015) described considerations the researcher must be mindful of while conducting the study. One consideration for this study is not selecting a sizable participant sample size. A large sample size would not be beneficial based on the data instruments and analysis utilized. I wanted to capture the views of all participants to hear their voices, analyze them with validity, and promptly alter lesson plans to switch for the following implementation.

Throughout the research, I was mindful of my participants, their feelings, and concerns by constantly having open dialogue within the after-school club. Using their discourse and knowledge as they continue to learn about Black culture and history in science will keep me grounded on the most important thing to research with my participants and not on my participants (Geertz, 2005).

Researcher Positionality

My K-12 education experience may have been different from the students I teach, with regulations on traveling, limiting school field trips, testing now being the primary focus of what students need to know, and a more data-driven curriculum. Therefore, as a sixteen-year science educator, as I conduct research, I acknowledge my biases. I have an excellent national and local standard science curriculum knowledge base. As a researcher, I come to the table with bias, and readers unfamiliar with youth conducting the research might be cautious of the chosen research methodology. To eliminate those biases of youth as researchers, I allowed my participants to

develop opportunities to work and plan the lessons while being members of the decision-making process (Ginwright, 2008).

The National Research Council (2000) stated steps to eliminate bias to formulate a research question, ground the explanation, and be open to revisions. Kirshner, Pozzoboni, and Jones (2011) have not found ways to eliminate youth participatory action research (YPAR) biases. Minimizing bias means reflecting on my personal or current beliefs, making sure that I consider the intersectionality of my youth researchers, and incorporating the ideas and thoughts they bring to the research table (Kirshner, Pozzoboni, & Jones, 2011).

Organization of the Study

Chapter 2, the literature review, first looks at how education can create a divide between race and racism. Later, how this led to the current state of the science curriculum and recent reforms to address these issues changed the curriculum. Then, in chapter 3, describe the layout of my research methodology, which was conducted during an after-school club.

CHAPTER 2: LITERATURE REVIEW

A famous Maya Angelou (1997) quote reads, “You can’t know where you are going until you know where you have been.” Looking at the racial divide in our society has also created a wedge in the education system. There is an ongoing battle of what should and should not be taught in the classrooms, mainly that of Black history. If students do not learn it at home, the consideration of where they will learn about history is presumed in the classroom.

Race and Racism

Looking at the root of critical race theory will help us better understand how it can impede the education sector. Derrick Bell is the father of CRT (Delgado and Stefancic, 2001); other legal scholars studied the difference between race and racism from a legal perspective.

Racism looks at the power structure of society and how society operates through scenarios. These systems identify if the oppression of other races is the group's objective. Parker and Lynn (2009) mentioned how foundational author Derrick Bell describes racism as “an endemic part of American life, deeply ingrained through historical consciousness and ideological choices about race” (p. 149). Terms of racism are consistently seen and rooted in education, from the segregation of schools, the writing of curriculum, and the funding of programs.

Beginning of Education

The realism of racism started from Plessy v. Ferguson to Brown v. BOE. The streetcar segregation and schooling segregation were ways to showcase superiority over the Black race. America wants to seem like they are doing the right thing, but it should not take other countries looking at us to implement equity in the interest of other countries. The sentiment of “humorlessly” (Alexander, 2019, p. 62), as a connotation used when describing Black students’ success in education, is a way to show how the perception white Americans feel about Black students achieving in education with hopes of them failing. The inferiority paradigm showed that schooling is negotiable as a legal issue, which meant social action created opportunities for Black students with CRT. The systemic problem of equilateral distribution of funds and Black students would obtain the same resources, rights, and class as their white counterparts. The thought of having the same material meant that there was an equal playing field for achievement. Lincoln and Guba (1994) describe paradigm shifts beyond the positivist viewpoint, meaning qualitative research methodologies must be restructured. Everything in education cannot always involve the numerical aspect to determine students’ success. A researcher's goal is to restructure the research done, gather insight from participants, and assist in making modifications and transformations within systems to make a situation better than what we found before the

research. So, thinking about the intentionality of CRT is education to bring forth issues that have been hidden and make progress as a society. So now, we will look at the current reform of the science curriculum on the national and state level to view ways the educational systems try to fix the previous problems of inequities in education by making slight alterations.

Current Reform

National Level

Science constantly changes due to new ideas, discoveries, and revisions to old concepts. One of science's veteran experimentation practices, the scientific method, involved steps for scientists to follow, hoping that the derived results are like those already found (Wivagg & Allchin, 2002). McComas (1998), Dispelling the Myths, stated how we have always learned to hypothesize for the experiment we wish to conduct using the scientific method. The problem with doing science the traditional way is that it formulates the notion that additional thinking, investigation, or rebuttals cannot occur within scientific discovery. It is suddenly not useful anymore; it just means that there can be an elevation in our understanding of how the world is changing (Kuhn, 1996).

Science education in the United States has been competitive, dating back to the Space Race over 50 years ago between the United States and the Soviet Union, which could be the first in space exploration (Marlin, 1987). The National Commission on Excellence in Education (1983) expressed in The Nation at Risk how current generations will not have the same nor be in a better place educationally in the future as an educational system, meaning that alternating the curriculum is viable to be competitive globally. The focus of the United States Department of Education was to reform education using the Neoliberalism approach of taking control of the education system to help modify the curriculum and move education in the direction that would

successfully produce students in science, technology, engineering, and math (STEM; Tobin, 2011).

The Next Generation Science Standards (NGSS; Next Generation Science Standards, 2013b) created a more inclusive curriculum for all students to reduce the achievement gaps. The purpose was to focus on underserved students and create a more equitable learning opportunity for students nationwide. Doing this meant creating standards that best support practices in the classroom for teachers in implementing instruction. If students were in a private, public, or charter school, what they learned and how they learned about science would remain the same based on the new NGSS that had expectations for even struggling learners to succeed by making connections within the science content. NGSS aims for students to take what they learn from year to year and build their understanding, make connections, and relate concepts to other content areas and what they know. By understanding the disciplinary core ideas and working as scientists with science and engineering practices, students would see how science can be cross-curricular and cross different domains in science with crosscutting concepts. Linking these concepts together allows all students to be included in science as it starts to transform from a Western perspective to a more holistic view for all students.

NGSS (2013) considered an opportunity to increase students' exposure to jobs during grade school due to declining enrollment in STEM fields. The goal of NGSS is to engage all students in the learning process of science through 3-dimensional learning. The 3-D framework is like a bridge that connects science from one year to the next. By using these standards, it links Science and Engineering Practices (SEP), Crosscutting Concepts (CCC), and Disciplinary Core Ideas (DCI) to concepts from different science disciplines, intending to have students learn scientific concepts through connections.

The big idea of the 3-D standards is to use the SEPs to get students thinking as they work and interpret what they encounter as scientists using inquiry skills learned in science courses (NGSS, 2013c). CCCs purpose is to create a way for connections on a larger scale through the views of different domains such as “patterns, similarity, and diversity; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; stability and change” (NGSS, 2013c, p.1). Students can also connect from one subject to another as an interdisciplinary content connection. DCIs should align with a minimum of two of the four ideas. The following ideas from the (NGSS 2013c) are essential for the science curriculum: Have broad importance across multiple sciences or engineering disciplines or be a key organizing concept of a single discipline.

- Provide a key tool for understanding or investigating more complex ideas and solving problems.
- Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge.
- Be teachable and learnable over multiple grades at increasing levels of depth and sophistication (p.1)

NGSS focuses on students using their knowledge through their encounters with other science courses to understand and build empirical knowledge. The goals are to access the scientific world with a more critical lens, allowing students to defend what they know through communication and transferable knowledge from one content area to the next level (National Research Council, 2012; Simon, Erduran, & Osborne, 2006; Sampson, Grooms, & Walker, 2011).

State-level

The 3-D model for Georgia Science Standards of Excellence transformed the traditional learning method from worksheet-based activities, students reading textbooks, and recalling by answering questions at the back of the chapter to a more robust form of learning. Teachers are now using the standards to do three primary things when developing their lessons: think about what students will *obtain* from the standards during class, evaluate students' understanding of the standards, and *communicate* what they have learned. The expectation is that students become facilitators of their learning through interactions with investigations, researching through multiple resources, and engaging in open-ended discussions while showing their understanding through presentations and final written scientific reports to enhance their communication skills.

However, teachers must create opportunities for students to ask questions, use models, analyze data, solve problems, and argue their findings. The state wanted teachers to help connect other sciences, building students' knowledge, problem-solving skills, and scientific literacy, bridging content areas from one year to the next (National Research Council 2012). Therefore, as Georgia transitioned to the GSE, the focus was on preparing teachers to have a mind shift in their content teaching. Dogan, Pringle, and Mesa (2016) described how learning communities are an excellent way for teachers to transition their pedagogy from traditional modes to current reforms while enhancing their understanding of the content. In professional learning communities (PLCs), teachers can collaborate, express their concerns, strengthen their skills, and have a support system as they continue to craft their skills (Hord, 1997; DuFour, DuFour, Eaker & Karhanek, 2004).

The shift from GPS to GSE meant that all students should engage more within the science classroom and make connections as they matriculate from each grade level. However, at the state level, the implementation of the 3-D standards did not eliminate standards being taught

in silos by unit topics. The focus of GSE should be to prepare teachers to educate diverse populations while enhancing the curriculum. GSE wants students to focus on what scientists must do. Therefore, teachers should focus on creating spaces and opportunities for students to conduct themselves as scientists, exploring and engaging fully in the content and learning process. These changes from a content-heavy curriculum to a more practice-based approach to science allowed students to design and think about science more complexly through academic discourse, experimentation, and communication (Bybee, 2014).

Despite using NGSS at the National Level or GSE at the state level, each approach differs. However, it is still similar in wanting students to become knowledgeable thinkers and inquire about the science around them. How to do that is by allowing students to become facilitators of their learning (Casti, 1989; Lederman & Lederman, 2014). Three-dimensional learning took the traditional scientific method to a new level of growth for students, where the transition from the process of discovery takes on a new meaning, then trying to determine what is the correct answer to the research question (Sagan, 1994; Casti, 1989; Kuhn, 1996). Ignorance limits us from thinking differently, and it is okay to charter the unknown territories of science, making science so unpredictable (Firestein, 2012).

NGSS Diversity and Equity

Even new ideas can hit roadblocks. Only twenty states have adopted the NGSS, showing that there is still much work within the science content area to grow and be accessible to all students. The NRC (2012) reported through consensus reports that science initiatives helped increase teachers' understanding of engaging students in diverse formal and informal classroom settings using these standards (Next Generation Science Standard, 2013).

Since only twenty states have adopted NGSS, the accessibility, as stated, "All Standards, All Students" (NGSS, 2013, p. 1), does not apply to all students. Select students can engage in

these standards. NGSS is known as higher-order thinking and an inquiry-based curriculum; only students who have typically performed well in school, “advanced, gifted, honors students” (NGSS, 2013, p. 1), enroll in a course using the 3-D framework. The notion of “All Standards, All Students” (NGSS, 2013, p. 1) has isolated students into categories of how the science pedagogy should be altered to teach students labeled as “non-dominant” (NGSS, 2013, p. 1). Students in underserved populations identify as “economically disadvantaged students, students from major racial and ethnic groups, students with disabilities, students with limited English proficiency, girls, students in alternative education programs, and gifted and talented students” NGSS, 2013, p. 2). The pedagogy would be a scaled-down version of what the dominant students would learn.

Discourse in science helps define what students come to learn about science. NGSS and the implementation’s layout to have students go through various communicative steps to analyze what they see taking place can challenge students in the non-dominant groups due to language barriers or learning disabilities. Learning basic skills labeled as proficient according to students in a dominant group will not allow for the same exposure to all NGSS standards. Students in these groups have less time to practice their science discourse and skills of communicating their findings due to focusing on “literacy development and numeracy” (NGSS, 2013, p. 4). Therefore, a setback in learning about science occurs, pushing these students further from understanding scientific concepts.

Understanding race and racism is an integral part of understanding the operation of the classroom. Knowing which direction to take with students and how these two components can impact teaching and learning is crucial for an educator. As educators, we might think about what students come to the classroom knowing, how students’ learning is enhanced through social

justice initiatives, and whether students visualize themselves in the content taught; these are vital questions to consider when implementing lessons in the classroom. In this chapter, I argue the importance of equitable learning with representation in the curriculum, to promote social justice for Black students in education, and show the lack of representation in the science curriculum.

Education Transformation

In a recent article, Ladson-Billings (2021) wrote about how education needs a "hard re-set," meaning that we cannot return to teaching after everything we encountered during the COVID-19 pandemic. This hard reset showed us that people, culture, and education matter. Black culture needs to be taught in schools and not in isolation for a day, a month, or when something happens, and we want to shine a light on situations. Black students and culture are all-inclusive of American history and should be in schools. The world saw how quickly a pandemic changed how schooling shifted from in-person to virtual; we also witnessed the creation of lesson plans to teach students about the virus; the same thing can happen during a lesson planning session by incorporating culture into the science curriculum.

Underrepresentation in Science

How often does a Black student open a science book and see a picture or an article about someone who resembles them in the science field? Opening a science book and engaging in the possibilities of being a scientist is not always an option for Black students. The usual thought is that Black students will learn about their history and culture during Black History Month; however, the accomplishments and contributions of several Black scientists and inventors are rarely addressed during February, much less during the entire school year.

Visintainer (2019) researched underrepresented students and their experience with racial views. She noticed that Black students did not see themselves in the science field; they

acknowledged other racial groups as the normalized view in science and felt a sense of inferiority because of the lack of exposure to encountering Black scientists throughout the school's science curriculum. Creating representation in the curriculum where students learn about their culture can show equity within science, and students can have a positive outlook on their identity in science.

Having Black students identify with Black scientists within science can open doors for learning and engagement. Students develop a mindset of who they want to become as early as elementary school; therefore, Ladson-Billing (1995) understood that race matters when students learn and can influence their career path or life goals.

Aschbacher, Li, and Roth (2010) stated that high school students found it challenging to determine their career path in school. The lack of representation of minorities, especially females, in the science field, created a lack of motivation for students to learn about different STEM careers. Since high school is the time to determine a career path, students must be familiar and comfortable with the options they choose to pursue. For example, the researchers chose the 10th-grade class in six California schools based on ethnicity and economic diversity to understand how students viewed themselves as they matriculated to 12th grade, seeing if their interest veered away from science, engineering, and mathematics (SEM) majors. More than half of the participants dropping out of science-related courses by 12th grade showed a decline in STEM-related careers. Therefore, the need to create cultural representations in science classrooms early in elementary and middle school can create opportunities to heighten students' interest in science (Aschbacher, Li, & Roth, 2010; Ceglie & Olivares, 2012).

As the literature shows, this research is needed to explore how students can become more aware of inequitable representation. Black culture and history within the science curriculum;

awareness charges for students to become more conscious about what they learn and how they learn content to represent their culture.

In the following sections, I will discuss how the science curriculum and textbook resources lack representations of scientists and do not adequately portray Black scientists in science education courses. Making connections is part of meaning-making and learning for students. Students connect to what they can see, which can transcribe to what students think they can do, who they can become in science through their lived experience from home, to school, to the community as influencers, and what students construct as the value of science (Brickhouse, 2001; Furman & Calabrese Barton, 2006; Lave & Wegner, 1991).

Science Curriculum

Science continues to be a white-male-dominant content area with a low acceptance rate of diversity. Research data shows that less than 10% of Black scientists are in the science curriculum (National Science Foundation, 2007). This is significant because it determines what and who is in the science content area. Information given to students only showcases part of the history of science from cultural perspectives. It leaves out discoveries, inventions, and triumphs of Black culture in the current science curriculum (Ceglie & Olivares, 2012; Lederman, 2003).

On a national level, the Next Generation Science Standards (NGSS, 2013), appendix D, showed inequities based on how schools should structure their science courses. The science standards stated the placement of students based on which category range met students' ability level, such as students with disabilities. They noted the quality of rigorous instruction is limited in special education classrooms (Next Generation Science Standards, 2013). Schools considered in the *dominant category*, "social prestige and institutionalized privilege" (NGSS, 2013, p. 1), have a step up in achieving science. Resources such as advanced placement classes, robotics

clubs, and smaller class sizes can engage students' interest in STEM fields (Orfield & Lee, 2006; Stiggins & Chappuis, 2005).

On the other hand, students in the *non-dominant groups* are the "ones underserved by the education system" (NGSS, 2013, p. 1). This labeled group continues to have the minimum courses required, remedial courses in place for Black students based on achievement levels in other classes, and a lack of ability to engage in higher-order thinking. Unfortunately, the limitations from the dominant group to the non-dominant include limited or no after-school science clubs to partake in and overfilled classrooms where teachers do not have the tools to engage students' interest in STEM education. Therefore, teachers must create opportunities for underserved students to engage in lessons that will allow them to be academically successful, and engaging in exploration is imperative for students (Ladson–Billings, 1995).

Textbooks and Curricular Resources

White scientists' images of who can be a scientist in high school *Biology* (Desalle & Heithaus, 2008) book made up 77% of the textbook compared to 10% of Black scientists represented in texts, showing a disproportionate representation of a diverse science curriculum resource (Ceglie & Olivares, 2012). Black students should have the same opportunity to learn about their heritage, similarly to their white counterparts, through the visual images of what success can look like for Black scientists in school (Howard, 2003; NSF, 2013). Seeing the underrepresentation in science shows that there need to be alterations in the layout of the science curriculum to represent a more diverse science population.

Ceglie and Olivares (2012) stated that secondary science textbooks, such as the one used in Georgia, *Biology* (Desalle & Heithaus, 2008), cannot incorporate minority students' cultural beliefs into the curriculum. Even though this is a high school and not a middle school textbook, Holt's publications are the books of choice for many Georgia high schools and middle schools.

The results of the tally mark analysis, where the researchers went through the texts and coded images, showcased that based on race, 54% of white individuals appeared in the science book compared to 15% of Black individuals. With this type of representation that students carry to class daily as a resource guide, how can I, as an educator, stress that science is essential and that Black students can belong in the science field? Therefore, resources aligning content and diversity can enhance teachers' ability to present the curriculum to a diverse student population with the potential to propel science to greater heights for Black students.

Science Teachers

The National Science Foundation (2013) showed how schools with a more racially diverse student population of 90% tend to have a more varied teaching staff; a less diverse school tends to have a lower diversity of teachers on their team. With the number of science teachers being around 211,000 for middle and high schools in the United States, less than 7% were Black (National Science Foundation, 2013).

Mensah's (2009) research showed the desegregation of institutions based on teacher preparation programs, lack of flexibility with the testing schedule, and content bias representing white experiences. Black science teachers were declining within science education due to increased enrollment scores for entrance into higher education institutions. With a decline in the representation of Black teachers within the science field, teacher retention was low due to a lack of support in the school system. Diversity in science teachers is essential because Black teachers are likely to work at " at-risk " schools (NSF, 2013; Ireland et al., 2018; Mensah, 2009). The demand to increase the representation of Black teachers is essential to the education of Black children in urban school areas that often see a decline in teacher retention and overfilled classrooms. However, the reality is that Black teachers have difficulty obtaining teaching

assignments due to their race (Atwater et al., 2013). Black science teachers are essential with the increasing demand for STEM professionals; based on what students see in the content resources, the feeling of not belonging to science and not seeing Black teachers places the idea that science is not for Black people.

Time for a Change

Crotty described constructionism as "claims that human beings construct meanings with the world they interpret" (Crotty, 1998, p. 43). Suppose Black students cannot identify themselves in the daily curriculum. How is it expected for opportunities to be afforded to Black students when the same curriculum that taught students' ancestors is present in schools now? Representation of Black students in science has gained my attention because I identify myself as Black, I teach science, and I am a student learning how the inequity of curriculum does not support the growth of Black students in STEM. The United States Department of Education (2019) identified Bryan School of the Arts as a Title 1 school. Title 1 schools receive federal funding to support the education of economically disadvantaged students, made up of seventy-four percent of Black students, who receive federal and state funding for operations.

There is a paradigm shift in schools. White males were the majority in schools, now becoming the minority group, according to researcher Howard (2003); the change in demographics within the schools also means that there needs to be a shift within the curriculum and how teachers present content materials to students. To eliminate the thought of intangible dreams for students about what they want to be when they grow up, the increased exposure to representations of Black scientists and inventors can lead students on a journey into other viable careers within their neighborhoods through experiences in the curriculum. However, those representations do not occur in the curriculum that districts or states have provided. In that case,

teachers can create avenues that will allow for the expression of culture within the learning space.

Enhancing Engagement in Science

The Committee of Ten understood the importance of science education. Their recommendation of science introduction begins in elementary school daily (National Educational Association Committee of Ten on Secondary School Studies, 1892). In the article, A Nation at Risk, the National Commission on Excellence in Education (1983) showcased how behind our education system is within the United States of America. Reform of education needed a catapult to catch up to other nations; however, decades later, we are still behind with a curriculum that is not student-focused, diversity not represented in STEM fields, and a lack of motivation among minority students within the STEM field. Howard (2003) described the need for culturally relevant pedagogy because of the empowerment it gives students as they create goals and become academically successful by presenting cultural materials.

Having students identify with Black scientists within the STEM field can create doors for learning and engagement. Through early exposure, students develop a mindset of who they want to become; therefore, Ladson-Billings' (1995) understanding that race matters when students learn can potentially determine their career path or life's goals.

Identifying that science alone is culturally different, teachers must acknowledge that some students must be equipped to understand the new language and science discourse they will learn. Engagement in learning science could spark the students' interest in lessons and activities to promote growth for the love of science. Hurtado, Cabrera, Lin, Arellano, & Espinosa (2009) discussed that students expressed an interest in science early on, shaping their passion as they matriculated through school. The reason was that a teacher was there to help facilitate the

learning environment, take what the students had a passion for, and enhance their knowledge and love for the content. Students must experience academic success, which is one criterion that Ladson-Billings outlines in her work through the examples of what teachers have done within their classrooms to show them the expectations to be successful students. Teachers address students who need additional assistance through Individualized Education Plans (IEP) or non-documented, but through classroom observations, which can direct the need for extra support. Teachers utilize their students' needs to drive instruction to catapult their learning. Therefore, teachers must find a way to continue connecting with students to increase their engagement as they bring the text alive within their classroom (Brown, 2017). Research has shown that student achievement increases correlations to the student's culture, dialogue, and connections within the community (Brown, 2017).

Howard (2003) mentioned how African American students who are underserved in schools tend to do poorly, either by not graduating from school or not learning and being labeled as "ineducable" (Howard, 2003, p. 196). Therefore, teachers play a critical role in implementing culturally relevant pedagogy (Ladson-Billing, 1995) in the classroom setting to create an atmosphere that can enhance the learning environment for students. Prepare teachers to cater to the diverse students who enter their classroom, even though their views may differ from those presented or required in the curriculum. Howard's (2003) research mentioned how teachers must be knowledgeable of their students' cultures and the differences in their beliefs and behaviors to encourage their students' academic success.

In science inquiry-based learning, students take what they know, apply it to concepts, and derive discoveries; conversely, according to Rodriguez (2015), no culturally connecting piece intertwines the students' culture with the content. But imagine science lessons taught from a

student's cultural experiences; more meaningful connections are made, promoting achievement within the classroom (Brown, 2017). Teaching for the love of science is to encourage students' engagement at a young age. Some students do not know what they want to study when they grow up, but placing an idea and sparking an interest in a science-related field ignites the joy of the content.

Informal Learning Settings

Not all learning is learned in the classroom, especially with cultural exposure lessons. According to Dierking, Falk, Rennie, Anderson, and Ellenbogen (2003), learning takes on a more holistic approach that derives from real-world experiences within a diversity of appropriate physical and social contexts, motivated by an intrinsic desire to learn. As children spend most of their time in school, the impact should be reflected beyond the four walls of a classroom. Differentiating the learning setting can afford the potential of being impactful since it "is a firm belief that learning rarely, if ever, occurs and develops from a single experience" (Dierking et al., 2003, p. 109). Therefore, having students continue their learning after the bell rings in an after-school setting affords students to think beyond the traditional learning settings.

Informal learning spaces meet kids where they are within their schools and the knowledge they carry from their communities, such as local churches, recreation centers, and other after-school programs. These spaces allow scholars to grow, learn, and thrive as they are given chances beyond the classroom to better understand science content (King, 2017). Utilizing an after-school space to discuss the contributions of Black history and the culture of science outside of regular school hours can offer more time and flexibility in planning sessions and experiences to occur outside of the standard class time.

Young and Young (2017) saw a problem among Black males and females that showed an opportunity gap for learning in classrooms serving large populations of Black students. They also noticed that high school students had a disconnect to enrolling in STEM career fields, which started with the reduction of students enrolling in AP courses in high school. Looking at the root of the problem, students still need to receive the foundation of STEM education through coursework or activities within the classroom in early education settings. To reduce this problem, out-of-school time (OST) programs are needed to create and engage students and showcase STEM opportunities for students. OST programs have shown to have benefits that are not always available within traditional settings, such as 1) content knowledge beyond the standard classroom curriculum (Rahm, 2008), 2) connecting real-world application to what is being learned during STEM lessons (Tella, 2007), and 3) open students to engaging in informal learning spaces and continue their path on learning about STEM.

OST is important because it gives underserved communities opportunities for Black youth to engage with STEM and take an interest early on to fill gaps in STEM fields in society. Students are more vocal as their learning starts to increase and could retain their interest in STEM as they show more significant academic growth in their formal classroom settings (Barton & Tan, 2010).

The benefits of informal learning settings fit into the epistemological view of social constructionism as having an opportunity for youth to reflect on knowing the content, collaborate with other peers, and learn about how science can have an impact on their lives (Feder, Shouse, Lewenstein & Bell, 2009).

In summary, I acknowledged the importance of CRT in education as a platform that helps promote representation in the classroom, alter the current curriculum, and promote social justice

for Black students. CRT can empower and strengthen teaching and learning through curriculum development. Thinking about the reorganization and restructuring of the content curriculum can have teachers think about how critical race theory in their classrooms can be a positive attribute to consider during planning. CRP and CRT can change urban schools' narratives and alter the outcome of students and their experiences in school and education courses. This “hard reset” (Ladson-Billings, 2021) can also focus on CRT tenets regarding students’ accessibility to education once schools move from their traditional brick-and-mortar setting to other learning modalities. Accessibility to knowledge is not always easy to obtain, so incorporating meaningful instruction into the educational curriculum can create interest in courses students may not have considered initially taking, leading to new possibilities.

CHAPTER 3: METHODOLOGY

This chapter describes the epistemological stance, participants, research context, data collection, data methods, and ethical considerations for this study.

Epistemology

Crotty (1998) described constructionism as interpreting the world as a person sees it. Social constructionism emphasizes the social and psychological worlds’ aspects through social interactions. Social constructionism formulated the notion that “all knowledge, and therefore all meaningful reality as such, is contingent upon human practices, being constructed in and out of the interaction between human beings and their world and developed and transmitted within an essentially social context” (Crotty, 1998, p. 42). Social constructionism views knowledge creation through interactions in formal and various learning settings. Gergen (2001) situated constructionism as taking action, looking at behaviors, and being reflective and transformative within research.

Constructionism allowed things done and seen in the past to encourage a push for change in the future, which gave communities hope to alter past experiences through collaborations. Lincoln and Guba's (1994) views of constructionism were multiple meanings made and in a comfortable space for individuals to create the authenticity of the building, gaining knowledge, and using the familiar and bridging together ways to address and alter things that do not fit within the social equities.

Using social constructionism as an epistemological stance for this research was based on what I noticed growing up and teaching in predominantly Black schools. Year after year in school, we would learn what was provided in the content literature by the school system. The textbooks were our primary resource to understand what we learned in science, math, social studies, and language arts. When I became a teacher, the textbook was the source of what teachers were encouraged to continue to use as the curriculum guide. The state standards did not represent me or my students or even focus on how this information could be used to propel students forward. Seeing students struggle in science and show a lack of interest in the data, I knew something more had to be done year after year to change the trajectory of students receiving the science curricula to engage in science education.

Social constructionism allows for knowledge from various resources, such as individuals sharing encounters with others, dialogues, cultural backgrounds, and elders' stories, for those lessons extend beyond textbooks and classrooms.

The social constructionism view of knowledge generated through interactions led me to research the importance of revamping the science curricula for Black students to encounter representation throughout the school year by becoming members of an afterschool science club. Science content through a social constructionism view gave insight into the stance of social

issues of equity due to the lack of cultural representation of Black history and exposure to Black scientists and inventors' contributions that showcase content from a Western European stance (Kendi, 2019; Kuhn, 1996; Sleeter, 2011).

With various paradigms, each unique, this study differs from positivists, who asserted that the truth can be viewed in one direction based on experimentation and observations that can exclude other probable results. Choosing constructionism as the epistemology acknowledges that all knowledge cannot be obtained from textbooks or instructors' lectures but through the learned and shared experiences throughout life's journey. Within social constructionism, students could be members of the science community and address inequities of social aspects in science education.

Qualitative Research

As research has shown, qualitative research is to understand a phenomenon, look deeper into societal issues that need to be addressed, and listen and see people in their natural settings to understand the "why" behind the research (Aspers and Corte, 2019). Interpretation and reflections of the research mean going beyond the numbers in the data collection. Obtaining quality in qualitative research means using various sources and analyzing the information to look at patterns and trends to see how they can offer a way to make a meaningful understanding of the research. The researcher interpreted these patterns and trends through encounters and experiences throughout the research process (Strauss and Corbin, 1998; Denzin and Lincoln, 2003). The opportunity to encounter themes as they serve can lead to a rich analysis with "thick descriptions" (Geetz, 1973) of participants' engagement in the research. The qualitative methods within this research study allowed me to understand how to reflect and analyze data for my research questions:

Research Questions

1. When given the opportunity to incorporate Black culture and history into informal science curricula, what can middle school students showcase about the contributions of Black scientists and inventors?
2. In what ways can Youth Participatory Action Research (YPAR) support the implementation of Culturally Relevant Pedagogy (CRP) in an after-school science club?

Youth Participatory Action Research (YPAR)

Representation in science and Black youths' perceptions of who is in science showed that students should see themselves within the science content to gain a greater connection and interest in STEM (Jackson, Galvez, Landa, Buonora, & Thoman, 2016). The demographics of groups of youth labeled as "marginalized or at risk" (Cammarota & Fine, 2008, p. 10) seldom had a seat at the table to speak for what they want to learn or see within curricula that can impact their future. Black science scholars should feel they can express their voices on how they learn and who they learn about and be able to see more representation as they learn about STEM fields.

Cammarota and Fine (2008) defined Youth Participatory Action Research (YPAR) as a qualitative methodology to recruit youth as partners in research. YPAR derived from Freire's (1998) notion of a praxis of critical reflection and action. This methodology aimed to take the youth's experience and develop outcomes that lead to transformation in systems and institutions to promote social justice. Within YPAR, students were co-researchers (Checkoway & Richards-Schuster, 2003). They had the opportunity to study social problems affecting their lives, gather information about issues, and use data to create results to determine action plans to solve problems that impact them (Cammarota & Fine, 2008; Checkoway & Richards-Schuster, 2003).

The goal of YPAR is to enhance the knowledge of youth through their experience by reflecting on the quality of the information provided in science education and determining ways to promote justice and liberation within the science curriculum as students can be agents of change. The following section will highlight the potential benefits and limitations of using YPAR as a methodology for this research study.

There needs to be more research literature to showcase why youth are starting to veer from STEM. This research uses YPAR to hear youths' voices to understand better what is missing and what knowledge can be obtained when incorporating culture within the classroom. The following sections will showcase why YPAR is a suitable methodology for an afterschool program.

Affordances

There have been notable benefits in using YPAR as a research methodology. The first benefit was a way for youth to "develop knowledge for social action" (Checkoway & Richards-Schuster, 2003, p. 23). For youth to act, they must know that a problem exists. Youths can sometimes take notice of injustices within their community, but until they know how to speak and act on these actions, there is a possibility that no action steps will occur. By looking at students' views and how they view Black scientists, they can notice that the representation in science is lacking and want to establish a plan to research and investigate inequities that are present in the science curriculum.

The second benefit of YPAR was that youth could use their political voice to activate change; Freire (1998) described this as a liberation of people. Hearing of changes needed from a researcher's perspective and hearing directly from youth affected by political decisions can range from better textbook adoption to science courses implemented in their schools. As youth spoke

up and expressed the change they wanted to see, their voices could be the catalyst that drives change within the science curriculum (Fountain, 1999).

The third benefit was that the door opened to knowledge for youth. Research does not have to consist of adults as the gatekeepers of knowledge. Still, it could share the "democratization of knowledge" (Checkoway & Richards-Schuster, 2003, p. 23) and delve into what became of the research study when partnered with youth. The science curriculum does not have to be taught verbatim as prescribed lessons; it can include cultural references that will allow participants to feel that there is a place to exist in the science curriculum (Ansley & Gaventa, 1997). The third benefit is also tied into the fourth benefit of YPAR perfectly. It prepared youth to be citizens in a democratic society, negotiating what they need and want and having a voice to involve the community for change. Equal sharing of power helped "foster relationship building, collaboration among students and us, and the contexts for rigorous and engaging inquiry-based learning" that typically remains only to the researcher (Rodríguez & Brown, 2009, p. 28).

Checkoway and Richards-Schuster (2003) described the fifth benefit of developing social and eliminating social inequity as participants worked for a common goal (Rodríguez & Brown, 2009). Youth that did not feel comfortable juxtaposing the science curriculum they received now stood on a platform to speak out about unequal footing in education and derived a plan for equality. Youth can be a hard group to work with, and I will now explain some things to consider when working with youth.

Considerations

YPAR considered that the researcher must get the buy-in from participants to engage in the research process. Contacting students to participate who are typically excluded from decision-making opportunities created a sense of hesitance among Black students (Rodríguez &

Brown, 2009). The youth that joined the Black History Club received an overview of how the research would operate, discussion topics and how to share ideas on what they want to learn and create. Students are often instructed on what they will learn and how they will learn content standards. However, in this YPAR study, youth could share their ideas and see how they could be implemented.

A second consideration discussed in the literature for YPAR described youth researchers becoming irritated with researching. As adult researchers, we know that research can take considerable time and commitment, whereas youth seek automatic gratification in their work. The third consideration is that youth need to experience the research outcome they hoped for and become discouraged. This leads to the fourth limitation of leaving the research not completed due to time, but being unable to see quick results during the research process can be tedious for youth (Checkoway & Richards-Schuster, 2003; Rodríguez & Brown, 2009). Leading with the end in mind, letting them know their work will be showcased and shown to stakeholders as a product of collaborations, letting them know that the work they did is not in vain.

Some research considerations can involve time and participants' ongoing commitment to the study. The state's education department created the curriculum framework, following a timeline of when units should begin and conclude. Students' completion of the content to take the state's mandatory end-of-course test is a significant consideration. It limits the opportunity to explore more about Black culture in science. To address this concern, I decided to do an after-school club with all middle school grade levels. Therefore, as the researcher, I did not have to compete with trying to finish the state's dated framework and the research agenda simultaneously.

Researchers might see these considerations as a reason not to engage in YPAR; however, with the opportunity to open doors and allow students to enter a space where they are typically not seen. A risk, such as using youth in research, may be worth it if it enables students to have a voice in what matters to them, as they can be change agents in science for years to come. As shown in Table 1, the benefits of engaging in a YPAR study, in addition to things to consider in doing a YPAR study, which is imperative for youth to grow and understand the power of representation in science.

Table 1: Summary of Benefits and Considerations of YPAR

Affordances of YPAR	**Considerations of YPAR**
Youth get involved with social action	Getting buy-in from youth participants
Advocate for change	Irritated: quick gratification
Ownership of knowledge	Preformed judgment on outcomes
Local citizens	Commitment to the process due to time
Change agents	

Power Dynamics

Within Youth Participatory Action Research (YPAR), the power dynamics can create a space where youth voices can be heard or silenced. This research study aimed to let youth voices be heard and used to address social injustice and inequities within the science communities (Bautista, Bertrand, Morrell, Scorza & Matthews, 2013; Cook & Krueger-Henney, 2017). I have decided to work with youth I do not teach after school to eliminate a power struggle within the classroom. However, I want all interested in middle school to join, but if they are enrolled in my science courses, they will not be included in the study data.

Youth voices are typically silenced and discriminated against; therefore, creating an all-inclusive space for sharing and promoting the expansion of input into their learning can be impactful, especially in marginalized groups. The researcher and youth co-researchers shared roles in the data planning, collection, and analysis. The researcher created pre- and post-surveys. During group sessions, the researcher and youth co-researcher will share survey data with the group to help include additional activities that will take place during each after-school club session.

Cogenerative Dialogues

Cogenerative dialogues (cogen) started as a co-teaching model that allowed two teachers to work within a classroom setting and incorporate their understanding into a lesson.

As teachers continue to model this method of instruction through teacher prep programs with their mentor teacher and co-taught classrooms, this model continues to evolve through practice. The input of each teacher during the instructional time is given, with the other teacher taking a step back when the other teacher takes a step forward in providing instructions. This model is called the step-back, step-forward, step-back model, offering an equal opportunity for the other's voice to be heard without interruption. To eliminate interruption, cues are given or learned through the model, such as hand gestures, body cues, or a pause in teaching (Tobin, 2006).

According to Tobin (2014), cogenerative dialogues are a way to improve the teaching dynamic and to balance the power role in a setting among the teacher and students. Cogenerative dialogue means teachers' pedagogical practices should adjust to a more student-centered approach. Hearing the voices of a diverse group during the research process allows a middle school population to be expressive as they learn about the science content. This form of

communication allows youth to express interest and question aspects of their learning in a shared community. At the same time, the teacher is there to address questions, and according to Tobin and Roth (2006), the best place for this dialogue to occur is within out-of-school instructional time. Tobin (2006) described how students who participated in cogenerative dialogues during instructional time found it hard to separate themselves as contributors to the learning. They became frustrated with other students who did not take the same ownership of their learning. The afterschool program in this study creates a shared space for the researcher and youth co-researchers to collaborate in a smaller setting where everyone can engage with dialogues and plans made within the group.

Cogenerative dialogues are used as a “reflective contract” in some teachers' classrooms, making their lessons adaptive to the students they serve. Teachers who serve marginalized students focus on the sociocultural aspect of the students and how changes can improve the learning and teaching practices for diverse populations of students. This dialogue can be done during or after class to adjust lessons and create more profound, meaningful lessons for students. Teachers are using cogen to create more equitable spaces for learning opportunities for students, as they are incorporating them in the meaning-making process. It also helps them learn about students and their learning styles, needs, and interests to become more adaptive to their students with their teaching (Rogoff, 2003; Beltramo, 2017).

The goal within cogenerative dialogues is for a growth of understanding, appreciation, and knowledge of everyone’s voice and experience that they bring to the group. Tobin (2001) considered cogenerative dialogues a breeding ground for more incredible things, especially with youth voices. The outcome could be that as youth learn about their culture and background, they

can spread what they know to their peers, and knowledge continues to extend beyond the after-school club and the teacher being a reference source.

The use of cogenerative dialogues in this study works through the researcher's and co-researchers' weekly encounters during the Black History Club. During club time, discussions will include lesson ideas, activities that can be implemented, and community outreach projects to showcase (Tobin & Roth, 2016). With the variation of age and grade levels of co-researchers, the possibility within this group showed benefits from the differences in ideas due to their experience and exposure to the science content on different levels.

Cogenerative Pilot Program

Having the opportunity to speak with six 7th-grade students after state testing was meaningful in helping me shift into gear on what questions to ask, practice not interrupting, and take on the role of a YPAR researcher. I asked students questions that pertained to their learning experience of science in seventh grade. The first eager student chimed in and described her likes and dislikes of the class. Then, the next student followed. They all agreed when they had the same sentiment on a comment. If I saw someone who did not speak, I asked them to share and restated the question to allow them to think about their response; then, I shared without the other students interrupting. The next question was derived from the conversation to understand their learning style. The group was excited to share, and the responses were full of excitement as the students stated that they learn best a certain way, but the teacher always teaches the same way. The group members chimed in, and I had to incorporate another group member who did not speak during that question round. On the third question, I asked the group, “How would you like your classroom instructional time to be conducted to maximize your learning opportunity?” One remarkable thing happened: my most outspoken person in the group said I would love to answer,

but I was going to give someone else the opportunity first. Then, the other group members started to share as the floor was open for their input.

The takeaway from conducting this pilot program was that as the adult researcher, I would have to coach the students on their roles the first week, pushing them to let them know that we each have equal parts in the research process. I saw that others can silence some voices, but when given a chance, they can shine through as they warm up to generate these dialogues in this YPAR study. I realize that the starting cogenerative dialogue sessions will be used to create action plans for this study's research questions. Students will then have an idea of what they are working toward collectively and have an end goal in mind (Edmin & Lehner, 2006).

Research Context

This YPAR study took place in an *informal learning space*, an after-school Black History Club (BHC). Bryan School of the Arts (BSA), a pseudonym for the research site, is located on the south side of the closest major city. This school is a magnet school for fine arts, such as dance, theater, and music, which students who are out of district must audition to attend if this is not their home school. The surrounding community includes two elementary schools, two middle schools, and two high schools. A local recreation center has a daily fee for entry and limited activities for children to participate in other than working out. The local churches are not open after school is dismissed and do not offer after-school activities for youth. The population of the area is predominantly Black / African American. Data shows that 93% of students in the area are from low-income families.

BSA's racial breakdown of students is 76.8% African American, 14.6% Hispanic, and 8.6% of two or more races, which can hopefully provide insight into what students want to learn, what is important to them, and how the implementation in science education can help lead to

seeing representation in science. According to the Governor's Office of Student Achievement (2023) school report card, BSA has a lower proficient and distinguished rating in science than its state's score. BSA offers youth the opportunity to be involved in extracurricular activities such as sports and content enrichment clubs after school. BSA is appropriate for this study since research has shown that Black students lose interest in STEM early in education.

According to Jager, Putnick, and Bornstein (2017), since the research setting consists of a high population of the same demographic of students, it helps to alleviate bias; doing so means making sure the participants' criteria are clearly defined and relevant to the population that will be served. The high proportion of African American students in the school will allow for high generalizability and reduce the risk of skewed data.

With a significant number of students of African descent within this research site, CRP assisted in analyzing how teachers can identify oppressive forces that might affect students' achievement and create equitable learning in informal spaces.

Research Participants

The research population was a mixture of 6th-8th Black male and female students. The criteria for selection are shown in Table 2. Only 6 participants were selected to participate in this research. Since this research involved youth, acknowledgment from parents was vital. Therefore, a returned parent consent form and signed assent form for minors were mandatory for participation.

Table 2: Criteria for Participant's Selection

Student at BSA	Identify as Black / African American
6th, 7th, or 8th-grade male or female student	Signed student assent form
Returned parent consent form	

Next, I have provided a snapshot of each youth co-researcher. Since youth are often not positioned as co-researchers in educational studies.

Recruitment for Research

Creating boundaries for selecting the participant population is beneficial in qualitative research to ensure that the data for the research questions are answered based on the specific youth population. Robinson (2014) stated four essential considerations when creating participant groups for a study. The first is inclusion, meaning who can be included in this study based on the researcher's qualities. In this study, youth recruitment was supposed to occur during the school's initial open-house meeting before the school year with youth who identify as Black or of African descent, ranging in grades sixth through eighth. Youth could have signed up to participate in the Black History Science Club and received a consent form to participate in the study.

As the Principal supported the after-school club's initiative, the initial recruitment plan of hanging flyers up was altered slightly to protect the school and me from any scrutiny of discrimination. Journalists are constantly writing about the ban on African American studies within the classroom in states such as Georgia and Florida, where it has become a topic that has reached the United States White House for further review of course material (Bunn, 2022; Garcia, 2023; Pendharker, 2023)

Therefore, I asked students who stayed after school in the aftercare program if they would participate. My coworkers who had children in the aftercare program agreed to allow their children to participate in addition to two other students.

The specific type of sampling for this study is Maximum Variation (Heterogeneity) Sampling (Patton, 2002; Suri, 2011), meaning that the participants meet all the exact inclusion requirements of the research criteria of the age range and grade level, see Appendix D, for a list

of the research participants and how they identify themselves. Choosing heterogeneity sampling allows for variations in the group based on the criteria and offers a better range of collaboration from the participants.

The second most important consideration of the research is the sample size. Having a large sample size can give you the most accurate data in a quantitative study; however, within this qualitative study, a smaller sample size is needed to have a more focal point of quality meaning and interpretation than the quantity. The most important aspect of a qualitative study is understanding the participants' experience. Robinson (2014) stated that there could be larger qualitative sample sizes, but doing this will require “time, money, many researchers, and a robust purposive sampling strategy” (p. 5) to accommodate the analysis workload. In social constructionism, meaning-making will happen throughout the group meetings and reflections; therefore, keeping accurate records of these encounters and interactions allows the participants' voices to flow. Based on how cogenerative dialogues work, to hear the participants' voices, I elected to have a small sample group of 6 youths, two from each grade level, to ensure that all grade levels are represented and agents of change are heard (Tobin, 2014). The goal is to have everyone who participates have equal time to speak and ask questions. Therefore, a small sample size is more favorable for this study. According to research, the selected number states that since youth requires “more time, energy, and care, " it is good not to overexert all participants (Golafshani, 2003).

The third consideration for the recruitment was knowing what sampling strategy was good; using convenience sampling will occur due to the participants located at the research site. The final recruitment strategy is recruiting potential participants, who will know about the study and decide if they want to participate. Youths who meet the requirements will receive a letter to

participate in the study. The selected participants who will be used will be the ones who contribute to the learning experience through group dialogue and activity interactions. Being intentional in purposeful sampling and selecting participants leads to a greater understanding of answering the research questions (Patton, 1990; Merriam, 2002). A student's withdrawal from the study will result in the next student's selection for the research study. Replacing a participant will happen if it is within a one-week timeframe of the research starting to ensure the ability to participate in the different data collection methods.

Introduction of Researchers

Each of my co-researcher's presence and contributions to the research shined differently. They played an intricate part in the development of this study. Researchers were given a pseudonym to protect their identities (Foster-Fishman, Law, Lichty, & Aoun, 2010). Some researchers decided to create their own, and others asked if I would select a name for them. I selected names that honored students' personalities through our group interactions. Names were derived around the fifth and sixth sessions as each person became comfortable with the club and opened up to the group. Table 3 introduces the youth participants, followed by a showcase of their personalities that contributed to this study:

Table 3: Study Participants

Study Participants			
	Grade	**Gender**	**Race**
Heaven 	8th grade	Female	Black
Sarah 	8th grade	Female	Black
Grant 	7th grade	Male	Black
Cassh 	7th grade	Male	Black
Bailey 	6th grade	Female	Black
Claire 	6th grade	Female	Black

Heaven.  Heaven selected her name. It was a name she said she would like to be called, and it is a great nickname. Heaven, an 8th-grader female identified as Black, was very vocal and had a strong personality. Her passion for science was almost obsolete. Therefore, she and her mother thought this club would increase her motivation to learn science and better connect concepts in her science core class. Being one of the older scholars in the club, she stood firm in her decisions at our first meeting. She initially set the impression for the other researcher that eighth graders would be the club's leaders. However, after the initial icebreaker game, she started to relax and welcomed the ideas of others as she began to hear the opinions of other scholars in the group. As each session came, the shift from wanting to be the leader to a co-contributor was revealed, and she offered a wait time to allow others to share. Heaven stayed a

consistent, warm leader, as the others took to her as a “big sister,” having positive vibes, offering smiles to the group, and showing compassion on difficult days.

Sarah.  Sarah asked if I could select her name for her. Since she was interested in learning about Sarah Goode, I thought that name was fitting, and she agreed. Sarah, an 8th-grade female, identified as Black and was the first one interested in the after-school club. She frequently stopped by my classroom to ask about signing up and if she could bring other friends into the group, and I gladly welcomed anyone she thought would enjoy learning after school. As a leader, she helped organize tasks before the next session. She is a worker bee, and those in the club knew she enjoyed working with her hands to get stuff done and build things. Her ability to work with little direction made her a leader within the group. She was a scholar-athlete with many roles within the school, but she attended club sessions amid other obligations.

Grant.  Grant asked if I could select his name. He was not sure of another name that would suit him. I asked him about the name Grant, which was named after Granville T. Woods. He thought that was a great idea because that was who he was researching. Grant was a 7th-grade male identified as Black with a calm personality, laid back, chilled, and a scholar-athlete. He worked well with others, allowed others to speak, and provided feedback when he saw fit. He eagerly got the job done by developing a plan and organizing research material to assist in creating the presentation about who invented potato chips because of his love for food. He broke the awkward tension at the first meeting by asking, “Will there be snacks?” He knew his soft laugh would open the door for others to feel comfortable in an unfamiliar space.

Cassh.  Cassh decided to select his name. It was a name that he was comfortable with as it was his common nickname at home. Cassh was a very quiet 7th-grade male who identified as Black. He had his routine and processed the conversations before speaking.

I was nervous that his voice would not be heard within the group as some of them already knew each other, and the dynamic of meeting others was uncertain. His mom did prep me for his quietness, but I assured her it would be okay if he were open to learning and working with other scholars. I got to know him on the first day and heard his voice as we played our icebreaker games during sessions that involved hands-on activities, which was when his light shined. He worked very intricately on projects, not asking for assistance, but he would gladly accept when someone asked if he needed help.

Bailey.  Bailey could not think of a name and asked if I would help her. I decided to use the name Bailey. The name Bailey means a law enforcer, and as the name has continued to evolve, the meaning of a strong and independent person seems fitting for her. Bailey is the middle child and the only girl among her siblings. She also established a strong sense of being during club time. Bailey, a 6th-grade female identified as Black, had a big personality. She has friends at each grade level and did not meet a stranger, so I knew that working with others at each level did not pose a problem of being intimidated by age, and her grade level, of being among the youngest, might not be a concern as I initially thought it would. She was a big vocal communicator; therefore, she was not a big fan of writing her reflections and preferred to record her thoughts. Being a scholar-athlete, she sometimes had other obligations but managed her time

well enough to participate in group discussions. She enjoys school, especially if it involves hands-on activities to keep her active.

Claire.  Claire is a 6th-grade female identified as Black. She was a creative, crafty scholar who enjoyed knitting, designing fashion, and building communities with her doll houses. Claire is a magnet student who is really focused on her schoolwork and strives in science class. She is swift in getting tasks completed and technology-savvy. She works well with others and offers input, ensuring her voice is heard within the group. She lets the group know what she can do and completes the task relatively quickly to ensure that we stay on schedule and are productive in our sessions. She is responsible for creating the presentation from the information collected from the group's other youth researchers. Claire was not sure of what she wanted her name to be for this study. She is very poised, direct, articulate, and has a great sense of fashion. These qualities reminded me of the television character Clair Huxtable from The *Cosby Show,* who always had things going on at home but could manage them all with grace.

Ms. Smith.  As the facilitator and researcher, I identify as a female Black educator. As a science educator with over 15 years of experience, I have developed numerous lesson plans for my classes with aligned content standards and a scope and sequence map to follow. As the researcher, I had to create lesson ideas and agendas based on what we did from session to session. Understanding the vital use of time and being productive, I had to ensure that scholars knew their role from the beginning. Planning a weekly agenda geared toward learning and

engagement for each, not knowing their personalities; I quickly had to situate myself as an active participant in the study. I kept my name in this study as a direct link to the work.

Research Design

The research study began once all parent consent and youth assent forms were submitted. Each meeting session was held in my classroom to access technology and materials quickly. The space also provided a group sitting arrangement so all researchers could be viewed using a large rectangular table without obstruction. Getting started with the after-school club involved me purchasing similar composition books, pencils, and snacks for each researcher. I did this to ensure everyone started the club with equal resources.

During the six-week YPAR study, the students co-construct lessons with the researcher to provide suggestions on including Black history and cultural representation in the science curriculum. Table 4 showcased the benefits of YPAR and how it relates to this study. In this six-week YPAR research study, students were asked to offer their input on their ideas of who is and can be a scientist. We collaborated on creating lessons that involve students' learning interests because, based on Obidah and Howard (2005), Black students and students from diverse backgrounds lack the opportunity to have cultural learning experiences.

Table 4: Summary of Benefits of YPAR and Connections to the Research Study

Affordances of YPAR	**How can YPAR, as a methodological approach, enhance this study?**
Youth get involved with social action	Youth co-construct lesson plans during sessions.
Advocate for change	Offer suggestions on how to showcase representation in other content areas in school.
Ownership of knowledge	Youths take and share what they have learned.
Local citizens	Determine what can be implemented in schools to demonstrate a need for representation in the curriculum.

Change agents	Continue to consider how the community can be involved with the school.

YPAR considerations, seen in Table 5, allow marginalized youth to become empowered and sit at the table to discuss what they learn and how they want to learn it. Too often, they do not receive an opportunity to be vocal, and within this study, they can be change agents within their community.

Table 5: Summary of Considerations for YPAR and Successful Implementation

Considerations for YPAR	**Considerations for Successful Implementation of YPAR in this Study**
Getting buy-in from youth participants	Listen and implement their ideas into the lesson plans. Weekly snacks.
Irritated: quick gratification	Showcase their knowledge growth weekly with reflections and artifacts produced.
Preformed judgment on outcomes	Do not lead the participants with the result in mind. Understand their interest and continue to build connections from there.
Commitment to the process due to time	Allow youth to have roles during each session that will keep them involved and feel an asset to the process—overall capstone pizza day.

There were many considerations in enacting this YPAR study. Communication of the learning targets at the beginning helped to make the youth more willing to stay connected since research has shown a lack of topics that will be discussed during the sessions. This study did not tie grades into the learning experience. Students did not have the pressure of thinking about academic grades being applied since this is an after-school club. The environment was more relaxed, and students could focus more actively on learning as they move around and collaborate with other youth (Christensen, Knezek, & Tyler-Wood, 2014). As schools are becoming more technology-driven with one-to-one devices, students do not have the opportunity to verbalize

what is occurring as they are learning, as well as concerns or questions that may arise in the lessons.

Data Collection

The data collection for the research study took place from September through November 2023 for six weeks with planning and engagement sessions. The use of questionnaires, cogenerative dialogues, artifacts, weekly reflections, located in Appendix B, the researcher's memos, and a culminating focus group are discussed in further detail as to how they were used and aligned with this study's methodology.

I have provided a snapshot of the timeline for data collection in Figure 2, which focuses on the study's two research questions. The top row shows my implementation and collection in the research as the researcher. The bottom row illustrates what the co-researchers were involved in producing for the data collection.

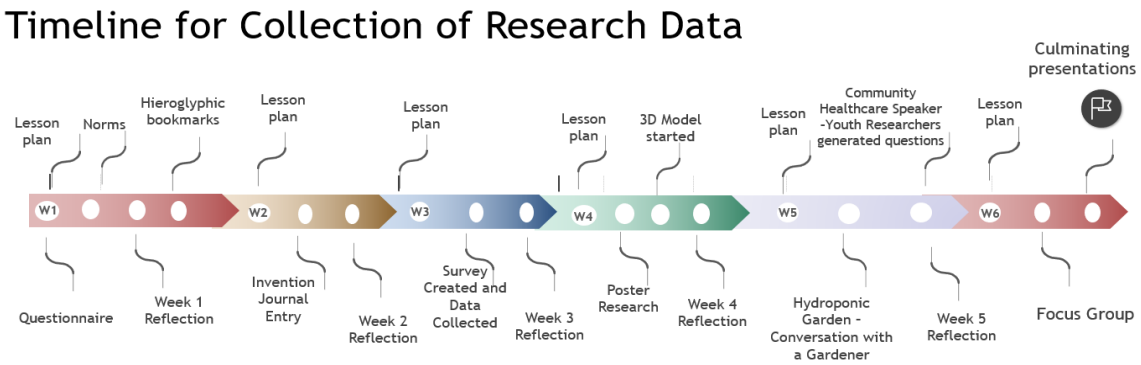

Figure 2: Timeline for Collection of Research Data

Youth co-researchers and I each had a STEM notebook to keep track of our daily thoughts and ideas during the sessions, which allowed us to reflect on the group's progress. Scholars' feedback enabled me to remember more about my teaching pedagogy throughout the research process based on how we navigated through each session experience together. This feedback allowed me to derive the following action steps within the sessions.

Questionnaire

Questionnaires were used to gather preliminary information about what they already knew about Black scientists and inventors, what they wanted to know, and how often they learned about the contributions of Blacks in science (Mathers, Fox & Hunn,1998). At the end of the research study, another questionnaire will be used to see if the research showed a change in participants' responses and what they have learned about Black scientists and inventors.

Focus Group

A culminating focus group was another data collection method. This focus group occurred at the end of the 6-week club sessions. The focus group was a semi-structured interview format with generated questions about the youth's experiences, see in Appendix B. This data collection method is essential because if all participants do not write their feelings out in a reflection paper, I want to have the ability to capture their experience; therefore, this will afford another opportunity to capture the essence of the youth's voices in the research. Checkoway and Richards-Schuster (2003) stated that creating opportunities for social engagement is beneficial for youth to engage in research. As the researcher creates these spaces for dialogues, the environment offers a system of support to speak freely and view others' points of view freely. The focus group lasted for 35 minutes.

Reflections

Weekly reflections were given with guided questions, as seen in Appendix C, allowing the researchers to analyze their experiences. Throughout the study, experiences and feelings provided a greater understanding of how youth can impact research as they collaborate to incorporate Black culture into the classroom (Connelly & Clandinin, 1990). The researcher and co-researchers reflections were kept in a written and video journal weekly, seen in Appendix E at

the end of each session, recalling the events, memorable moments in learning, the growth and glows of the lesson, and allowed for revisions to be made within the lesson plans.

Researchers' Memos

Under the third method, I incorporated researchers' memos. As researchers, we could keep track of the plan of action for weekly meetings, each participant's roles during each session, the topics, the agenda, and the artifacts created (Gillis & Jackson, 2002; Mulhall, 2003).

In YPAR, seeing youth become citizens, use their voice, and make a democratic way of negotiating the unequal aspects of science education offered me, as the researcher, a way to view what matters to participants. Participants take what they discussed in group interactions through cogenerative dialogues and implement their plans. Youth researchers documented their plans and roles within their journals to keep track of who was working on different tasks. Research has noted that examples of YPAR projects consistently show that youth empirical research participation significantly enriches the quality and depth of findings (Livingstone, Celemencki, & Calixte, 2014).

Documents

Research data collection included the following documents: lesson plans and researchers' work samples. These documents provided evidence of the emergence of and incorporation of Black history and culture into the science curricula. The use of these data sources increased the research through "distinctive features in three main ways, through (a) strategies of document selection, (b) consideration of the social exchange of documents, and (c) consideration of the socially produced nature of documents" to explain the interest of the youth (Miller and Alvardo, 2005, p. 349). The youths' work showcased who they are and what they have learned during the

process; for students to be able to speak on their work created a significant amount of ownership that increased how they felt about representation in science.

Lesson plans

Lesson plans are used as a guide for teachers to know what content they will be presenting and the pacing for the unit. A similar lesson planning method laid out the weekly content throughout the research. Youth encountered a variety of Black scientists and inventors weekly, with a culminating task at the end of each week. Lesson plans throughout the after-school sessions include Black culture and history in the lessons, followed by the participants' artifacts to showcase their learning. Lesson plans were co-constructed with youth during the YPAR process. Snapshots in Appendix D of the initial lesson plans, the revised lesson plan, and the overall outcome of the lesson after our cogenerative dialogues allowed youth to add feedback.

Youths' Work Samples

Youth participants utilized a variety of models to showcase their knowledge gained during the sessions. The initial thought was that youth would use a virtual or hard copy of a STEM journal to house the work and document their experience throughout the weekly club sessions. However, their vision was to do something different from their standard class time. The journal included their weekly reflections and explanations of the changes created to the lesson plans. Their journals also included memos about the job responsibilities of other researchers within the group.

Figure 3 showcases how these data sources informed one another throughout the data collection process. The collection process was ongoing for six weeks and was altered as needed to enhance the learning experience. It was a cyclical process, constantly revisiting other data

methods for reassurance of meaning-making.

Figure 3: Data Collection Strategy

Data Analysis

The 6th - 8th-grade middle school co-researchers meet on Tuesdays and Thursdays for 6-weeks from September through November of the first semester. This time was conducive to the participants' schedule based on the data collected on the interest surveys. Data collection was done before, during, and after each session to create a plan to segway into the next lesson based on group discussions. Each session was recorded and transcribed using the Otter AI software. The transcripts were placed in Nvivo to look at patterns within the data from different data collections used within the study, which consisted of a questionnaire, degenerative dialogues, researchers' memos, and artifacts.

I used thematic narrative analysis (TNA) based on my chosen methods, allowing for themes of culturally relevant pedagogy (Ladson-Billings, 1995), which emerged through the questionnaires, cogenerative dialogues, and reflection of the youth participants (Fereday &

Muir-Cochrane, 2006). Inductive analysis of the data collected assisted in identifying emergent themes through these data collection methods (Braun & Clarke, 2012; Creswell, 2003; Fereday & Muir-Cochrane, 2006; Hatch, 2002; Riessman, 1993). TNA allows for flexibility with the coding based on specific themes that can arise throughout the research process. With accessibility to transcripts and recording, this data analysis was beneficial in interpreting the data (Braun & Clarke, 2012). Using "thematic analysis through an inductive approach gives me the ability to give voice to participants," which can provide insight into what students are learning throughout the study (Braun & Clarke, 2012, p. 59).

Using TNA for this qualitative research meant using open coding to develop primary themes within the transcripts during the transcribing process after reviewing reflections and recording (Strauss & Corbin, 1998). The coding process involved looking at terms and words that were commonly stated during each session. Then, establish a relationship to develop the associated theme (Alhojailan, 2012; Braun & Clarke, 2012). Thematic narrative analysis has six phases to analyze the data: 1) familiarization with collected data, 2) generating initial codes, 3) searching for themes, 4) reviewing themes, 5) defining and naming themes, and 6) presenting and discussing themes. As the research cycle continued for each instrumentation tool, I analyzed data to create a narrative as a weekly journal for the research. The analysis helps provide substance and insight into the research questions while displaying the findings.

I present the data as a narrative to describe the collaboration of the researcher and youth coresearchers' perspectives based on integrating cultural aspects into the science curriculum. The narrative consists of participants' voices through the different instrumentations used, the reflections derived, the work of the lesson planning sessions, and the acknowledgment of the

work the participants created in their artifacts. This data analysis method includes all voices within the after-school club.

Thematic Narrative Analysis

Thematic Narrative Analysis allowed for the narratives of our discussions in our sessions to be told with an understanding of the importance of including culture and history during a learning process. The methodology of youth participatory action research solicits the voices of the youth to be heard throughout the study. The themes were derived from CRP tenets of 1) academic success, 2) cultural competence, and 3) sociopolitical consciousness derived throughout the study. I used the themes to align my analysis based on these themes to gain knowledge about my research questions. According to the first CRP tenet, students should show "academic success" (Ladson-Billings, 1995, p. 160). Specific themes that I looked for to arise in participants' statements through the various data collection methods included learning, understanding, growth of knowledge, and increasing exposure, which were some of the themes that responded to the first tenet.

The inclusion of cultural content in lesson planning and activities was evident during the initial planning stages and through the collection of artifacts. Ladson-Billings (1995) states that for teachers to have a culturally responsive pedagogy, culture must be at the forefront of the learning. "Cultural consciousness" (Ladson-Billings, 1995, p. 160), the second tenet, means to put in the work of planning and to be intentional when creating learning opportunities for students. Students learned about scientists and inventors each week based on the agreed-upon topics. Lesson plans included connections between how Black pioneers in science have contributed, and we discussed how this newfound information can contribute to their culminating project. The openness of the youth discussing in their learning sessions a need for more diversity

and inclusion within the science curriculum indicated that we were on the right path. Within their journal reflections, researchers noted what they knew, learned, and wanted to continue to learn about scientists.

Youth can be socially aware of what is happening in their community and the educational setting. Communicating with stakeholders and voicing changes that should occur in education can be a powerful statement from youth. The third tenet of CRP is to be socially aware and conscious of whether equity and equitable situations exist or if there is room for growth within a population. We will look at how the youth planned activities involving the community and what the focus was to enhance the community of inequities in science.

Using these tenets to analyze themes within the data collection method helped create a flow for writing a thematic narrative analysis for this research.

Research Products

The research products for the youth showcased a variety of the youth's work samples collected weekly. The artifacts included what the youth researchers created from their learned experience and collaboration during the club sessions. The work of these youth co-researchers can be seen as models through activities that exhibited what they have learned about Black culture and history in science. Foster-Fishman, Law, Lichty, and Aoun (2010) described the importance of the voices of youth being heard throughout the research process, and they should be able to explain their work to a community-based audience. Wayne (2009) described how the youth presentation of their work was meaningful to showcase and present their work as co-researchers.

Ethical Considerations

The use and outline of the Institutional Review Board (IRB) is the primary checkpoint for ensuring ethical research. Since students are the participants, there are considerations to address before beginning the study. One is if students will receive a grade for participation, and the other is a power dynamic since I am an educator at the school.

To ensure that parents and students were aware of the unique nature of the after-school club, I held a parent meeting to discuss the overview of the club. Parents and students then receive forms allowing authorization from the participants to assent and the parents to consent to the student's participation in the study (Georgia State University, 2020). At the beginning of each club meeting, participants are notified that they are free to walk away from the study without penalty or a grade reduction because this is an informal after-school club that does not issue grades for participation.

Acknowledging culture as a driving force in hearing the vulnerable voices of the participants, I ensured that I grasped the essence of students' reflections through their daily interactions. Capturing participants' voices was done by creating a safe space for the participants to join in group discussions and share their thoughts during weekly questionnaires. Protecting the students' views and giving them a safe place to express their feelings is very important in managing the credibility of the research. Ethically, I used pseudonyms to protect the identity of the participants and the site that the participants attended (Tracy, 2010). In addition to keeping records confidential, recordings and transcripts were held in a safe space until the end of the study and discarded afterward. The formulated protocol will allow me to treat all the participants equally in questionnaire responses, session times, and data collection sources (GSU, 2020).

Trustworthiness

To create trustworthy work in the research, I decided to triangulate my data with various methods and ask my committee members to help check my codes for reliability. Denzin and Lincoln (2005) described data triangulation as an approach to enhance the validity of the research. Each of the data collection methods can capture or miss something important. Therefore, having multiple ways to capture what the research questions are trying to answer is essential for the study.

Credibility

To ensure the *credibility* of the research study, Patton (1999) set criteria for enhancing the research and ensuring that data has adequate gathering methods. Multiple methods were used to analyze data and determine patterns, which was essential to determining patterns in the research and ruling out items that did not relate to the study. The triangulation process to see how different methods could provide data valuable to answering the research questions was essential to robustly analyzing the research content and finding "inconsistencies" (Patton, 1999, p. 1193) within the study. Ensuring credibility within this research meant becoming a community member and participating in the decision-making process by showing an investment in the study. As a researcher, this offered an investment in my work with youth researchers. Member checking was beneficial in upholding participants' voices within the study. Constantly confirming what we hear within group settings allowed a clear interpretation of the researcher's analysis.

Transferability

Graneheim and Lundman (2004) described the transferability of how research can display trustworthiness through the ability for the research findings to be seen in various areas and not just for the intended content. As the audience reviews the work, they should be able to make additional connections to other fields and transfer the data to other areas of study. This study

showed the transferability of using the lesson plans and content from an informal after-school club and the ability to apply it to the formal classroom and community outreach. Using state standards to develop lesson plans based on science units that students learn throughout middle school, the opportunity to transfer knowledge from one setting to another can show the value of how multiple learning settings allow students to construct an understanding of knowledge inside and outside the classroom.

Dependability

Dependability in qualitative research refers to the notion that the research was consistent. Knowing the study process allowed the researchers and participants to feel a sense of structure in the organization of the study (Guba & Lincoln, 1994). Creating a timeline and outline of the research plan allowed all researchers to know the prescribed plan of the study. Having clear communication and a draft made discussions meaningful and valuable usage of time.

Confirmability

Confirmability in the trustworthiness of research requires the relationship to continue throughout the research. Analysis of the study was always at the forefront in developing the description of methods used, data collected, and how the data would be analyzed (Postholm, 2019). I confirm that throughout the study, I did not impose my views on other researchers and that each researcher-participant's voice was heard through the data collection methods selected, discussed, and used in this study.

Subjectivity Statement

Growing up near the city, I lived in a predominantly middle-class area. I frequently experienced history, culture, and science with my friends in the neighborhood, from attending New African Scouts meetings to visiting various museums with my parents. Enormous credit to who I am today that my public elementary school, Thomaston Elementary, did not fall short of

incorporating Black cultural aspects of learning throughout the school year. As a rising 6th grader, this was the first place I experienced science and how it could exist in my world. Everyone knew that 6th grade was the explorative grade at our school; Ms. Sampson taught me so much about identity and your purpose in the world. Ms. Sampson offered girls in the 6th grade the opportunity to partake in Sisters of the Circle, a group focused on girl empowerment. Simultaneously, the boys participated in the Winning Circle, which her uncle, a community leader, led. Exposing students to future opportunities in the 90s STEM was new, exciting, and inviting for me as a student. My parents took me to the Scitrek museum in Atlanta, GA, with my friends, but we students knew how everything operated over time and slowly became disconnected from the thrills it first offered. During my 6th grade year, I believed I would be like the characters I saw on *A Different World* television show attending an HBCU. The opportunity to stay overnight for a three-day STEM convention on Spelman College's campus, which Ms. Sampson planned for the 6th-grade class. The chance to compete among other students around the state was when I first fell in love with science. To see the passion and history we learned during our short time there, I knew that would be my subject to study while attending my dream school.

For the next few years of science, I had teachers who inspired me from middle to high school. I entered class daily, expecting hands-on activities after my teacher briefly provided instructions. Once I attended college and started as a pre-medicine major, I quickly realized that the support and compassion differed from the college professors I had felt in my earlier school years. After retaking a few science courses, I changed my major to education. The professors' lack of support differed from what I wanted other students to encounter in their schooling careers. I wanted to be like those science teachers I had who inspired me, showed me the way, and allowed me to make mistakes while still assisting me. I wanted students to learn how to

engage in research, experiments, and discoveries while having fun and learning about their history and how it all belongs together. I wanted to be that teacher who sparked their interest in a subject that some students say they never like, especially if they do not see the benefits of science. I enjoy taking moments from the past and present, then making connections for my students, building upon what they already know, and letting them see how STEM can propel them in the future.

As a science teacher for over fourteen years, I have watched my students learn and grow while mentoring them to apply for fellowships at nearby colleges as high school students because they had a spark to light their fire in science.

From a personal experience, being hired as a science teacher midway through the school year at a metro-area school in the southeastern part of the United States, the students and I noticed that I was the only Black science teacher in the hallway. I started to feel like a teacher magnet for Black students as more students approached me to ask science questions, ask for assistance with work, and express that they were starting to excel in science by understanding the content; this was a memorable moment. At that moment, I knew that representation in the curriculum and classroom matters.

Teaching at a predominantly Black school has led me to this research. I have observed a declining motivation in my students to learn science. The students like science; however, they need to see its use and know how science can fit into their lives. I want to help them change the narrative on how they view science and see themselves in science education. Representation in science is a must for Black males and females to see that there is a place in science for them to exist and thrive.

If my students, a predominantly Black student body, are empowered to learn about STEM, I hope to help them gain interest in STEM topics and industries they want to participate in as they grow up. I want to do this research to show my students the representation of scientists and inventors who look like them in science within the science curriculum.

CHAPTER 4: THE FINDINGS

Using Youth Participatory Action Research (YPAR) (Cammarota & Fine, 2008) as my methodology allowed youth co-researchers voices to be heard in an after-school club setting. The themes developed through the analysis were based on students' learning experiences in traditional classroom settings and how their views change in an after-school setting. I divided each section into a phase to show the themes, storyline, and visual summary of the steppingstones for the growth of the voices heard throughout our informal learning time together. Throughout this experience, I have shown the benefits of learning in an informal learning space rather than a traditional classroom.

Informal Learning Space

Young and Young (2018) describe out-of-school time (OST) as an informal learning space to strengthen the content connections for youth beyond classroom time. Exploring cultural aspects during classroom time is not readily available for underrepresented students. Therefore, offering the Black History Science Club as an avenue to promote the learning of Black culture and history content was important in this study.

This informal learning space established a space for scholars to share ideas, work together, and learn cultural content outside the traditional classroom learning time. The Black History Science Club provided a space where students could learn freely in the least restrictive environment. The flexibility allowed the youth researchers to learn about each member without

the time constraints of the curriculum map. The ease of sharing who they are through icebreakers in the initial meeting was a strategy used by the YPAR hub site (https://yparhub.berkeley.edu/home). The following activities showed how the YPAR project was ignited and opened a space within the group during the first encounter.

Freedom of Speech

"Good afternoon, teachers, and students. Let us get ready for dismissal," is heard from the intercom system. Dismissal signifies the end of the school day for most teachers and students; however, six youths have decided to partake in an additional learning experience. Participants proceeded down the 8th-grade hallway to my classroom for our afterschool club time. As I was so excited about the opportunity to work with these youths, I wanted each one of them to feel comfortable as they entered this safe space that was new to them. I had their notebooks and pencils ready to begin our learning sessions and embark on conversations about learning and that day's happenings.

The Black History Science Club started early in the fall semester before competing with after-school performances, sports competitions, and school breaks. It was something new and exciting to begin the new school year. In the first session, I knew what I wanted these scholars to gain from the club, but I also wanted their expectations met. I set up our after-school learning space to establish a relationship with each coresearcher; I set out matching composition notebooks and pencils for everyone to reference that we are all equal in this research. The scholars were nervous and quiet on the first day, but they had many questions about what research is and what they were going to be doing. This was a mixed group of individuals who knew each other; for others, this was their first time in each other's presence. We utilized the resources from the YPAR Hub (https://yparhub.berkeley.edu/home); icebreakers were used to

familiarize each participant. Each participant from a different grade level could have posed a hierarchy issue at the onset of the study. Therefore, we started the session using icebreakers as a creative way to introduce ourselves.

Icebreakers

The purpose of the icebreakers allowed us to open a space for dialogue and conduct teambuilding exercises before the start of the study. We were able to gauge the personality of each coresearcher as we engaged in dialogues and activities. We built trust among the group through our interactions, and the momentum, in the beginning, continued throughout the STEAM team club sessions. Icebreakers helped to build trust between the participants and myself to get unfiltered answers throughout the study. I have outlined how I introduced the participants to several icebreaker activities to begin the team-building process.

The first icebreaker was *two truths and a lie*. This allowed each person to guess the one thing that was not true about someone, and then once they found out started to laugh. This icebreaker allowed the dialogue to begin and flow organically.

Claire:  So my name is Claire, and the boy beside me is my brother. I own a dog, and I like to collect things.

Heaven:  That's not your brother.

Claire:  That is my brother.

Bailey:  For real.

Claire:  Yeah.

Ms. Smith:  She likes to collect things.

Heaven:  So you don't like dogs?

Claire:  Nope, I do not even own a dog.

The second icebreaker, called *categories*, required participants to list objects alphabetically for a particular category. After two attempts, we tried one last time.

Ms. Smith:  Okay, since Bailey knows how the game goes. I'm going around this way first, and you can say any food that starts with the letter that lands on your turn. Hands up, (*clap, clap*), we're gonna get, (*clap, clap*) names of food, starting with Ms Smith ending with Cassh; apples.

Bailey:  Banana.

Sarah:  Catfish (Everyone laughs). D, D bruh yeah, yeah.

Grant:  Icecream

Heaven:  Jelly beans

Claire:  Okay. no way, no. That is not ABC order.

Cassh:  Kettlecorn, that's what I want to say.

Ms. Smith:  We tried that was fun.

That game was challenging, and we laughed as it was hard to get the hang of it. These two icebreakers were conducted to get the participants to talk and laugh and see that they could laugh at each other without the judgment zone.

The final icebreaker game, *scribbles*, was slightly different. Scholars each had a piece of paper and drew lines until I said stop; they then passed the paper to their right, and the next person had to try and create a picture from that person's scribble after being given 3 minutes. Later, they each shared what they made from their peer's drawings. I explained to the youth co-researchers that this activity allowed them to see that our idea may not look like anything independently. Still, as a cohesive group, we can use each other's ideas to derive our plan and goals and see a different picture.

During our initial meeting, the fun continued with naming the club. I asked the researchers what they wanted to call it, and they asked me the current name. The initial name I had given the club during the proposal phase was the Black History Science Club. As we started to work and share ideas, a new name was derived for the group as a collective dialogue exchange occurred:

 : Do y’all remember the science club from last year, the STEAM Team?

 : Yeah, the other teacher was doing it.

 : It was kind of like this because we could do cool stuff.

 : What did y'all do?

 : We built stuff and did experiments.

 : That sounds like fun.

 : We can just use the same name.

 : That is cool with me.

 : I agree. I will do whatever the group likes.

 : I like the name.

 : Okay, our new name is The STEAM Team, Ms. Smith.

 : It also rhymes.

 : (laughter from everyone).

 : That sounds good to me, The STEAM Team.

The STEAM Team will be used throughout the remainder of the paper to honor the selection from the researchers. This interaction showcased the importance of informal learning settings. Students can connect to things that are meaningful to them and have an impact beyond the classroom setting.

The STEAM Team had more decisions to make on day one after the icebreakers and the naming of the group. With each scholar having the opportunity to share their thoughts and opinions, we set norms during our first session to adhere to for the remaining sessions. I explained what norms were, similar to rules we would adhere to respectfully when someone shared their idea. As we sat at the square table, each coresearcher said what came to their mind,

and the other coresearchers asked more about the norm if they needed clarity, stated that they agreed or disagreed, or provided feedback.

 : I want you to embrace what everyone is saying and what we are all bringing to the table as far as our ideas because it's not about Ms. Smith's voice. It's not about just one person's voice in the group. However, it's about all of us together. Does that make sense? Okay, when we are here together, what are some norms that we can jot down like as far as our rules for the group that we can think about each time we come together? So, what are some things as far as being respectful toward each other that we could think about? What we call these are norms. Like the rules. What do you think?

 : Like we should never judge.

 : So, Ms. Smith, if you want to hear from everybody, we should not talk while others are talking.

 : Okay, these are all good so far. Do we need to add other norms?

 : How about we do not take objects that are not for us?

 : Basically (In an agreement manner with Bailey).

 : Okay, continue to think. I want everyone to offer their suggestions.

 : We need to be respectful to each other.

 : I think that we should raise our hand or pass around objects to speak.

Each coresearcher had a chance to share what they wanted to see within the group settings so that each person's voice could be heard. There was no particular order in which we placed the norms; therefore, we did not number them because each was equally important and was provided and agreed upon, as shown in Figure 4.

Norms for club sessions

- **Never judge**
- **Not talking while others are sharing**
- **Be respectful**
- **Do not take objects that do not belong to us.**
- **Raise hand or pass around object to speak.**

Figure 4: Norms Cogenerated During Session

The first two sessions involved the foundational setting of the STEAM Team, from establishing norms to ensuring that the youth researchers understood their role. The group used a chart from the YPAR Hub (see Figure 5) to decide how much participation they felt was

appropriate. Based on their age and the time allotted for each session, the youth decided that medium-high participation was okay for them.

High Level of Youth Participation	
Highest involvement	Youth-led research/evaluation is institutionalized as part of the organizational planning cycle. Experienced youth researchers/evaluators act as peer trainers. Youth are paid staff.
High involvement	Youth-led participation in the entire process. Youth roles include research design, data collection, data analysis, reporting finding and recommendations, and implementing change.
Medium-high	Youth design and administer research instruments. Example: youth design and give out a survey to their peers. Adults analyze the results, develop findings, and implement changes.
Medium-low involvement	Youth input on progress. Example: youth give adults feedback on adult-designed survey questions.
Low involvement	Youth as data collectors. Example: you collect data for adult evaluators with an adult-designed survey.
Little youth involvement	Information is collected from youth. Example: youth take an adult-designed survey.
No/Low Level of Youth Participation	

Figure 5: Youth Participation Chart from the YPAR Hub Site

The STEAM team moved to an area of trust, which was evident in the conversations. Figure 6 summarizes the STEAM team's initial steps, from joining the afterschool club to sharing their ideas on the club's structure and participated in icebreakers to learn about each team member and inform me of their knowledge status through a questionnaire. The more the STEAM team continued to meet there was growth, and new moments emerged with the progression from

week to week, with forward movement toward the completion goal.

Figure 6: STEAM Team Initial Step Visual Summary

"They Didn't Teach Us That": An Examination of School Science Curriculum

Throughout the data analysis process, the researchers commonly stated that they were not taught the information I was presenting to the STEAM team in school. This section showcases their understanding of science and influential scientists from their point of view.

After analyzing the researchers' questionnaire titled *Who is a Scientist?* I examined and included details of each question with the commonality of their responses. The preliminary findings from the questionnaire showed the following results: 1) *What is a scientist?* The reactions were common among the scholars that a scientist is someone who does experiments. Clair added, "A scientist research to make the world a better place." 2) Who can be a scientist? Scholars had a general idea about what a scientist is; however, they did not have a clear idea of who could be a scientist. Four of the six scholars who responded to this question stated, "I don't know." The thought of representation was signified here that scholars cannot be what they do not see. I knew I had to arrange for students to meet real-life scientists and STEM professionals. The responses to these questions signified why exposure is imperative for students at an early age (Garrison, 2013). 3) Naming Black Scientists and Inventors was not an easy question. Scholars

could only name George Washington Carver and Dr. Marie Daly (Bailey). 4) Regarding opportunities to meet Black scientists, they responded that they had never met a Black scientist. However, one scholar stated that if Mrs. Smith considers herself a scientist, they met one (Heaven). The final question was to name STEM occupations that might interest them. Sarah replied, “An engineer because they like to build things and make them better than they previously were.” Based on this data source, I knew that I had to make sure that these scholars were not only coresearchers but also gained knowledge about their culture and could pass it along.

After the initial questionnaire, questions were analyzed. The action plan of integrating Black culture and history was visibly needed. The first two weeks of the STEAM team were to build a foundation of cultural and historical understanding. Research question two: How can Youth Participatory Action Research (YPAR) support the implementation of Culturally Relevant Pedagogy (CRP) in an after-school science club? I set the stage with prewritten lesson plans of ideas the scholars would enjoy learning about. I have provided a snapshot of the lesson plan template used during our first week’s meeting. These lessons were geared to teach about Black culture and history and provide a cultural aspect I sought to incorporate into each lesson, as shown in Figure 7.

Week 1 Initial Plan - History	Data Collection
Who is a scientist? History of science in African culture	• Students will answer a questionnaire on who is a scientist? • Create a one-pager (scrapbook page) on who is a scientist - magazine clippings, drawings, Canva • Describe how they feel as their place in science. • Research and discuss the history of African culture in science. • Create hieroglyphic locker name plates. • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors?

Figure 7: Initial Lesson Plan

During our sessions, scholars received historical information, and then questions began to be generated throughout the following sessions, “Why is it that we have never learned about this?” (Heaven) Why don’t we talk about this in school? (Grant). CRP's tenet of cultural competency showed that students became aware of the inequities in science content presented in their classes. While our STEAM team worked on their showcase project, the group was freely talking, and I felt that this was a comfortable time to receive feedback from my youth researchers:

 : So, let's talk a little bit while we're working. So how are y'all feeling so far? I know that we've been doing a lot of different things. So, tell me, what have you learned? How have your feelings been towards what we've been doing? So just talk to me while you're working.

 : I have learned more about Black scientists and inventors than I ever had.

 : I agree with her (Heaven), other than at school.

 **:** Like, y'all talked about it at school?

 : Just the names. We never went deep into it. (Heaven says something...Claire keeps talking) They just say: Oh, you'll learn more about that in this grade (waving hand, signifying another grade level).

 : Oh, Okay,

 **:** Then they do the same people over and over each year.

 : So, it is being pushed off, but they never circle back around to? What did you say, Cassh?

 : Maybe, you will learn it in high school, they say?

 : Oh.

: No, that's what always happens is like, Oh, you'll learn more about this in. Like, when I was in fourth grade, we will learn about Washington, and she brung up somebody else I forgot. But she was like, well, you learn more about this in fifth grade. And so I asked about the person in fifth grade and we never, never learned about it.

: So, you're like anticipating fifth grade. And then it comes around, and you're like, we didn't know about that person. So, maybe I learned about it in sixth grade. And then, now, you're in sixth grade. You're waiting to see if you will learn about this person or that person.

The anticipation in their voices of wanting to know about their culture and history was never met as they had hoped for the following year. It was like a “Dream Deferred” (Hughes, 1951) the hope, the passion, and the gut-filling eventually just went away until recently when they started to learn and see scientists and inventors discussed during our STEAM team time, as they inquired about in the past.

Say It Loud

First, scholars learned about Ancient African culture and their contributions to STEAM through tools, medicines, navigation, engineering, and math. We dived deeper into the content about the hardships of African Americans in obtaining patents. Scholars learned about Black scientists and inventors, some of whom are still alive, and reflected on how these inventions impact or improve their daily lives—this allowed for more exposure to the contributions of Black scientists and inventors. The learning continued with modern-day inventors of items they might

use at home or play with, such as the super soaker created by Lonnie Johnson. We then thought about inventions that are beneficial in our daily lives—this week's discussion allowed for a more in-depth discussion about equity. During the session, the openness of the conversations sparked several questions from researchers as they dug through information to learn about historical figures in science, and they were able to think about who they were and what they would create if they had an opportunity.

I posed the reflection question of the day as they shared aloud after they reflected on their writing in their STEM journal, "If you were an inventor, what would you create?"

 **:** What is something you might need at home that you want to create or make doing a task much easier? Think of something that you maybe don't like to do that you like to make it easier to accomplish. Sarah, would you like to share?

 **:** Fold clothes

 **:** Fold clothes. Well, oh my gosh, that is one thing. Suppose I could get a machine to help me fold clothes. That will make my day a lot easier. So folding clothes is yours. Okay. What about you?

 **:** A silent vacuum

 **:** Oh, you said a silent vacuum. Oh, okay.

 **:** So my mom, likes just to vacuum early in the morning and late at night.

 **:** You know, vacuum cleaners have a super loud noise. So, making it a lot quieter. Does anybody else have something they want to think about?

 **:** Wireless internet cameras.

 **:** We do have wireless. Do you mean not connected?

 **:** We have wireless.

 **:** *laughter from the group*

 **:** Oh, do you mean like a wireless charger?

 **:** No.

 : Okay, so you mean you want wires to be gone all the way?

 **:** Yeah, like, what's the point?

 **:** Okay. That is going to be something to think about.

Now that the youth researchers are starting to work like scientists, they have more investigations to do to understand the contributions of other Black scientists and inventors to their culture. They had to do research. It could not just come from me showing PowerPoint and lectures, a traditional way of teaching. They needed to have ownership of the knowledge they had obtained.

Although scholars attend a predominantly Black school, the curricular resources still did not reflect their racial identities. Scholars expressed through cogenerative dialogues how their learning expectations were not met year after year and that they had to wait for learning to occur in other areas, which never happened. Figure 8 shows a recap of this phase of examining the school science curriculum that scholars say they have not been taught. This theme showed the youths' limited learning experiences of Black culture and history year after year in school. Their openness to share helped to move the STEAM team forward with progress as we continued to push toward our learning endeavors each week.

Figure 8: They Did Not Teach Us That Visual Summary

"I Didn't Know a Black Person Did That": An Exploration of Black Contributors

Scholars' continuous conversations and questionnaire responses led to this theme. They expressed how they did not know Black people were responsible for noteworthy inventions and scientific discoveries. The decision to research was a response to the continuous deferral of not receiving feedback to their questions about learning about prominent Black figures in science year after year. Scholars selected to be instrumental in their learning and begin the research process. Researching Black scientists was necessary based on the prior week's questionnaire; scholars knew only two scientists or inventors. Referencing research question two, CRP scholars were learning content and increasing their knowledge of what they did not realize during week one. They also did not think they could be an inventor. Scholars started to see more representation as they delved into the research during planning sessions, shown in Appendix F. One thing that scholars noticed when looking up different inventions was that there was a lack of information about Black inventors, and they had to search harder to find information. I asked the female scholars to search for Black female scientists, and Heaven stated, "I keep seeing old white men" (Heaven). They said it was hard to find one. Claire followed with the same sentiments of being unable to discover much information in her search.

Co-researchers determined how important it was to get the word out to other students about Black scientists and inventors. They decided they wanted to do a museum gallery walk, that entailed learning about historical figures in the science community; then, they would showcase the information they obtained with others.

 : Okay, how do we plan to showcase what we are learning?

 : I remember when we did a living museum in 7th grade, and we had to dress up like the person. We can do something like that.

 : Oh, that sounds interesting. Would y'all be willing to dress up and speak about the person you have researched?

 : You mean we will have to speak in front of everyone? Oh no!

 : Nah, I don't want to do that.

 : Well, maybe we can just do it like a science fair project and post it up.

 : And we can include like a 3D model. I have a camera to take pictures.

 : Oh that way it can be a small 3D model or something that we can carry.

 : That sounds good, because you can still research the information, and everyone can still come to see it.

 : Yeah, that sounds like a better plan. I do not want to talk in from of people.

 : If we have, like posters and stuff then everyone can see our work.

 : Okay, so what we can do is create models and posters so they can be shown as a gallery walk and you can hear the feedback for those that see your work. How does that sound?

 : That will work…sounds good (*all coming to an agreement*).

Research question one focused on allowing opportunities to emerge within an afterschool learning setting as youth researchers planned to showcase their knowledge. The growth trend among the youth researchers heading in that direction was prevalent in the coming weeks. After learning about a few scientists and inventors, they wanted to know what things their classmates could not live without and how these daily occurrences were probably attached to a Black scientist.

YPAR creates a door to be open for youth to explore. Youth researchers decided to create a survey. Scholar Claire created the survey by typing it out as the group agreed on what it would say. They decided it should be one question so they could administer it to their homeroom class and tally on the same day. I assisted in making the copies. Each researcher picked up the surveys to take to their classes the following morning. Co-researchers Heaven and Bailey tallied the results to determine the interests of students. The survey responses from students in Figure 9 set the foundation for their research. They shared files to work on the presentation collectively and shared ideas of what should be included for each historical STEM figure. The scholars took significant ownership in coming to my classroom to retrieve the printed copies of the surveys they created, administering them, collecting, returning, and reading the results.

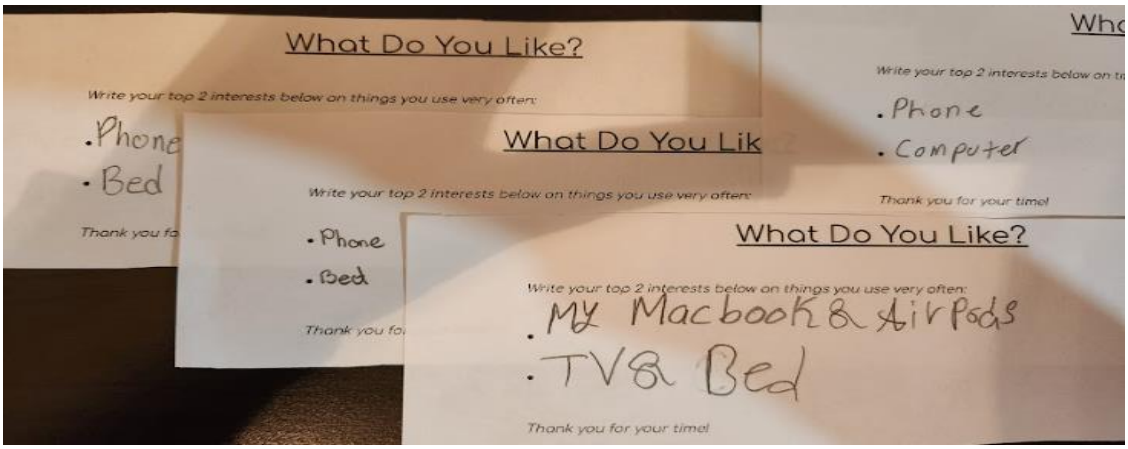

Figure 9: Survey Responses

The results determined that students enjoyed their phones and beds. Therefore, the youth co-researchers chose to look into who created the bed and the history of the telephone. The youth researched using different websites and learned about Sarah Goode's invention of the cabinet bed. In addition to Granville T. Woods having multiple patents, the “telegraphony” was one the researchers found intriguing, allowing messages to be sent through wires. Grant made a connection: “It's like an old version of text messaging.” The youth were able to see how inventions from the past have an impact on today’s daily routines.

Learning did not happen only through the computer to research inventors or scientists, but I also wanted scholars to be aware of scientific figures in their neighborhoods. Youth researchers learned about George Washington Carver, but I also thought about the tenets of CRP of “sociopolitical consciousness” and how to be socially aware of their community (Ladson-Billings, 1995). Scholars had limited knowledge of scientists or different job descriptions of scientists; therefore, I wanted to plant a seed of knowledge for them.

I wanted them to think outside the box of a scientist, not just someone in a lab coat blowing things up, but something more along the lines of what they could do in the agricultural field.

 : Do you remember our discussion about George Washington Carver?

 : That he didn't invent peanuts.

 : Oh yeah, yeah. yeah. He was the peanut man (yells from across the room in

excitement).

 : He was the peanut man.

 **:** He did not invent peanuts. Just ways... he came up with different ways to use the peanuts.

 : Right, good. He came up with different medicines and several different ways to utilize peanuts. Do you know any Black farmers?

 : No. Now?

 **:** Well, would you like to be a Black farmer?

 : My dad does [plant] carrots, tomatoes, cucumbers, and watermelon.

 : Okay, so that's kind of why your dad is like a modern-day farmer, even though he might not feel like he doesn't have that whole landscape. But still, he's growing his vegetables.

 : And saving money.

 : He said the system, they be putting fake food out there. Oh, yeah.

 : Like cloning and stuff.

 : Like basically, he only plants his favorites, though.

 **:** Okay, so he's thinking about the genetics of it as far as GMOs like genetically modified foods. And so he's like, I don't trust this science. Therefore, I am going to create and grow my own. So I know what's in it, where it came from.

The mistrust of science led me to have the youth grow their vegetables. This allowed them to have a firsthand encounter with being a gardener and have something to show through

their learning experience. Figure 10 shows the youth's process of creating their hydroponic plant.

Figure 10: Hydroponic Gardening

Fascinating parts of the hydroponic garden included the growth process when youth researchers could see the root system emerge. They were delighted to see how quick and rewarding the growth process could be.

Representation of STEM careers is important at an early age; therefore, I arranged for the scholars to meet with the local gardener to ask questions. Ms. Green, the gardener, spoke about being conscious of our local food area as a food desert and how we, as community members, can combat it by growing our vegetables and sharing them throughout our community. Youth researchers also enjoyed seeing the harvest of a real-life Black gardener in their local area. She introduced how youth can be farmers and discussed the benefits of hydroponic gardening, such as less pesticides. The opportunity for CRP was present, even with STEM guest speakers, shown in Appendix G, to raise awareness of inequities, such as medicine within their community. For scholars, to learn early on that they can be agents of change within their community through a community leader was an impactful moment.

The outcome of this section is shown in Figure 11, which discussed that scholars did not know about Black scientists and inventors that they wanted to take ownership of their learning therefore, they created a survey to determine their peers' needs, which led them on a search for several Black scientists and inventors and created exposure of cultural representation within the science curricula. The STEAM team moved headed with so much forward progress. The growth of the group was seen in this section as each member contributed their ideas, asked questions they never felt comfortable asking in class and worked as a team.

 : Do you know any inventions that Black inventors have created?

 : Light bulbs.

 : Traffic light.

 : Peanut butter.

 : Did a Black person make a bed?

 : I am going to allow you to research in just a moment.

 : Fans.

This openness to share out their thoughts in a nonjudgemental zone allowed them to continue to respond to the question and reflect on what they already knew. Referring to Heaven's question on who made the bed, I allowed the youth coresearchers to explore and see what information they could discover online. They discovered that a similar bed to that of the invention by Sarah Goode was created now known as the Murphey bed. I asked the youth what they noticed, and Heaven response was:

 : And she's a female, right? So she's also Black. She didn't get her props.

Just the ability to have the opportunity to research, share and ask questions created an open door for learning. Let's move to see how all their engagement has led to growth.

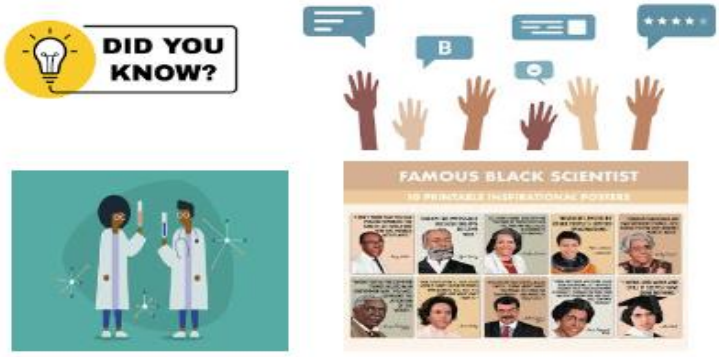

Figure 11: I Did Not Know a Black Person Did That Visual Summary

"We Thought We Could So We Did": A Collective Engagement Toward Solutions

After meeting with the STEAM team, one thing that emerged was the importance of out-of-school time. It was not just about meeting up and mingling with other scholars, but it allowed

for opportunities not granted during school due to time constraints to be addressed in a more flexible setting. As we worked to learn about Black scientists and inventors, the ownership of learning was developing in the co-researchers. They wanted to know more; they researched, asked questions freely, and started seeing themselves as scientists.

Our Voices Heard

Just as a baby cry signify they want to be heard; youth talk to see if anyone is listening. A small yes can be a significant gesture in their eyes. Communication was a huge factor in how the study evolved over six weeks. Youth researchers had to feel a sense of being a partner in the decision-making process to continue allowing other decisions and revisions to be implemented weekly. From day one, the STEAM team made decisions by developing the norms, determining the use of artifacts, creating surveys, and assigning roles. This section will outline the negotiation process throughout the engagement of completing the overall YPAR project.

They asked a simple but mighty question if they could change the use of an artifact that I had planned. The initial plans for researchers to create locker nameplates using hieroglyphic writing were changed to bookmarks as they discussed what they wanted to use for their artifact in Figure 12.

 : Ms. Smith, can we use it as a bookmark instead?

 : OK, why do you want to use it as a bookmark and not on your locker?

 : I use my books in class more, which will be seen more than at my locker. We only go to our locker twice a day.

 : Yeah, I'd rather keep it with me.

This dialogue exchange let me know that the youth coresearchers were becoming more comfortable in the decision-making process to navigate their learning and what they wanted to see the outcome. As the facilitator and researcher within this YPAR study, it was essential to let go for the researchers to feel like their voices were heard.

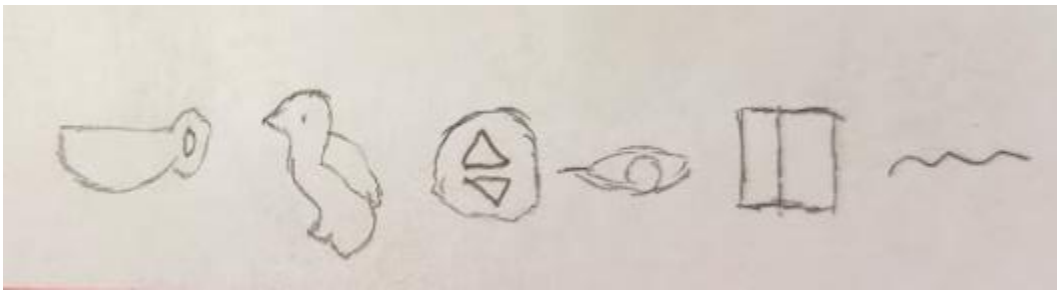

Figure 12: Youth Participant's Hieroglyphic Bookmark

Shout With a Voice of Triumph

As we continued to move forward in the research, Scholars enjoyed working together. From the onset of the surveys to sharing files to work on the presentation collectively and sharing ideas of what should be included for each historical STEM figure. The scholars took significant ownership in coming to the STEAM Team each week. They knew that each researcher played a key role in developing the outcome of the research product. The process of

how the coresearchers worked through and planned to produce a showcase project is shown in Figure 13.

Figure 13: Sarah Goode's Cabinet Bed Showcase Project

 : Alright, so I have pieces for the cabinet bed here; we're going to have to hot glue it or tacky glue it. So, do you want to go ahead and glue or figure out how we can get these pieces together? So, your brother painted these pieces. Did he do a good job?

 : Yeah.

 **:** So, we can figure out how to get this cabinet bed to stay up. Oopsie Oopsie. So, we can do it where we have to glue that back on. And we could probably do a where

it is like this glue it onto here. Then we might even want to pivot the bed. What do you think?

All right, so what we're gonna do this part is broke here, but let's figure out how I know if you know, it broke. But that's okay, we're gonna fix it. So, it could be more like a pivot. I don't know how big this stuff is because I did not open it. I wanted to open it with you, scholars. And see, it's a lot of different pieces where we can put it together all this is actually pretty big to make the cabinet bed.

 **:** So, it gives us like, oh, this is the drawer.

 : What did you think it is? It's like a broken dollhouse.

 **:** So, it's like the cabinet pieces. Right? So, we can make it work, you guys, and we can make it work. Isn't it cute? I thought it was the cutest thing. I was like, we might run out of time building.

 **:** Can we make like a whole room?

 **:** We can. And use the box as a room or an office. Right?

 **:** Yeah, so we can use it.

 **:** So what are we going to do with that piece?

 : Let's first take everything out. So that's take all that out. I'm so excited. I was so excited to show you the additional pieces.

 **:** Honestly, you know, there's like this. It's like an old time.

 : So, we can make you where it's gonna open up and then make it where it can be sat on.

 **:** Like a couch set.

 **:** Okay, so we could do it here remember, we need to do the cabinet bed, that is the focal point, we can have one chair, and we'll leave all the extra pieces out.

 **:** So that's gonna be like the cabinet.

 **:** What do you think of this armoire piece as the cabinet? Remember, the bed folded out of there. What other pieces do we have? Is that it? Okay, so let's figure out how we're going to put together all of our design ideas to make it work. Okay. We might have to paint, or we can leave it how it is.

 : I want to paint because it is not giving vintage.

 **:** Okay, so what we need to do first is let's put it together then paint.

 : Yeah.

 **:** Okay, can I put hot glue on these drawers?

 : You can or you can leave it open. It is up to the group. If you don't think we will need it ever again.

 : Well, we might need to hot glue it so the drawers will not come out.

 : Will you like the other pieces?

 : I don't play with dollhouses.

 : Laughter in the group

 **:** Well, you can hot glue it.

 **:** Do you want it?

 **:** Want what?

 **:** The whole thing, all the pieces after we are done with it.

 : Sure.

 : Claire says she might want it after. I figure she would. So, let's figure out how we're going to put this bed together with the dresser and the armoire piece. So, if this is a cabinet bed, can we do it where...you might need to take those out...

 : How will we lift it up?

 : That's a good question. How will we lift it up STEAM team?

 : Strings

 : Straws

 : So that's what we're going to do, some straws?

 : Then cut them in half.

 **:** To just lift it? Or, like, pull it?

 **:** Okay, let me get back to work.

 **:** Yes, I have straws.

 : We might have to leave it like this because if we do it with adding the straws, it is going to be ugly.

 : But remember, the point is for the viewer to take away the image of knowing the idea of the cabinet bed.

 : But maybe we can just talk about the bed's design or put a picture behind it like of her original blueprint.

 **:** Oh, good idea. So, when the cabinet bed goes up, we have a painted picture of Sarah Goode under it.

After several weeks of researching and developing, the researchers presented a walk-through exhibit in my classroom for others to see. They showcased their final product of Sarah Goode's cabinet bed that they put together and posters of their research seen in Figure 14.

 : Ms. Smith, I finally finished the presentation and that painting.

 : This looks good now that we put the black fabric over the box.

 : Oh wow, this is finally coming together, I did not know how it was going to look in the beginning when we were planning it, but it looks good.

 : I told ya'll that I like to build, and we could do this model.

Scholars could explain to others what they had learned and shared in a safe space. We showcased our cabinet bed design and slide presentation to the parents, teachers, and peers. The sentiments that were heard from their peers and the oohs and aahs were worth the time that we spent together learning and laughing in a safe space.

Figure 14: Culminating Showcase Projects

The following recap Figure 15 showcases how, throughout this section, the youth voices were uplifted and heard to accomplish a set goal. YPAR involves the participation of youth whose voices are frequently silenced to be uplifted and transcended as we bring to light Black culture and history in an after-school informal learning setting. Seeing the smiles on the youth coresearchers' faces was a pleasure as they presented their final product. Classes took part in a gallery walk-through to see the cabinet bed and poster the youth created. To hear positive feedback from their peers was priceless. The STEAM team has done what they set out to accomplish. This led me to my final theme about the researcher's experience as a researcher-facilitator.

Figure 15: We Thought We Could So We Did Visual Summary

"Let Me Clear My Throat": A Facilitator's Reflection

As an educator for over 16 years, that does not mean I know everything. I have been given a space to learn. Reflecting on this experience has been a journey to reevaluate my

pedagogical style within my classroom. I now take into consideration three things: the ability to shift and compromise, the importance of hearing the voices of youth, and the space for autonomy for youth to grow and thrive. I will explain each of these points in detail through my final reflection.

Shifting means that moves are made in different directions at any given moment. Sometimes, as an educator, staying on autopilot is much easier because it is a known pathway. The YPAR pathway can have alternative routes that lead me on an unknown path, but the outcome was rewarding. The YPAR process was not only for youth researchers to learn about Black culture and history. Still, it was a place where I could learn how to become more culturally aware as an educator and implement lessons relevant to the scholars I encountered. I learned how to hear the voices of youth and consider their knowledge when making pedagogical choices based on their needs. I wrote out lessons I wanted to teach the youth based on my preferences. However, as we shared ideas and discussed details of each week's upcoming agenda, things were altered along the way. Figure 16 showcases the initial week two lesson plan that I created prior to meeting the coresearchers. The dialogue that follows showcased the negotiation process that took place to alter the plans based on the interest of the youth.

Week 2 Initial Plan - Astronomy	Data Collection
Unveiling Black Hidden Figures in Astronomy Youth viewpoints on representation in space travel	• Learning how Egyptians documented the mapping of the sun, moon and constellations. • Students will research about the contributions of Mae Jemison, Katherine Johnson, Ed Dwight, Ronald McNair, Guion Bluford, Fred Gregory and many more. • Create graphic organizers to showcase and discuss their findings. • Create rockets to launch at the end of the week. • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Figure 16: Week 2 Initial Lesson Plan

 : We talked about Egyptians and their contributions to STEM; do we recall what STEM is?

 : Yes, we have science, technology, engineering, and math.

 : So, we have science, technology, engineering, and math. And so, we think about a lot of those. Where did that root from? Where's the start of it? So like math whose favorite subject is math? Anyone?

 : *Group laughter*.

 : I don't like subjects.

 : That's okay. Because with math, we think about number systems, we think about, you know, volume and counting and different things like that. Do you like money?

 : Yeah.

 : Then that is a component of math. So, what about astronomy? Do you like stargazing?

 : No.

 : Okay. What do you like?

 : What is stargazing?

 : Looking up at the sky and star constellations.

 : No, I'll look at the sky. (Laughs)

 : The same.

 : So, one thing about it is, you can it's not just necessarily looking for stars, but it's also about the planets about the asteroid. It's about understanding the universe.

No matter how hard I tried to make astronomy seem interesting, they did not care to learn about it during their time in this after-school club. I had to honor their notion that this topic was not their favorite and shift my lesson plan. Part of YPAR means to listen to the voices of youth, so I did just that and asked them what they cared to engage in learning, so I could tailor the lessons according to their desires.

 : Okay, what are some things that interest you?

 : I like to fix things.

 : Me too.

 : I made a car before.

After delving deeper into what the youth liked, I knew that the lesson plans had to be revised. We changed the plan to accommodate the interest of all group members from the feedback that was shared through our cogenerative dialogue. Figure 17 shows the revised portions of the plans that the youth decided that they did not want to learn about. Followed by the outcome shown in Figure 18 of what was argued upon by the group and their interest of learning about engineering.

Week 2 Revised Plan - ~~Astronomy~~ Science Legends	Data Collection
Unveiling Black Hidden Figures ~~in Astronomy~~ science Youth viewpoints on representation ~~in space travel~~ science	• Learning more about patents, think about our own invention. Look up inventions from Black scientists. • Students will research about the contributions of Mae Jemison, ~~Katherine Johnson, Ed Dwight, Ronald McNair, Guion Bluford, Fred Gregory and many more.~~ • ~~Create graphic organizers to showcase and discuss their findings.~~ • ~~Create rockets to launch at the end of the week.~~ • Researchers implement data collection from peers • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Figure 17: Week 2 Revised Lesson Plan

Week 2 Outcome Plan - Science legends	Data Collection
Unveiling Black Hidden Figures science Youth viewpoints on representation science	• Learning more about patents, think about our own invention. Look up inventions from Black scientist. • Students will research about the contributions of Mae Jemison. • Learned about a living legend Lonnie Johnson. • Described our own inventions and why would this invention be beneficial. • Researched from various sites other patents and inventions and looked for patterns in who they saw represented in their findings. • Researchers implement data collection from peers. • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Figure 18: Week 2 Outcome Lesson Plan

I showcased in Appendix C the full set of lesson plans that includes, the initial lesson plans, the revised lesson plans, and the outcome of the lesson plans. Each week was rewarding as I considered their feedback and then saw the joy on their faces as they showed up to participate.

Key components that I wanted to implement into the STEAM team included community members such as the physician assistant and local gardener to discuss STEM careers and answer scholars' questions.

 : What do you guys do?

Physician Assistant:  What is a PA? So the main thing that we do is conduct physical exams. So, when you come in to be seen because you're sick or you got something going on, we use medical equipment, like a stethoscope or an otoscope, which

is what you see this provider using right here on this little girl. We use tuning forks, reflex hammers, blood pressure, cuffs, all of those things to obtain information and data about what's going on in your body. So that we can make a good decision about how to help you get better. Okay, in a lot of ways we use science to help us to do that. So diagnosing and treating illnesses, so what are some things that you see going on here on the slide that may be related to science?

 : Doing an X-Ray.

 : Diagnosis one of them.

 : They’re making medicine.

 : Okay, so PAs don't make medicine, but we prescribe medications. And medicines come from substances, scientific or chemical substances that are put together to create, you know, something that will make you feel better, right. Okay. Someone else over here was saying something.

 : Looking at a test.


: Yeah, so for the ordering and interpreting test, what's on that picture above there? It's like a sample, too. And so when you go to the doctor, sometimes you have to draw blood, right? So, in order for me to understand something about someone's health, I may order a nurse to draw some blood from them, send it off to the lab, and check certain levels in their body, and that can help me to make an educated decision on what I should do for them to help them to feel better. We also provide education; we do rounds in hospitals, and we can perform minor surgical procedures alone. If it is a big operation that needs to take place, PAs will often serve as the first assistant in surgery. Diagnose and treat illnesses by using things like X-rays, CAT scans, and MRIs; we were trained on how to read all of these types of things. Okay. Why should you become a PA? So, for the number one reason, it is one of the best professions in the country right now. It's considered the number two best profession in health care. And the number three best job in America. All right. Some source called Kiplinger's called it one of the greatest careers for your future. Absolutely agree with that. There's also a lot of job security in being a PA, what does that mean? What is job security mean? And why is that important?


: What is job security?


: Job security, what do you think it means?

 : Save your job.

 : Your job is usually generally going to be protected, meaning that as a PA, the job market is great, meaning it's very easy to find a job. There are lots of opportunities to work as a PA, and you will almost never have a difficult time finding a job.

The interaction between the PA and the researchers offered a first-hand experience in a career field that they did not know about. Creating a space, such as the STEAM Team, to bring in community partners allowed for scholars to think of different opportunities in the STEM field. Heaven's mom stated at the start of the club that this would be an excellent opportunity for Heaven to possibly increase her interest in science. She mentioned that Heaven took a dislike to the content a while ago, and she wanted something to spark her interests. She said the moment that Heaven brought her the interest letter for the club, she eagerly signed it, hoping this would provide the boost of eagerness to learn science once more.

During the session with the PA, I saw Heaven open up and share that she wanted to be a traveling nurse like her older sister. She inquired about the classes she would need to take to pursue her dream.

 : So, in order to go to PA school, you would have had to take certain classes as an undergraduate, in order to apply to a PA school. And most of those classes are going to be science classes. So, we say select an appropriate major, most individuals who are pursuing PA school have an undergraduate major in a natural science. So, something like

the things that y'all name. So, most of us are biology majors, chemistry majors, exercise, science majors, physics majors. That's not always the case.

 : You took them all at one time?

 : No, you take them over the course of four years. So, you got a long time, to take the classes that you need.

 : May I add one thing? Some of these courses, if you're an eighth grader, when you go to your next, when you go to high school, are available for you to take. So it's kind of like you get a little glimpse of being able to keep your notebook and all that stuff and use it in college.

 : So, do nurses have to take all of them, too?

 : Most of the pamphlets in nursing schools are slightly different, but let's say you take many of the same classes.

Knowing that Heaven had an opportunity to speak candidly to a professional in her desired career field was a major accomplishment for the growth of this scholar and others in this informal learning space.

Scholars were excited to see their hard work and dedication come to fruition. Hearing them say they finally had an opportunity to see themselves represented in science was priceless. The final reflection was based on the initial questionnaire located in Appendix A, to see if the after-school science club was impactful. The first question asked was: “What is a scientist?” The responses were answered with more confidence than initially, with reactions such as; “someone who studies about science (Bailey)” “a person who dedicates their studies to science and problems that can be popular or important for a select few, (Claire)” and “someone who likes to do experiments (Cassh).” Another question focused on research question one of exposing youth to science asked what they liked about the after-school science club. They stated, “I liked learning about Black scientists” (Bailey), “the friendships among the group and the laughing we did”(Claire), “how much it helped me learn” (Grant), “We learned about some Black inventor” (Cassh), “We learned about Henrietta Lacks and her cells” (Heaven), and “the history behind Black scientist and us being able to build what was made years ago” (Sarah).

When given a space and the option to choose their pathway of choosing to be a participant in another study, they shared the following feedback, which was based on research question two: “Would you participate in another YPAR study?” Explain your decision. The co-researchers stated, “Yes I would; this club gives me an opportunity to express myself and learn about Black American scientists” (Sarah), “Yes, I have learned about Black scientists” (Heaven), “I honestly think that I can see myself be a researcher” (Cassh), “Yes, because it helped me learn lots of new things” (Grant), “Yes! The reason I say yes is that it is a fun experience and a good way to meet new people” (Claire), and “Yes, because what we did in the YPAR was really fun and I will love to do it again” (Bailey).

I will conclude the findings with the first question I asked my Youth researchers in the initial questionnaire: “Who can be a scientist?” They all replied that anyone can be a scientist. Since they considered that anyone could be a scientist. I followed up with the question: Do you think you are a scientist? Explain. Four of six scholars stated that they are scientists because they study science. The other two students did not consider themselves scientists because they needed to devote more time to learning science. There was one thing that also stood out in the final reflection, and it was from Claire, who mentioned that she did not care for science a great deal, but this experience has made her think about future decision-making, such as attending an HBCU (Historically Black Colleges and Universities). The responses showed excellent knowledge gained throughout the six weeks of after-school club sessions.

Using several data methods such as STEM journals, researcher’s memos, reflections, and documents provided for voices to be captured in various ways. Listening, reading, and reflecting on these voices allowed me to navigate through this study while keeping the participants and the research questions at the forefront. The visual summary Figure 19 shows how plans were created, reflected, revised, and altered based on the experiences and knowledge that everyone brought to the table.

Figure 19: Let Me Clear My Throat Visual Summary

CHAPTER 5: DISCUSSION

The lack of representation within the science curricula has shown that students lose interest in science early on, therefore showing a lack of interest in STEM careers as they matriculate through school (Aschbacher et al., 2010; Leonard, Chamberlin, Johnson, & Verma, 2016). This study aimed to increase exposure to Black culture and history within a middle school after-school setting. The findings kept the following research questions at the forefront to expose youth culturally while engaging in science.

1) When given the opportunity to incorporate Black history into an after-school science club, what can middle school students showcase about the contributions of Black history and culture in science?
2) In what ways can Youth Participatory Action Research (YPAR) support the implementation of Culturally Relevant Pedagogy (CRP) in an after-school science club?

Review of Findings

The themes, located in Appendix D, that emerged from this YPAR study were the lack of voice within the classroom and curricula, limited exposure to cultural content, available learning opportunities, and pedagogical shift. These themes explored what can happen when youth experience a space to showcase what they want to learn. The findings showed that middle school students with limited exposure to Black culture or history had a flame ignited when they had an opportunity to grow and learn their way. They saw representation of Black scientists and inventors through their research and felt empowered by seeing representation within learning resources.

YPAR allows youth to be members of their learning. Often, instructions are given to students to inform them of the content and the learning timeline throughout the curriculum's

scope and sequence; however, YPAR allows for a shift in that narrative (Cammarota & Fine, 2008; Livingston et al, 2014; Davis, 2016). Studies have shown that there is little information known about YPAR. Therefore, it is imperative to continue to elevate the voices of youth through research and offer spaces to contribute and share their knowledge. When given these spaces, youth were engaged because they had an avenue to express their perspectives and utilized this setting for their growth (Anyon et al., 2018).

Research has shown that educators do not have to be the ones to encourage and empower youth to believe in themselves. When youth can speak about education the way they want it, the transformative action of being a change agent in their learning takes place (Caraballo et al., 2017). When there is a continuous push for more opportunities to exist for youth to be represented in education and address their needs, they push for the change as they "trusted" (Warren & Marciano, 2018) through the implementation of a project.

The research findings for research question one Indicated that students stated that they did not receive lessons incorporating Black history and culture in school. The notion was that each year, it would be another teacher's responsibility to integrate cultural context into the curriculum (Lee, 2001). There is a need for resource materials to encompass the essence of Black students. When educators rely on materials produced by content developers to educate students, the materials needed to showcase stories from a diverse angle to represent the contributions of the Black heritage. Another suggested avenue to decolonize the science curriculum is to merge what is already in use and enhance it with the experiences and stories of African American culture (Quilan, 2023). This does not have to occur all at one time, but as an effort to gradually incorporate the learning of Black culture into the curriculum, it can start as unit projects once a

semester in the fall and spring. This will allow educators to have the opportunity to research and learn the content and feel at ease when presenting the information to students.

Research has shown that representation matters in guiding African American and Black students toward STEM fields that are not being filled. Creating opportunities means guiding students as early as elementary age and having them gain an interest in the fields by learning and doing science that represents them, hoping to spark a passion as they matriculate through school. Underrepresentation in science is not only in the text but also in the classroom setting. Meeting students' needs early can increase their interest in pursuing careers in areas they have been exposed to (Lee et al., 2022). Muhammad (2020) stated that before learning occurs, students must see themselves present to see the bigger picture for learning to occur. Participants could research and showcase their knowledge weekly and share their findings through reflections. The youth felt like this was a way that they were heard and continued to engage in this process each week. These reflections led to the empowerment seen from learning about historical and cultural aspects that continued to drive the study.


: (Grant's first reflection) One thing I learned about so far most of them (Black inventors) have created more than one invention. Some of them were just stolen by white people. Or like the girls may have found, or created, but like me (guys) got the credit more even though it was invented second.

The sentiments for the first reflections were similar, short, and straight to the point. In week 2, the coresearchers' feelings about their experiences grew more.

 : (Grant's second reflection) All right, so this is what I think about this club. I think this club is a very good club, and you can learn easily about the life sciences of inventors and get to work together. My role in this club is to research the scientists, help people out the creator, and give her information (referring to Claire creating the posters from their research). I've learned about new inventions so far and a lot about scientists that I didn't know about before. I learned about water guns, cellphone inventors, different beds, and kind of peanut stuff like that. I would like to see more.

 : (Bailey's second reflection) Okay, what I think about this club is I feel like it's inviting me in like, inviting me to new like new things. My role in the club right now we're I'm the builder. Like I do the inventor things. What have I learned so far? Well, I've learned about black American inventors and scientists. And what would you like to see more? I would like to see more Black American inventors. I would like to learn more. I will share like good experiences. I will share the new things I learned.

 : (Sarah's third reflection) I think the club is influencing me about Black inventions and who could obtain a patent. I learned that white males and Blacks that were free could have a patent. So far, I have learned about different Black women inventors and different Black medicines and tools in things I didn't know that Black people have made. I like to see more representation of people that look like me when I am looking up information.

 : (Heaven's fourth reflection) Obstacles that I encountered while working with other youth researchers were that we all had different mindsets and different strategies to what we were working on. And that we had different designs for the research. The strengthens that I felt that I offered to the research was accountability and respecting others and getting a chance to understand other people's responses.

 : (Heaven's fifth reflection) I believe that Henrietta Lacks have changed our lives in the medicine field. Certain illnesses that have impacted my family have been heart attacks, I have had family members die from heart attacks. One medical illness that I think has impacted my community is COVID, because people are always sick, and it does not look like it is going anywhere.

Data from the study showed that through research question two, YPAR allowed youth voices to be heard while alterations were made to planned lessons to best suit the participants' learning needs. While most of my participants were females, research shows that their voices are typically not heard within the science community (Davis, 2020). Creating an informal learning space for all participants to be heard was impactful through their collaboration and creative ideas for their culminating artifacts. The culminating project consisted of thoughts from the youth researchers that I helped to facilitate and supply them with resources to execute their ideas.

Implications

The following implications discuss what is needed to propel the science curricula to the next level in cultural diversity. I will discuss the implications for Black educators, YPAR in class, and STOP Woke to push the science curricula forward.

Research

Now, more than ever, it is essential to reevaluate the teacher preparation program and the connection to relevant teaching resources. Black students are getting left behind in STEM because of the disconnect they feel from the content, the treatment they receive in STEM content classes, and the lack of support (Cutts, 2020). Students think some teachers care, and other teachers discourage them from taking the STEM avenue in high demand of more cultural representation to bring a more diverse field into a forever-changing world.

Therefore, if there is a lack of interest beginning in high school for students wanting to move into STEM fields, then there will be a lack of students who wish to teach in the STEM fields, and then it becomes a lack of students' overall interest in STEM fields. There is a domino effect of what can happen if change does not occur with the preparation of more Black teachers present within these marginalized learning spaces that are at risk of losing a diverse population of students, not only to teach the content but to be a support system and be advocates for students' growth. "The problem, with teacher education from an African perspective, is a problem of theory as well as practice" (Hilliard, 1995, p. 9); therefore, increasing representation of Black teachers can create a bond between the teachers and the students and drive students' closers to understanding how they are represented in cultural and historical spaces.

Practice

As this YPAR study took place in an after-school club, the flexibility of participants to be researchers in their learning played a significant part in their growth. The opportunity to break

down barriers that challenge the notion of not discussing the inequities within the classroom could be addressed in this safe space. If other students who sit in classrooms daily can have the opportunity to learn about different cultures, ask questions, and the opportunity to seek answers, they too could have the chance to be advocates for other minority groups and become change agents within their communities (Means, Blackmon, Drake, Lawrence, Jackson, Strickland, & Willis, 2020). This YPAR project and others have shown that participants can gain a sense of ownership, connectedness, and openness to share along the learning path. While some YPAR projects might get complete participant buy-in, youth can offer valuable feedback by creating a space that promotes cogenerative dialogues (Foster-Fishamn et al., 2010).

Cogenerative dialogues can be used during YPAR to develop a sense of community within classrooms. This helps navigate teachers' instructional practices. Once the teacher begins to open the floor through the flow of these dialogues, understanding what students need, their readiness level and ability can allow the teacher to gauge the class's next steps (Beltramo, 2017). Only some things we teach as educators are given within textbooks or from our preparation program, but from the lived experience of other cultures and the communities we serve.

Policy

With the heightened fear of empowerment and advancement from knowledge gained, policymakers deem it illegal to learn outside history that is not represented in content resources, which is currently creating an uproar in education. Georgia established House Bill 1084 that prohibits the teaching of "divisive concepts," which is defined as racism and bias against other races. Teacher education programs cannot engage in this discussion with teacher preparation participants, and classroom instruction has to be minimized, in addition to the suspension of waivers to those schools that want to engage in the teaching (Georgia General Assembly, 2022).

Similarly, its neighboring state of Florida has created a new law, House Bill 7: Stop the Wrongs to Our Kids and Employees Act (Stop WOKE), to control how race is taught and enforce consequences for people who violate the law (Russell-Brown, 2022). States have started creating policies that ban teaching Black history and other minority groups within school districts and states (Borum, 2023; Garcia, 2023; Pendharkar, 2023). The continuous push of only seeing one side to the narrative of what is known as American history in school resources limits the exposure and stories of Black and other ethnic groups' contributions to what makes up American history. One reason for such fear of incorporating the untold stories of Black history is the lack of cultural knowledge that teachers bring to the classroom. The implementation of creating a space for learning and growing their awareness starts at the top with professional development opportunities (Affolter, 2017). Affolter (2017) revealed in their recent study that teachers were uncomfortable teaching the history of other cultures. However, throughout the five-month-long professional development sessions, teachers were starting to feel at ease.

Suggestions for Further Research

Scholarships and grants are currently awarded to Black scholars majoring in STEM fields, such as plant science and horticulture, which are not predominantly occupied by Black or African Americans (UNCF, 2024). However, if students need to be made aware of these opportunities available to fund their continuous education, this is an opportunity for students who need financial assistance to attend school.

This study aimed to set a foundation for the history of Black scientists and inventors so that the youth can continue to carry the torch to light the pathway for others as their ancestors did before. This study sought a way to introduce students to various branches of science while also listening to what youth wanted to learn about. Each day, as a teacher, I am instructed to teach a

set of standards that students should know once they leave their current grade level. As a researcher working with youth, I could finally hear their voices, move in the direction they wanted to learn, and watch their minds take off in an explorative direction.

Scholars can only connect to careers that they have adequate knowledge of. Exposure is the key to encouraging scholars to take advantage of opportunities at the next level in informal learning spaces. Denson, Austin, Hailey, and Householder (2015) stated that informal learning spaces are beneficial to underrepresented groups of scholars. This study showed how informal learning spaces allowed youth to become open with their dialogue and freely express what content they wanted to learn, which was not frequently taught in the traditional classroom. However, there is a need for continuous research on how to connect the learning continuum in the traditional classroom setting.

Concluding Thoughts

One moment's impact can last a lifetime. As a facilitator, working with youth in this study has shown the void in the science curriculum. The question repeatedly asked throughout the afterschool club was, “Why don’t we learn this in our science classes?”.

As an educator, my voice is typically elevated in the classroom, as the pacing guide keeps me on a strict timeline for learning content material. However, as a facilitator/researcher in this study, I allowed my participants/co-researchers to explore, speak up, share the floor, and be more conscious of their learning. I also allowed myself to be flexible in the lesson planning that I had set for myself.

It is not that the content cannot be taught, but where the priority of culture fits into the curriculum. Week after week, we delve deeper into unveiling hidden figures within the science content, and the dialogue is more robust each week. I think about what could happen within a

regular classroom setting if this learning modality took place where students could have a voice. It is not just the thought of having a voice but also seeing representation within the science curriculum so students can stop thinking that their goal is less obtainable because they cannot think of the possibility of being in a career in STEM.

As a community, we must start opening doors and conversations so youth can stop thinking that science achievement is only achievable by other ethnic groups because they do not see theirs represented.

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Appendix A

Who is a Scientist? Day 1 Questionnaire and Final Focus Group

1. What is a scientist?
2. Who can be a scientist?
3. Name Black scientists and inventors you know.
4. Do you have the opportunity to learn about Black scientists and inventors in school? If so, when?
5. Where have you met a Black scientist or inventor?
6. What are some recommendations for science classes in your school?
7. Name a STEM (Science, Technology, Engineering, and Math) occupation that may interest you.

Focus Group

The focus group will be semi-structured at the end of the STEAM TEAM 6-week session.

1. What is a scientist?
2. Who can be a scientist?
3. Has this club made you think about recommendations you would like to offer for your science classes in your school?
4. Would you participate in another YPAR study if you can? Explain your decision.
5. What are some highlights from the BHC (Black History Club)?

Appendix B

Weekly Reflection Questions

Week 1 Reflection Question:

Reflecting on the inventors we discussed so far, what was one thing they had in common?

Week 2 Reflection Questions:

1. What do you think about the STEAM TEAM?
2. What is your role in the STEAM TEAM
3. What have you learned so far that has empowered you?
4. What would you like to see accomplished during each session?
5. What experience would you share with other peers?

Week 3 Reflection Questions:

1. Who could obtain a patent?
2. What did you notice about the list of men and women who have inventions?
3. Did you notice representation during your research?

Week 4 Reflection Questions:

1. What obstacles did you encounter while working with other youth researchers?
2. What strengths do you feel you offer to the research?

Week 5 Reflection Questions:

1. What contribution was so impactful in the Life of Ms. Henrietta Lacks?
2. How have certain illnesses impacted your family?
3. Think about your community: What illnesses have infiltrated your family or neighborhood, and why do you think this has happened?

Appendix C

Weekly Lesson Plans (Initial, Revised, Outcome)

Week 1 Initial Plan - History	Data Collection
Who is a scientist? History of science in African culture	• Students will answer a questionnaire on who is a scientist? • Create a one-pager (scrapbook page) on who is a scientist - magazine clippings, drawings, Canva • Describe how they feel as their place in science. • Research and discuss the history of African culture in science. • Create hieroglyphic locker name plates. • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors?

Week 1 Revised Plan - History	Data Collection
Who is a scientist? History of science in African culture	• Researchers will answer a questionnaire on who is a scientist? • ~~Create a one-pager (scrapbook page) on who is a scientist - magazine clippings, drawings, Canva~~ • ~~Describe how they feel as their place in science~~. • Research and discuss the history of African culture in science. • Create hieroglyphic ~~locker name plates~~ bookmarks. • Learned about patents and who they could be obtained. • Weekly reflection ~~of activities, thought and artifacts inserted into their science journal~~ recorded. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors?

Week 1 Outcome Plan - History	Data Collection
Who is a scientist? History of science in African culture	• Researchers answered a questionnaire: Who is a scientist? • Discussed ancient African culture in science • Created hieroglyphic bookmarks. • Discussed patents that were obtained and looked at inventions by Black scientists. • Weekly reflection completed through a recording and the use of the STEM journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • In what ways can YPAR support the implementation of CRP in informal science learning spaces?

Week 2 Initial Plan - Astronomy	Data Collection
Unveiling Black Hidden Figures in Astronomy Youth viewpoints on representation in space travel	• Learning how Egyptians documented the mapping of the sun, moon and constellations. • Students will research about the contributions of Mae Jemison, Katherine Johnson, Ed Dwight, Ronald McNair, Guion Bluford, Fred Gregory and many more. • Create graphic organizers to showcase and discuss their findings. • Create rockets to launch at the end of the week. • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 2 Revised Plan - ~~Astronomy~~ Science Legends	Data Collection
Unveiling Black Hidden Figures ~~in Astronomy~~ science Youth viewpoints on representation ~~in space travel~~ science	• Learning more about patents, think about our own invention. Look up inventions from Black scientists. • Students will research about the contributions of Mae Jemison, ~~Katherine Johnson, Ed Dwight, Ronald McNair, Guion Bluford, Fred Gregory and many more.~~ • ~~Create graphic organizers to showcase and discuss their findings.~~ • ~~Create rockets to launch at the end of the week.~~ • Researchers implement data collection from peers • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 2 Outcome Plan - Science legends	Data Collection
Unveiling Black Hidden Figures science Youth viewpoints on representation science	• Learning more about patents, think about our own invention. Look up inventions from Black scientist. • Students will research about the contributions of Mae Jemison. • Learned about a living legend Lonnie Johnson. • Described our own inventions and why would this invention be beneficial. • Researched from various sites other patents and inventions and looked for patterns in who they saw represented in their findings. • Researchers implement data collection from peers. • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 3 Initial Plan - Cells and DNA	Data Collection
All in my DNA - The Immortal Life of Henrietta Lacks Trusting Medical Research	• What contribution was so impactful from the Life of Ms. Henrietta Lacks? • VIPS in Medicine: Dr. Patricia Bath, Dr. Charles Drew, Otis Boykin And many more • Discuss disparities Blacks often face in receiving medical attention. • How has certain illnesses impacted your family? • Think about your community: what illnesses have infiltrated your family or neighborhood, and why do you think this has happened? • Invite a local doctor to speak about genetics and healthcare to youth. • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 3 Revised Plan - ~~Cells and DNA~~ Inventions	Data Collection
~~All in my DNA - The Immortal Life of Henrietta Lacks~~ ~~Trusting Medical Research~~	• ~~What contribution was so impactful from the Life of Ms. Henrietta Lacks?~~ • ~~VIPS in Medicine: Dr. Patricia Bath, Dr. Charles Drew, Otis Boykin And many more~~ • ~~Discuss disparities Blacks often face in receiving medical attention.~~ • ~~How has certain illnesses impacted your family?~~ • ~~Think about your community: what illnesses have infiltrated your family or neighborhood, and why do you think this has happened?~~ • ~~Invite a local doctor to speak about genetics and healthcare to youth.~~ • Created a survey to determine what to research about different inventions that are important to us currently. • Create what we would create as young inventors and the benefit. • Decide on what we are going to complete for a culminating project based on our learning. • Weekly reflection in STEM Journal, survey and data Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 3 Outcome Plan -Inventions	Data Collection
Who was able to obtain a patent? What did you notice about the list of men and women that have inventions? Did you notice representation during your research?	• Created a survey to determine what to research about different inventions that are important to us currently. • Create what we would create as young inventors and the benefit. • Decide on what we are going to complete for a culminating project based on our learning. • Weekly reflection in STEM Journal, survey and data Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 4 Initial Plan - Agriculture	Data Collection
What will I eat today? How can you contribute to fresh herbs and veggies in your community?	• George Washington Carver - He did not invent the peanut, just peanut butter - innovation at its best. • VIPS of Agriculture - Frederick McKinley Jones, Henry Blair & Alice H. Parker. • Research benefits of agriculture. • Is there a lack of fresh markets in our community? If so, why? Is there a way to increase fresh foods within our community if there is a need? How can we get the community involved? • Creating hydroponic plants to grow anywhere. • Operate a school can food drive to give to local families in need. • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 4 Revised Plan - ~~Agriculture~~ Engineering	Data Collection
~~What will I eat today?~~ ~~How can you contribute to fresh herbs and veggies in your community?~~ Building of our 3D bed replica similar to that one of Sarah Good. Created a virtual presentation about historical figures	• ~~George Washington Carver - He did not invent the peanut, just peanut butter - innovation at its best.~~ • ~~VIPS of Agriculture - Frederick McKinley Jones, Henry Blair & Alice H. Parker.~~ • ~~Research benefits of agriculture.~~ • ~~Is there a lack of fresh markets in our community? If so, why? Is there a way to increase fresh foods within our community if there is a need? How can we get the community involved?~~ • ~~Creating hydroponic plants to grow anywhere.~~ • ~~Operate a school can food drive to give to local families in need.~~ • ~~Weekly reflections of activities, thought and artifacts inserted into their science journal.~~ • Disseminate out roles for who will be working on the various design parts of the 3D model. • Determined who would be working on the presentation. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 4 Outcome Plan Engineering	Data Collection
Building of our 3D bed replica similar to that one of Sarah Good. Created a virtual presentation about historical figures	• Disseminate out roles for who will be working on the various design parts of the 3D model. • Determined who would be working on the presentation. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 5 - Initial Plan Force, Motion & Energy	Data Collection
Tag Your It Science in motion	• Lonnie Johnson - nerf guns - See if we can get him to come to the school for an assembly to discuss his invention • Build roller coasters • Youth will research and discuss data that they find on the amount of Blacks in Science and Engineering fields. • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 5 - Revised Plan ~~Force, Motion & Energy~~	Data Collection
~~Tag Your It~~ ~~Science in motion~~ All in my DNA - The Immortal Life of Henrietta Lacks Trusting Medical Research Growing My Own Food	• ~~Lonnie Johnson - nerf guns - See if we can get him to come to the school for an assembly to discuss his invention~~ • ~~Build roller coasters~~ • ~~Youth will research and discuss data that they find on the amount of Blacks in Science and Engineering fields.~~ • ~~Weekly reflections of activities, thought and artifacts inserted into their science journal.~~ Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 5 Outcome Plan - Cells, DNA (Tuesday) & Agriculture (Thursday)	Data Collection
All in my DNA - The Immortal Life of Henrietta Lacks Trusting Medical Research Growing My Own Food	• What contribution was so impactful from the Life of Ms. Henrietta Lacks? • VIPS in Medicine: Dr. Patricia Bath, Dr. Charles Drew, Otis Boykin And many more • Discuss disparities Blacks often face in receiving medical attention. • How has certain illnesses impacted your family? • Think about your community: what illnesses have infiltrated your family or neighborhood, and why do you think this has happened? • Invite a local doctor to speak about genetics and healthcare to youth. • George Washington Carver - He did not invent the peanut, just mastered its uses - innovation at its best. • VIPS of Agriculture - Frederick McKinley Jones, Henry Blair & Alice H. Parker. • Research benefits of agriculture. • Is there a lack of fresh markets in our community? If so, why? Is there a way to increase fresh foods within our community if there is a need? How can we get the community involved? • Creating hydroponic plants to grow anywhere. • • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 6 - Initial Plan Youth in Science	Data Collection
How do you see yourself in science? Youth viewpoints on representation in science	• Youth will research how youth in the science field have a role in their community. • They will think of a final product that they want to share out that will leave a positive impact on their community • Post questionnaire on who is a scientist and recreate their initial sketch from week 1. • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 6 - Revised Plan [You]th in Science	Data Collection
How do you see yourself in science? Youth viewpoints on representation in science	• Youth will research how youth in the science field have a role in their community. • ~~They will think of a final product that they want to share out that will leave a positive impact on their community~~ • Post questionnaire on who is a scientist ~~and recreate their initial sketch from week 1.~~ • Present 3D model and poster presentation • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Week 6 - Outcome Plan [You]th in Science	Data Collection
How do you see yourself in science? Youth viewpoints on representation in science	• Youth will research how youth in the science field have a role in their community. • Post questionnaire on who is a scientist • Present 3D model and poster presentation • Weekly reflections of activities, thought and artifacts inserted into their science journal. Research Questions connection: • How can incorporating Black history and culture into informal science spaces expose students to the contributions of Black scientists and inventors? • How does Youth Participatory Action Research (YPAR) increase the implementation of Culturally Relevant Pedagogy (CRP) in afterschool science programs?

Appendix D

Themes from Data Source

Theme 1: *"They Didn't Teach Us That":* An Examination of School Science Curriculum		
Research Question 1: When given the opportunity to incorporate Black culture and history into informal science curricula, what can middle school students showcase about the contributions of Black scientists and inventors?		
Relationship to CRP	Youth Researchers Statements	Data Sources
• Academic Success	Ms. Sanchez did say something in class once" - Grant "Sometimes, they [the teacher] will go over it during Black History Month" - Claire	• Questionnaire • Cogenerative Dialogues

Theme 2: *"I Didn't Know a Black Person Did That":* An Exploration of Black Contributors		
Research Question 1: When given the opportunity to incorporate Black culture and history into informal science curricula, what can middle school students showcase about the contributions of Black scientists and inventors?		
Relationship to CRP	Youth Researchers Statements	Data Sources
• Cultural Competence	We only talked about George Washington Carver" - Cassh "He is the peanut man" - Heaven	• Youth Researchers Generated Survey • Cogenerative Dialogues

Theme 3: *"We Thought We Could So We Did":* A Collective Engagement Toward Solutions		
Research Question 2: In what ways can Youth Participatory Action Research (YPAR) support the implementation of Culturally Relevant Pedagogy (CRP) in an after-school science club?		
Relationship to CRP	Youth Researchers Statements	Data Sources
• Academic Success • Cultural Competence	"Can we do like a living museum, where we show the people [scientists and inventors]" - Bailey "Can we create a survey and ask people in our class?" - Sarah	• Documents • Researcher Memos • Cogenerative Dialogues • Weekly Reflections

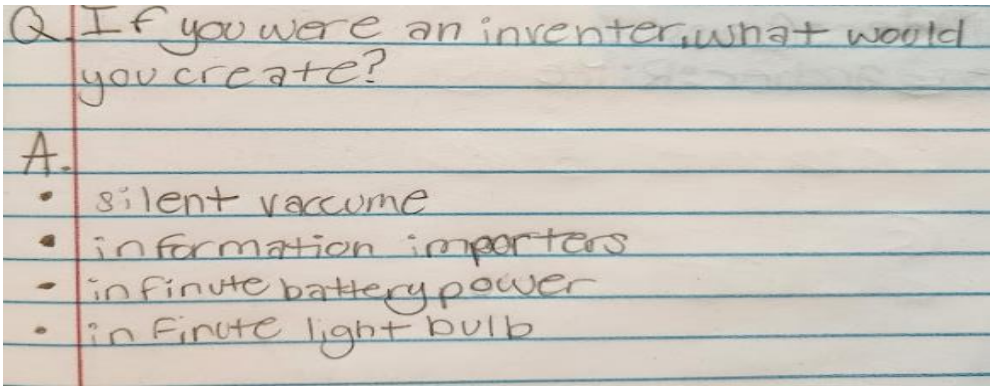
Theme 4*: "Let Me Clear My Throat":* A Facilitator's Reflection		
Research Question 2: In what ways can Youth Participatory Action Research (YPAR) support the implementation of Culturally Relevant Pedagogy (CRP) in an after-school science club?		
Relationship to CRP	Researcher Memo's	Data Sources

• Academic Success
• Cultural Competence
• Sociopolitical Consciousness
	- Brought in outside healthcare worker to discuss mistrust in medicine.
	- Allowed for alterations of lesson plans.
		• Researcher Memos
		• Focus Group
		• Documents
		  • Lesson Plans
		  • Reflections

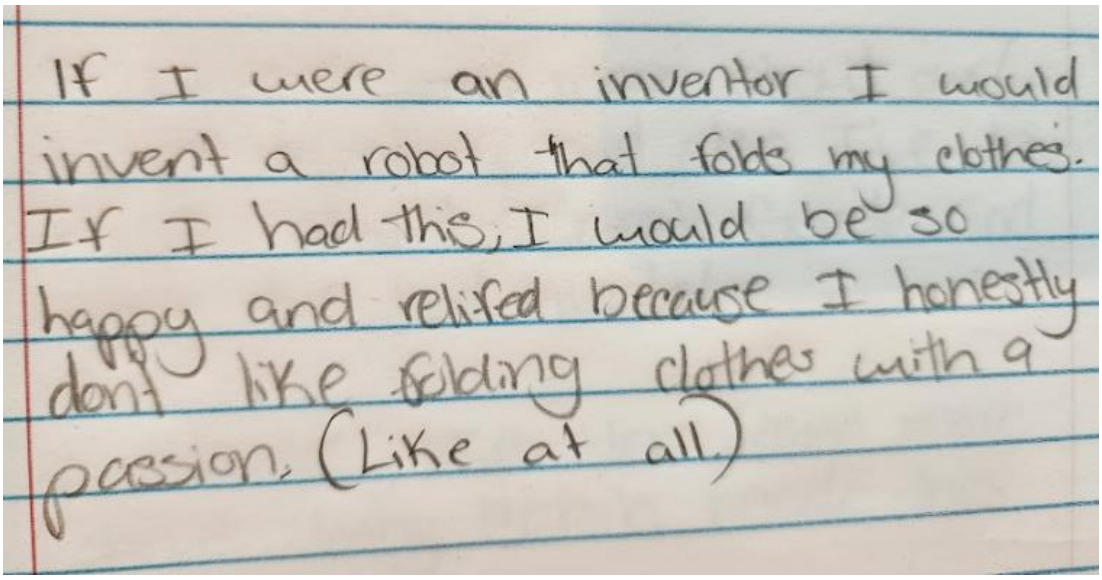
Appendix E

Co-Researchers' STEM Journal Entries

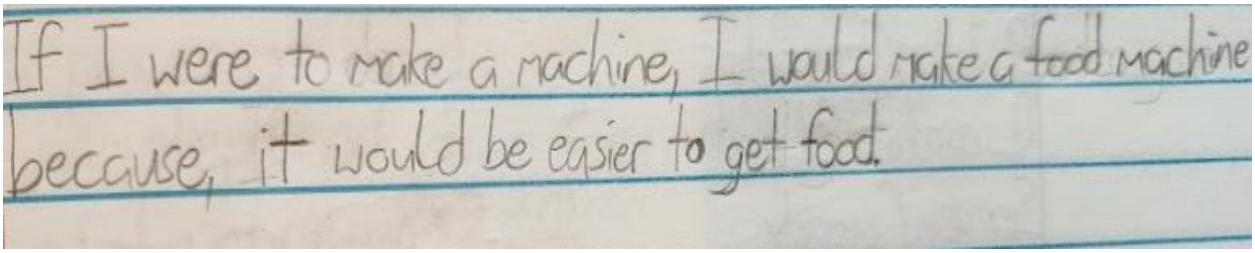
Claire's STEM Journal Entry



Bailey's STEM Journal Entry

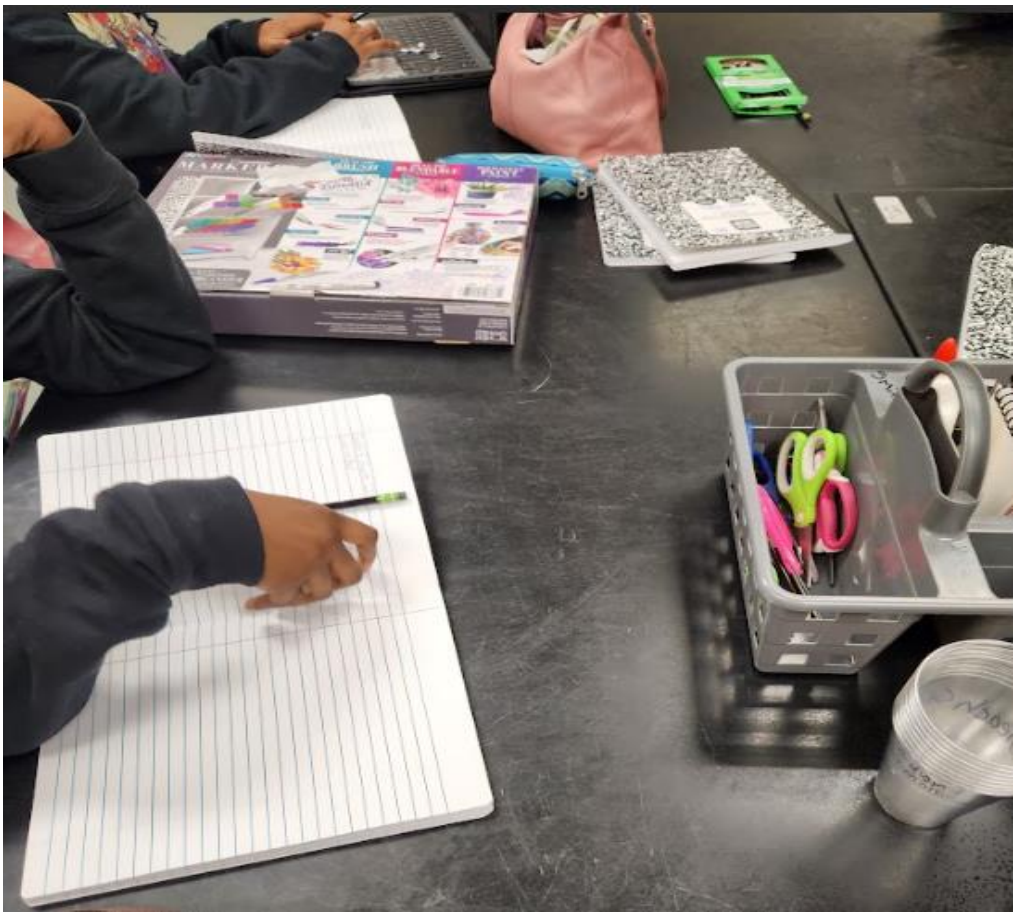


Cassh's STEM Journal Entry



Appendix F

Co-researchers Planning Session



Appendix G

Community Member's PA Presentation