The impact of an antiracist math program on learning outcomes for economically disadvantaged students of color

An Action Research Study

Submitted to Dr. Mary Rountree

by

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In partial fulfillment of the requirements for the Master of Science in Educational Administration

National University

March 26, 2022

National University

School of Education

Department of Educational Administration

We certify that we have read this action research of MATTHEW J RECTOR entitled The impact of an antiracist math program on learning outcomes for economically disadvantaged students of color and that, in our opinion, it is satisfactory in the scope and quality of an action research project for the degree of Master of Science in Education Administration in the School of Education, National University.

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Abstract

California's economically disadvantaged students of color deserve to have a high-quality mathematics education. Historically, over 80% of these students leave high school below standard in math which denies them access to the economic and social benefits of being able to do high powered math and denies California the workforce it needs. This action research study is designed to determine if a set of antiracist interventions will help high school students overcome these math learning outcome deficits. This study focused on two research questions: What is the effect of participation in an antiracist mathematics program, consisting of a specific set of interventions, on student perceptions of confidence and competence in mathematics? What effect does participation in an anti-racist mathematics curriculum have on student engagement as measured by student survey data?

The participants of this study were predominately (over 90%) economically disadvantaged students of color at an urban, public high school in northern California. One group of students received the antiracist interventions (Target Group) for a semester and the other group (Control Group) did not. Target Group students were given perception surveys before and after the first semester of school year. They and the Control Group were then asked an additional set of questions designed to measure their perception of growth in their mathematical confidence, competence and engagement over the semester. Target Group students were also asked a follow up set of questions in order to clarify their intentions.

This action research revealed that the antiracist interventions did indeed help students feel more competent, confident and engaged in their mathematics classroom.

Chapter 1

Introduction

The State of California has recognized the importance of students graduating high school with mathematical proficiency by adopting the Common Core State Standards for math. These Standards are evaluated for the final time by the Smarter Balanced Assessment Consortium (SBAC) test at the end of students' eleventh grade. Twice as many students of color score below standard on the test than White students. Because the ability to do high powered math has such an impact on students' ability to succeed economically and participate effectively in our society, leaving the vast majority of our students of color behind is not only bad for them, but for our state as a whole. In an effort to help students of color overcome the effects of systemic racism within the mathematical educational system in California, a system of antiracist math interventions has been developed.

Background and Statement of the Problem

In Brown v. Board of Education (1954) the United States Supreme Court ruled that separate but equal is inherently unequal. This ruling paved the way many more court rulings intended to establish an equitable public education system for all children but even after 77 years the struggle for equity continues. While courts and elected leaders continue to try and establish a level playing field, those efforts have yet to produce equitable math learning outcomes for students of color in California as a whole.

The State of California determined the levels of mathematical proficiency for students when they adopted the current Common Core State Standards (CCSS) for mathematics. They then contracted the Smarter Balanced Assessment Consortium (SBAC) to create a summative assessment (Assessment) to measure students' progress. The Assessment is given at the end of

third, fourth, fifth, sixth, seventh, eighth and 11th grades. The Assessment ranks student achievement into four categories. If a student receives a one, they are far below standard. A two means they are approaching standard, a three means they are at standard and a four means they have exceeded standard. On the 2019 11th grade assessment for math only 14 percent of Black and 20 percent of Latinx students scored at or above standard, whereas 45 percent of White children scored at or above standard. These results are similar to previous years and while they might imply a failure of high schools, they are, in reality, part of a consistent pattern of disenfranchising children of color starting in third grade as evidenced by the Assessment results for grades three to eleven from 2015 to 2019 (CASPP, 2019).

In order to help overcome these inequitable learning outcomes textbook companies take an assimilationist approach instead of designing curriculum that meets the needs of all of our students. They just change the names of the characters in word problems to ones that sound more "ethnic" without making any significant changes to the way math is taught or learned. This has led to three fundamental problems that create barriers for economically disadvantaged students of color to succeed at high school math.

The first barrier to success is that every level of math is designed with the assumption that students achieved some level of mastery in their previous course, which SBAC Assessment results, every year it has been given, tell us is not true for the vast majority of students of color. In order for a curriculum to be adopted by the state of California must it must first and foremost have "Mathematics Content/Alignment with the Standards. Content as specified in the CCSS for Mathematics with California additions, including the Standards for Mathematical Practices, and sequence and organization of the mathematics program that provide structure for what students should learn at each grade level." (California Department of Education, 2014 p.9). The Standards

show that in order to understand the current level of a Standard a student needs to have achieved a certain level of mastery of the previous level of that Standard. A quick perusal of any adopted math text book will confirm this as demonstrated by this statement from the teacher's guide of an adopted Integrated Math Three text book, "Sometimes students who have large deficiencies in their prior skill development and conceptual understanding of prerequisite mathematics are placed in a class. Overcoming these problems requires **more instructional time** than can be found in a typical class period. These students should be re-assigned to an appropriate course whenever possible" (Core Connections, Integrated III Teacher's Edition, 2015).

The second barrier to success is the assumption embedded in adopted text books is that students will do 30 to 60 minutes of homework every night. This is an average estimated time of completion for the recommended homework problems assigned in an adopted text book (Core Connections, Integrated III Teacher's Edition, 2015). Unfortunately for students of color that live in poverty, the ability to do homework is challenged by their living conditions. Many students work full time jobs or are caregivers as well. According to multiple informal surveys of teachers at the targeted school, historically, less than 10% of students complete homework with fidelity on a regular basis.

The third barrier to success is the assumption that students want to or believe they can succeed in their math class. Personal interviews of students at the target school have revealed that most students of color don't see a place for themselves in the world of Science Technology Engineering and Math (STEM). One of the reasons for this may be that people that work in these fields are not generally in their or their families' peer group. The percentages of Black, Hispanic, American Indian Children who had a parent with a bachelor's degree or higher are among the lowest. For example, the percentage for Black children is only 17% and Latinx is only 11%

compared to White, 44% (NCES, 2010). 96 of the 100 top paying college majors require higher math (Underwood, Angela (2021). Hence a person who has achieved a higher level of mathematics mastery earns a middle or upper middle-class salary. This is further evidenced by the demographics of students graduating with Science Technology Engineering and Math (STEM) degrees which require high levels of math mastery. According to the University of California (UC) only seventeen percent of UC's STEM graduates (in 2019) are from underrepresented racial/ethnic groups (URG; African American, American Indian, and Hispanic/Latino(a)), up from 9 percent in 2000 (UC stem to degree pipeline, 2019). Another reason students may have trouble believing that they can do high powered math is that every year they take a test (SBAC) that tells them they were below standard. Before Carol Dweck coined the "Growth Mindset" phrase (Dweck 2007) or Jo Boaler applied the theory to learning mathematics (Boaler, Dweck 2015), Henry Ford said "Whether you believe you can, or believe you can't, you're right."

In order to help high school students of color who come from economically disadvantaged homes overcome the barriers to their mathematical success, a system of antiracist math was created based on research, institutional knowledge and trial and error. The system consists of five parts: Mindset Monday, Team Building Tuesday, Wild Card Wednesday, Thoughtful Thursday and Formative Friday.

Every week begins with Mindset Monday. This consists of students being shown a video that helps them understand they are able to do high powered math in a variety of ways. As teams are changed every other week, the Mindset Video is followed up with an Ice Breaker activity that helps students get to know their new team mates. Multiple studies have shown that students with a growth mindset achieve at higher levels in mathematics and that when students change their

mindsets, from fixed to growth, their mathematics achievement increases (Blackwell, Trzesniewski & Dweck, 2007; Boaler, 2019)

Teambuilding Tuesday is a low floor-high ceiling activity, that allows everyone to find success regardless of previous knowledge, but allows participants very few limits on how far they can take it. This activity takes place during the first five to ten minutes of class and challenges teammates to work together to solve problems that do not involve doing arithmetic or algebra. Studies going back to the 1970s have shown again and again that when students learn math cooperatively (in a team) they learn it deeper, better and faster. Research has verified this so often that very few studies are even conducted on it anymore (Dineen et. al., 1977; Cohen et. al., 1982).

Wild Card Wednesday consist of creative, fun and unique ways of practicing review math problems. Sometimes students will do a carousel walk as a team. They go from station to station and solve the problem posted. Each station has a unique problem for them to solve. Students will have three minutes at each station, a different song will be playing during each three-minute segment. On other days some sort of gaming software like quizizz will be used. While timed math and speed math are generally counter-productive to helping students become mathematicians, students do both of these activities in teams which allows for collective struggle.

On Thoughtful Thursday students are asked to activate another problem-solving part of their brains in one of two ways (Boaler et al, 2016). One week they try to recognize patterns and differences by looking at four images and finding two things that make each one unique. This is important because human minds want to see and understand patterns (Devlin, 2006). The next week they watch a short Conundrum video that poses a scenario that has a variety of possible

solutions. Each solution has its own merit and none is the “right” answer. Students are then asked to pick one of the solutions and state their reasons in writing. These are “real world” scenarios which help students relate mathematics to their lives (Hammond, 2015).

The week ends with Formative Friday. Students take a formative assessment, as a team in one week and as individuals in the next, that they correct themselves. Both assessments use a unique three read graphic organizer. Students organize and explain their thoughts on how they solve the problem. This is important because when students explain their thoughts in writing they get a deeper understanding of the concept. The scoring rubric puts an equal value on each step of the process: What do we want? What do we got? How are we going to get it? And the actual solution. This shifts the students’ focus from “answer getting” to problem solving. After students have had enough time to work on their tests, desks are cleared, students are given a colored marker and the rubric for each step of the problem is projected so that students evaluate their own assessment. This makes each assessment a growth tool by giving students immediate, meaningful feedback (William, 2018, p.123), gives students agency over their own learning and provides for an opportunity to grow their brains. (Moser, et al, 2011).

Purpose of the Study

The purpose of this study is to determine whether a set of specific antiracist math interventions can help students of color overcome the effects of a decade of institutionally racist mathematics education, as evidenced by SBAC scores in math. These interventions are designed to help more students engage in more math, in more ways, more often and improve their growth mindset with regards to learning math. Students learn more math on a deeper level when they believe they can eventually solve the problem which accelerates their mathematical growth. Students learn best when they are actively engaged in questioning, struggling, problem solving,

reasoning, communicating, making connections, and explaining. The research is overwhelmingly clear that powerful mathematics classrooms thrive when students feel a sense of agency (a willingness to engage in the discipline, based in a belief in progress through engagement) and an understanding that the intellectual authority in mathematics rests in mathematical reasoning itself (in other words, that mathematics makes sense) (Boaler, 2019 a, b; Boaler, Cordero & Dieckmann, 2019; Anderson, Boaler & Dieckmann, 2018; Schoenfeld, 2014). Students at a northern California high school that both have and have not received the antiracist interventions will be used for this study.

Significance of the Study

The goal of this action research is to study the efficacy of specific antiracist interventions in helping students of color increase their perceptions of their ability to learn math and engage more actively and effectively in the process. This will be measured by student perception surveys of both the group of students who receive the interventions (Target Group) and students in other math classes at the same school who didn't receive the interventions (Control Group) after both have received a semester of math instruction. The results will be compared in order to gauge the difference in perception of growth in competence, confidence and engagement between the two groups. The Target Group also will be surveyed before and after the semester in order to gauge their perception of growth in confidence, competence and engagement as well.

In 2019 417,496 graduated high school in the state of California. Of those 22,312 were Black, and 216,451 were Latinx (CDE, 2020). This means that 192,248 Black and Latinx students were allowed to graduate high school below standard in math. If this program can help reduce that by even a few percent, thousands of adults will have better job opportunities,

employers will have access to a higher caliber of workers and universities will have more students working on Science Technology Engineering and Math (STEM) related degrees.

Research Questions

This study will be guided by the following questions:

1. What is the effect of participation in an antiracist mathematics program, consisting of a specific set of interventions, on student perceptions of confidence and competence in mathematics?
2. What effect does participation in an antiracist mathematics curriculum have on student engagement as measured by student survey data?

Context of the Action Research

This study will take place predominantly at a large urban public high school in Sacramento, California. It is a Title I school in which 92.8% of the students are socioeconomically disadvantaged and 5.2% are classified as homeless. In 2021, 2088 students were enrolled. Of those students 17.4% are Black, 53.3% are Latinx, 15.2% are Asian, 4.5% are White and 3% are Pacific Islanders. 21.4% of students are English learners, 35.6% are classified as Fluent English proficient and 7.8% are reclassified Fluent English proficient. On the first year of the SBAC, 2015, only 5% of students were at or above standard in Math, this rose to 11% in 2016, 11% in 2017, 13% in 2018 and 15% in 2019 the last year the test was taken.

Assumptions

While conducting this action research study it is assumed that students will answer truthfully to all survey questions and interviews.

Limitations

Due to the limitations of time, effective quantitative assessment tools and the pandemic, this study will be qualitative in nature. Data will be collected over a short period of time and only at one location. Lastly, all of the data will be based on student perception.

Definition of Terms

For the purpose of this study, the following words are defined:

Antiracist – A person who opposes racism and actively seeks to undo racist systems.

Antiracist Math – A system of interventions that helps to undo the damage caused to children of color by the systemic racism embedded in the vast majority of mathematics curriculums in the State of California.

Disenfranchised Students – Students that have been denied equitable access to mathematics education.

Formative Assessment – An assessment whose purpose is to clarify, share and understand learning intentions and success criteria, elicit evidence of learning, provide feedback that moves knowledge forward, activates learners as instructional resources for each other and activates learners as owners of their own learning (William 2018, p. 52).

Formative Friday – A system of formative assessments that alternates between individual and team assessments that students evaluate themselves using a rubric.

Growth Mindset - The belief that your basic qualities (like intelligence or the ability to do math) are things you can cultivate through your efforts (Dweck 2007 p.32)

Individual Test – A formative assessment that students do by themselves.

Low Floor-High Ceiling Activity – An activity that every student, no matter their skill or knowledge level, can participate effectively in while at the same time not limiting how much growth they can get out of it.

Mindset Monday – The use of videos and other activities, every Monday at the beginning of class to help students develop a growth mindset (especially when it comes to math), believe that they can learn and do high powered math and that it has value in their lives.

Students of color – Any student who isn't or doesn't identify as White.

Team Building Tuesday – Fun team building activities that start every Tuesday's class that help students grow their ability to work as a member of a team to solve problems.

Team Test – A formative assessment that students do as a team.

Thoughtful Thursday – Low floor, high ceiling activities to begin each class on Thursday that help students recognize patterns, make connections and explain their reasoning.

Wild Card Wednesday – Creative, fun and unique ways of practicing review math problems on Wednesdays.

Summary

Developing an effective antiracist math program that helps the most disenfranchised students of color learn more math will help tens of thousands of Californians improve the quality of life for themselves and their families every year. The vast majority of students at the target school have struggled with math their entire academic careers as evidenced by their scores on the SBAC. Starting in the third-grade students of color at the target school begin to lose ground mathematically so much so that by the time they enter high school over 85% of them are below standard according to the SBAC. This pattern is emulated across the State of California. This study seeks to evaluate the efficacy of a systematic approach to help these students overcome the

failures of a system that has failed them. By instituting a system of specific antiracist interventions, it is hoped that students will improve their confidence, competence and engagement in math.

Chapter 2

Review of the Literature

As stated in Chapter 1, the purpose of this research is to study the efficacy of five specific antiracist interventions on the mathematical confidence, competence and engagement of students of color from economically disadvantaged households at a northern California high school. Students of color have been failed by the mathematics educational system in the state of California as evidenced by the Smarter Balanced Assessment Consortium's annual assessment (Assessment). The Assessment is given at the end of third, fourth, fifth, sixth, seventh, eighth and eleventh grades, and students' results are reported on a scale of one to four. A one, which means that the standard is not met on the appropriate California approved Common Core State Standards (CCSS) for that grade level. If a student scores a two on the Assessment, the standard is nearly met. If they score a three they are at standard and a four means they exceeded the standard. On the last Assessment given, 2019, 45% of 11th grade White students scored at or above standard whereas only 21% of Latinx and 15% of Black students were at or above standard (CASPP, 2019). To even further exemplify the disparity, 22% of 11th grade White students scored a one whereas 57% of Latinx and 66% of Black students scored ones (CASPP, 2019). The results are even more disparate when the economic status of students is considered. These results are consistent with previous years and across grade levels and confirms the systemic racist learning outcomes in California's mathematics education system. While the system yields racist results and needs to be fixed from students' first day of school, this study concentrates on interventions in the eleventh grade at a specific high school in northern California. In order to design effective interventions to help students feel more confident, competent and engaged in the mathematics classroom, many aspects of mathematics education

were researched; but in order to effectively plan ways to overcome the burdens of racist learning outcomes in the math classroom it is important to understand racism in the United States and California.

Historical Overview of Racism in the United States of America

Racism is not a natural phenomenon. It was and continues to be created and perpetuated by the rich and powerful to make money. It all began in 1415 when Prince Henry of Portugal hired the writer Gomes Eanes de Zurara to write his biography, *the Chronical of the discovery and Conquest of Guinea.* This was the first known defense of African slavery which he justified by claiming that slavery was really just missionary work and the purpose was to "civilize and Christianize the African "Savages" (Kendi, Reynolds 2020, p.6). Prince Henry went on to make a lot of money stealing and selling human beings under the guise of doing God's work, as did many other Europeans engaged in the slave trade which came to the American colonies in 1619. In August of that year a Spanish slave ship named the San Juan Bautista was captured by pirates who in turn sailed to Virginia where they sold 20 slaves to John Pory, a cousin to the Governor, George Yeardly, who owned a lot of land. By this time both had realized that tobacco would make them a lot of money as long as they had people to do the work of farming it. Thus, the slave trade in what was to become the United States began (Kendi, Reynolds 2020, p.18).

While Gomes was the first to use religion and God to justify making money off of the enslavement of fellow human beings, he wasn't the last. Every time some person or group spoke up against owning people like property, a new slew of propaganda would be unleashed by those that profited from it to justify its continuation. But propaganda was just part of the package (Kendi, Reynolds 2020).

In 1676 Nathaniel Bacon, a White frontier planter, realized that slavery was really a class issue and he was tired of being taken advantage of by the White elite, so he declared liberty for slaves, teamed up with Native Americans and staged a revolt (Kendi, Reynolds 2020, p.26). Even though he was able to put down this revolt the governor at the time, William Buckely, "knew that if Blacks and Whites joined forces, he'd be done. Everything would be done. It would've been an apocalypse" (Kendi, Reynolds 2020, p.26). Thus, in order to drive a wedge between poor Whites and Blacks he created White Privileges: "…at this time they included: 1. Only the White rebels were pardoned; legislators prescribed thirty lashes for any slave who lifted a hand 'against any Christian' (Christian now meant White). 2. All Whites now wielded absolute power to abuse any African person" (Kendi, Reynolds 2020, p.27).

Slavery ended with the Civil War in April of 1865, but racism did not. Lincoln's successor, Andrew Johnson, allowed the Confederate states to create "Black codes - social codes used to stop Black people from living freely. They quickly became Jim Crow laws, which were laws that legalized segregation" (Kendi, Reynolds 2020, p.108).

Racism was not and is not just White people oppressing Black people. It is a tool that the rich White plantation owners used to keep poor Whites, Native Americans and Blacks from banding together, but they were not the only ones who employed this tool. There lots of examples of this divide and conquer strategy in the history of the world and the United States. For example, rich sugar cane plantation owners in Hawaii used to import workers from Portugal, the Philippines and Japan. They kept them as segregated as possible so that when one of the groups would go on strike for decent wages and working conditions, they would just use the other groups to break it. Eventually the groups learned to communicate with each other and

successfully organized a union after the second World War (“University of Hawai’i’s Center for Labor Education & Research” n.d.).

California’s rich and powerful also used the technique of pitting racial groups against each other in order to keep wages low. In the 1850s Chinese immigrants were used to drive down labor costs in the gold mines and on the railroad. This upset workers from other ethnicities and eventually led to the Chinese Exclusion Acts (US Department of State, n.d.).

To this day, workers of color earn less for doing the same job as White people all across the United States (Earnings Disparities by Race and Ethnicity, n.d.). This may in part be attributed to the disparity of students of color earning college degrees that needed high powered math. In fact, only 17% of University of California Science Technology Engineering and Math (STEM) graduates were people of color in 2019 (University of California, 2020). This is significant because 96% of the highest paying college degrees were in a STEM discipline (Underwood, 2021).

Historical Overview of Racism in Education in the United States of America

While racism was not and is not exclusively used to oppress and exploit Black people in the United States, the system of slavery lasted for so long, generated so much wealth for the exploiters that it is deeply embedded in US culture. While some of the cultural reminders are visual like the use of the Confederate battle flag and the white hoods of the Ku Klux Klan, others are a bit subtler. Terms like Master bedrooms, Black list, and sold down the river exemplify racism in everyday vernacular and life (Andrew, Scottie & Kaur, Harmeet (2020). Education as well is polluted by it. This is exemplified by inequitable learning outcomes in math for students of color.

The Struggle for Educational Equity

The history of the fight for equity in education begins with Brown vs the Board of Education where the US Supreme Court ruled against the Jim Crow segregationist laws of the former Confederate states' separate but equal policy. Chief justice Earl Warren wrote that, "…in the field of public education the doctrine of 'separate but equal' has no place," as segregated schools are "inherently unequal" (Brown v. Board of Education, 1954). This has led to a plethora of rulings, including Lau v Nichols which was filed by Chinese speaking students against the San Francisco Unified School District in California. The United States Supreme Court ruled that non-English speakers must receive instruction in standard English (Lau v. Nichols, 1974). This led to congress passing the Bilingual Education act. The next most significant and recent case with regards to equity in California's education system was the Williams case.

According to the California Department of Education's website titled "The *Williams* Case -- An Explanation", almost 100 San Francisco county public school students sued the State of California in 2000 (California Department of Education, n.d.). The students sued because the agencies failed to provide them with equal access to instructional materials, safe and decent school facilities, and qualified teachers. The state settled out of court with the passing of the William's Act in 2004 which provided additional funding for schools in need and established a metric for deciding need. Schools in California that serve economically challenged students now have more money under this system, but inequitable outcomes still remain as evidenced by SBAC scores.

Analysis of High-Quality Mathematics Instruction

In order to create an antiracist math program that helps students of color overcome the trauma of a mathematical system that began to fail them from the third grade as evidenced by the disparate SBAC results in math for students of color (CASPP, 2019). the first thing that must be considered are the indicators of a high quality, high powered math education program. The next thing that must be considered is how to help students who have known very little success for the majority of their mathematics career to have the confidence to participate effectively and engage fully in that program.

A high-powered math program is evidenced by students being actively engaged in questioning, struggling, problem solving, reasoning, communicating, making connections, and explaining. Research tells us that this only happens when students have agency over their learning, are willing to engage in the process, believe that they can learn math and that it has value in their lives. (Boaler, 2019 a, b; Boaler, Cordero & Dieckmann, 2019; Anderson, Boaler & Dieckmann, 2018; Schoenfeld, 2014).

In order to help high school students who have had very little success in their mathematical educational career participate effectively in a high-powered mathematics education program, a set of specific interventions were created and tested.

Mindset Monday consists of two specific activities, the first being an ice breaker activity, which asks students to choose one of three options, is used every time new teams are created. Prior to the beginning of the activity, each member of the team (students work in teams of four) is randomly assigned a specific role, Recorder-Reporter, Task Manager, Resource Manager and Facilitator. The team member that is the Recorder-Reporter is asked to record each of their teammates' names, answer to the question, why they answered as they did. They then report out

to the class after all of the questions were answered. The first goal of this activity is to start students communicating with each other, to know each other's names and build a sense of community. Because it demands students' participation and immediate feedback, it generates interest and motivation (Zhang, 2000). Further, the simple act of making a choice between three options stimulates the ventral striatum of the corticostriatal region of the brain, which in turn reinforces the perception of control and self-efficacy. When people feel they are in control, their motivation levels increase (Leotti, Delgado, 2011). The second part of Mindset Monday is to show a video designed to help motivate and increase the growth mindset of students. Research shows that when a student has a growth mindset when doing math, they are more engaged, more likely to take chances and less afraid of making mistakes (Blackwell, Trzesniewski & Dweck, 2007; Boaler, 2019).

Team Building Tuesday is the next part of the program, which consists of an activity that takes place during the first five to ten minutes of class every Tuesday. Every activity is designed to help students get excited about doing math, growing their brains and solving problems in creative, collaborative ways that also help them to build their 21st Century skills. The challenges are low floor-high ceiling activities that every student can participate and find success in. The parameters for an activity's design are that it must be able to be done in five to ten minutes, need every team member to be working at the same time, be easy to judge a winner, allow for creative and multiple solutions and be fun and accessible for everyone. These are hands on activities that generally don't use numbers or equations, but allow students to explore math in multi-dimensional ways (Boaler, 2016, 2019; Cabana, Shreve & Woodbury, 2014; Louie, 2017; Hand, 2014; Schoenfeld, 2002). Not only are they designed to foster team work and communication, but they are supposed to help students build their pattern recognition skills and develop their

Common Core State Standards of Mathematical Practice (MP) number one, “Make sense of problems and persevere in solving them,” MP two, “Reason abstractly and quantitatively,” MP five, “Use appropriate tools strategically,” MP six, “Attend to precision,” and MP seven, “Look for and make use of structure” (CCSI, n.d.) in a fun, engaging way. They also help students build their twenty first century job skills of critical thinking, collaboration, adaptability and flexibility, emotional intelligence and lastly judgement and complex decision making (Buckle, J., nd).

Wild Card Wednesday is the third, unique antiracist intervention. Because 98% of the students of color from the target school are economically challenged, the school has had little success using homework as a learning tool. Interviews with teachers have revealed that less than ten percent of students at the target school do homework with fidelity on a regular basis, but research has shown that mixed spaced practice of mathematical concepts is important to students deeper understanding, longer lasting memory and procedural fluency (Carpenter et al. 2012). The goal of Wild Card Wednesday is to get students to engage in mixed spaced practice in fun and unique ways. One week, students will perform a “station race” activity. This entails nine unique mixed spaced practice problems placed at nine different stations. The classroom has whiteboards on every wall and a station is just a section of a whiteboard that a problem is taped to. Each student has their own individual solution sheet that has enough space for them copy and work each of the problems. The activity begins with the start of a timed slide show that plays an upbeat piece of music for exactly three minutes before an audio cue signals them to move to the next station and problem. Students work together to solve each problem but they must do their own work. Unless there are mitigating circumstances, students remain standing while they circulate and work on each problem. Research suggests that students think better while standing (Dornhecker, Blake, Benden, Zhao, Wendel, 2015 p. 271-280). The second activity is the use of

the Quizizz.com, an online platform, for students to do mixed spaced practice. While they still do their own problems, they work in teams and assist each other. This is a multiple-choice platform which is the only time, other that quarterly district benchmark and the SBAC summative assessments, that students are exposed to multiple choice problems. This helps them build multiple choice test taking skills as well since students win more "points" the faster they get something right. While research shows (Engle 2002) that timed tests are detrimental to growth of mathematicians, there are no negative consequences for the ranking in the game and students are constantly reminded that great math is not about doing math fast, but about thinking deeply (Boaler, 2016).

Thoughtful Thursday is the next antiracist intervention which also alternates from week to week and helps students by engaging their brains mathematically in two ways (Boaler et al, 2016). One of the activities asks students to recognize patterns and deviations in them by looking at four related images and ascertaining "What makes them unique?". This activity was borrowed from the "Which One Doesn't Belong?" book by Christopher Danielson. The activity helps students build their mathematical confidence to see and understand patterns (Devlin, 2006), but the title is inappropriate for the antiracist classroom as it implies that if something (or someone) is different, it (they) doesn't (do not) belong. All students are unique in their own ways and it is important that they are celebrated for that, hence the title of the activity was changed to "What makes it unique?" and the instructions were changed to read "1. Each one of the images is unique in its own way, just like us!!! 2. Your job is to figure all of the things that make each shape different from the other three. 3. Hint: This is a good chance to brush up on your vocabulary and understanding of each shape's properties. 4. Be ready to explain your reasoning to the class." A student is randomly called on to select one of the images and then describe two things that make

it unique amongst the four. If after enough time has passed and the student's struggle no longer remains productive (Boaler, 2019), the student is allowed to consult their teammates while another student is called to find what is unique in a different image. After every image is discussed, any student that consulted with their team is called on again until every image has been completely analyzed. This is a low-floor high ceiling activity that every student will find success in, which helps to consciously counter the racialized ideas about mathematical success (Larnell, Bullock, & Jett, 2016). The second Thoughtful Thursday activity has students watch a short 60 to 90 second video which poses a conundrum that gives students three to five choices as to which option they would choose. For instance, three people each did something different, who is most responsible for the outcome, person A, person B or person C? They then write a short, two sentences, reason for their choice. Following which there is a quick classroom discussion about the various choices where the merits for each choice are celebrated. There is no wrong answer. In these "real world" scenarios students get engaged with mathematics on a different level that has meaning in their lives (Hammond, 2015) and increases their motivation (Leotti, Delgado, 2011).

Formative Friday finishes off the week of antiracist interventions. Students take a formative assessment, as a team one week and as individuals the next week. Both assessments use a unique three read graphic organizer that helps students focus as much on the process of solving problems as much as getting the right answer. Each assessment consists of two or three high cognitive demand, Depth of Knowledge problems. Each problem's solution is broken up into four parts. The first part "What do we want?" is where students identify what solution the problem is actually asking for. The second part "What do we got?" ask students to identify all of the numbers (quantities), units, formulas, rules and tools that they have at their disposal that they

may need to solve the problem. Part three “How are we going to get it?” asks students to describe their step by step plan for solving the problem in writing. Lastly, the “Solution” section asks students to actually solve the problem mathematically. Each section is worth the same number of points which is intended to help shift the students’ mindset from answer getting to problem solving. This allows every student to engage in every problem at multiple levels and see themselves a member of the mathematics community (Boaler & Staples, 2008; Boaler, 2016; Langer-Osuna, 2015; Walton et al, 2012). For both individual and team assessments, students are allowed to use computers, calculators and notes. Phones are not allowed only in an effort to reduce distractions. With 15 minutes left in class, students are asked to clear their desks of everything but their test paper and a color marker which is given to them. A rubric is then displayed on various large screens around the room where students evaluate their own answers. It is important to note that students are instructed that if they have an answer that isn’t the same as the one in the rubric, they can ask for the teacher’s immediate evaluation. This is another important element of the assessment because it allows students to give themselves immediate feedback which is critical to making the assessment a tool of growth as opposed to just a ranking device (William, 2018, p.123). This also helps give the student agency over their own learning which research has shown leads to greater mathematical growth for students (Boaler, 2003). The final part of the antiracist formative assessment process comes with the individual assessment. Once students have evaluated their own assessment, handed it in and the scores are recorded, they can come back in before school, during lunch or after school (Saturday school also when available) to redo every part they lost points on for full credit. This is designed to reinforce that this is a tool of growth, not judgement, and to help them take ownership and agency over their learning and achieve mastery of the concept. Research shows that this type of scaffolded

response is the most effective (NRC, 1993). Because of the structure of the three read system, it is easier for students to assess what part of the problem-solving process they are struggling the most with. When the students come back in to work on their tests it is with the teacher's assistance which allows for individually tailored productive struggle toward mastery (NRC, 1993).

Conclusion

While people of color in the United States have made great progress toward equity since Gomes invented White supremacy in 1415 to justify the ownership of one group of people for the profit of the rich and powerful, the struggle continues in all aspects of our economy and society, including education. In order to help students of color overcome the racist learning outcomes of California's current mathematical educational system, a system of research driven, antiracist interventions designed especially for economically challenged high school students of color that have known little success in the mathematical education has been developed.

Research has determined many aspects of what high quality mathematics education looks like and multiple court cases and laws have tried to create a more equitable educational system, but data from the last seven years in California shows that very little progress has been made. The literature review in Chapter 2 reviewed both the history of racism, education in general and mathematics education in specific. The research shows that the historical tools of racism are the antithesis of good mathematics education. Throughout the history of the United States the rich and powerful have used the tool of racism to divide different races in order to prevent them from working together to solve the problem of inequitable economic outcomes. While the literature has shown this in many aspects of our society, it can be seen particularly in mathematics classrooms that have students working by themselves on low level problems with low cognitive

demand. Research shows that students who work together, on low-floor high ceiling tasks to solve complex problems have the greatest mathematical learning results. Research also shows that when these tasks are combined to help students overcome a fixed mindset and develop a growth mindset in an educational program that is designed for growth, not judgement, learning outcomes are improved. Lastly, the research shows that equitable math learning outcomes lead to equitable economic outcomes, showing that helping students of color learn high powered math is antiracist.

Summary

Chapter 2 reviewed literature on racism in the United States society, in education in general and in mathematics education in California to be specific. There is plenty of research on what constitutes a high-quality mathematics education program, brain growth and motivation. A set of specific antiracist math interventions where created in order to apply it in a unique way to help economically disadvantaged students of color in a northern California high school gain the confidence and competence needed to engage fully in their mathematics education. Reviewing the literature demonstrated the need for such antiracist interventions in creating a more equitable educational system and economy. In Chapter 3 a detailed description of the process used for this action research student will be provided.

Chapter 3

Research Design

Chapter 3 will define the action research and design used to answer the research questions posed in Chapter 1: “What is the effect of participation in an antiracist mathematics program, consisting of a specific set of interventions, on student perceptions of confidence and competence in mathematics?” and “What effect does participation in an antiracist mathematics curriculum have on student engagement as measured by student survey data?” The methodologies presented will be used to determine whether a specific set of antiracist interventions, as defined in Chapter 2, will help students of color from economically challenged households at a specific northern California high school become more engaged in their mathematic classroom as well as gain more mathematical confidence and competence. In Chapter 2 the need for these interventions, in the state of California, was clearly established by analyzing the disparate, inequitable math learning outcomes as evidenced by the state’s annual summative assessment of mathematics. While the data demonstrated the need for effective interventions from third to eleventh grade, this study only looks at the efficacy of a specific set of interventions as used in high school.

Setting

This action research was conducted at a single large urban high school in Sacramento, California that was built in 1932 and has operated as a school ever since. In 2021, 2088 students were enrolled, 92.8% of whom are economically disadvantaged and 5.2% are classified as homeless. 17% are Black, 53% are Latinx, 15% are Asian, 5% are White and 3% are Pacific Islanders. 21.4% of students are English learners, 35.6% are classified as Fluent English proficient and 7.8% are reclassified Fluent English proficient. The vast majority of the students

have not been successful in their mathematics education journey as evidenced by California's annual summative assessment (SBAC). In 2015, only 5% of the eleventh-grade students at the target school scored at or above standard on the SBAC in Mathematics, this rose to 11% in 2016, stayed at 11% in 2017, gained two points to 13% in 2018 and climbed again to 15% in 2019 the last year the test was taken. That same year, eighth grade students from the two middle schools that feed the target school only had 6% and 11% of their students score at or above standard. Those eighth graders would be this year's juniors. The feeder schools have very similar demographics to the target school. The target school and its feeder schools are all within the same district which includes both urban and suburban schools. While many of the schools within the district are quite old, the district itself is rather new having been formed in 2007 as a result of a ballot measure that combined four districts. It has a current enrollment of approximately 27,000 students with 50.2% being classified as either English Learners or Fluent English Proficient. The overall student body is made up of 11% Asian 11.9% Black, 41.6% Hispanic, 1.4% Native Hawaiian or Pacific Islander, 26% White and 4.5% of students listed as two or more races. 83% of the district's students come from economically disadvantaged homes. The district consists of 35 elementary schools, 19 middle schools and nine high schools.

Participants

The participants in this action research are the students from five different math teachers at the target school. These students are split into two different groups: students who received the antiracist interventions (Target Group) described in Chapter 2 and the ones who did not (Control Group). The students who received the antiracist interventions were spread out between five different classes that were taught by the same teacher. All five of those classes were at the Integrated Math Three level. The Control Group students were in four different math teachers'

classes at the target school. Students from the target group are 17% tenth grade, 75% eleventh grade and 8% twelfth grade. Because of anonymity of the surveys from the Control Group the exact demographics of the participants could not be determined, but Integrated Math Three classes are predominately made up of eleventh grade students and Integrated Math Two students are predominately in the tenth grade. Teachers of the Control Group have teaching experience ranging from five to thirty-five years, predominately at the target site. The teacher of the Target Group is in his 21st year of teaching and eighth year at the target site.

Data Gathering Methods and Procedures

In order to help answer the guiding questions of this study, both student perception surveys and questionnaires were used. The survey questions were broken down into four data sets. The first data set compared students from the target population's (the students who experienced the interventions) answers to questions on a perception survey that was given at the beginning of school year 2021-2022 and again at the end of the first semester. The first question asked was "Do you have a 'Math Brain'?". The students had the options of "No," "Maybe," and "Yes." The term "Math Brain" was not defined for students and if one asked what it meant the only response was "You decide." In order to analyze the data a value of zero was given for a No answer, one for Maybe and two for Yes. The numbers were then averaged and the percent of change was calculated. The second question asked was "Do you think working in teams helps you learn more math?" The students had the option to choose from a one to five scale with one being "No, I learn less when I work with others," and five being "Yes, I learn more doing math with others." The response values were averaged for each survey and the percent of change was calculated. The third pre and post semester one question was, "No one has a growth or a fixed mindset 100% of the time, but if you had to rate your average mindset what would it be?" The

students had the options of choosing from a one to five scale with one being “Fixed Mindset” and a five representing a “Growth Mindset.” The responses were then averaged and the percentage of change between the two was calculated. The second and third set of data asked the same questions to the target population as well as other math students at the same school for a basis of comparison.

In order to gauge students’ perception of their confidence, competence and engagement, twelve questions were created, two positive and two negative questions for each research question. Students had five options to answer: Strongly Disagree, Disagree, Neutral, Agree and Strongly Agree. The answers were then assigned point values from one to five. On positive questions Strongly Disagree received a one and Strongly Agree received a five, whereas on negative questions the scale was reversed with Strongly Disagree receiving a five and Strongly Agree getting a one.

In order to measure perceived growth in confidence, the two positive questions asked were “I am more confident in my mathematical abilities than I was at the beginning of the school year” and “I am more confident in my abilities to explain my reasoning than I was at the beginning of the school year.” The two negative questions were “I am less confident solving problems in a team than I was at the beginning of the School Year” and “I am less confident that I can solve complex problems than I was at the beginning of the School Year.” There was a total of 118 responses from the target population and 221 responses from the control group of students. The point value for the answers of each question were averaged and then the averages were compared to determine the percent of difference between the two. The next set of questions were designed to understand students’ perceived growth of competence.

In order to assess students' perceived growth of competence, the two positive questions were, "I am a better mathematician than I was at the beginning of the school year" and "I am a better problem solver than I was at the beginning of the school year." The two negative questions were, "I am worse at explaining my mathematical thinking than I was at the beginning of the school year" and "I am worse at recognizing patterns than I was at the beginning of the school year."

The final area to be surveyed was students' perceived change in engagement. The two positive questions intended to gauge students perceived increase in engagement were, "I try harder now in math class than I did at the beginning of the school year" and "I am more likely to continue struggling with complex problems than I was at the beginning of the school year." The negative questions were "I spend less time in doing math in class than I did at the beginning of the school year" and "I enjoy math class less now than I did at the beginning of the school year."

There was a total of 118 responses from the target population and 221 responses from the control group. The point value for the answers of each question were averaged and then the averages were compared to determine the percent of difference between the two.

Ethical Considerations

The data collection for this study was very low risk. The surveys that Control Group students submitted were completely anonymous, even from their teachers. All of the teachers were volunteers and they signed a consent form as proscribed by National University, as did the Principal of the target school (See Appendix A). While the surveys from the Target Group were not anonymous, to allow for a before and after comparison, no one had access to the survey results other than their teacher who is also the researcher.

Summary

In order to answer the two essential questions of this research, study "What is the effect of participation in an antiracist mathematics program, consisting of a specific set of interventions, on student perceptions of confidence and competence in mathematics?" and "What effect does participation in an antiracist mathematics curriculum have on student engagement as measured by student survey data?" students from the Target population were surveyed both at the beginning of the school year 2021-2022 and after the first semester had ended. The second survey contain elements from the first survey and new questions designed to ascertain students' perceptions of their own mathematical confidence, competence and engagement after a semester of antiracist interventions. In order to create a base line for comparison, other students from the same school that were in other math classes that did not receive the antiracist interventions, were surveyed with the same perception questions. All of the answers were converted to point values in order to allow for quantitative analysis of the data. In Chapter 4 this data will be analyzed, compared and interpreted in an effort to answer the essential questions of this research.

Chapter 4

Data Analysis and Discussion

In Chapter 3, the design of the research done to answer the two essential questions of this project, “What is the effect of participation in an antiracist mathematics program, consisting of a specific set of interventions, on student perceptions of confidence and competence in mathematics?” and “What effect does participation in an antiracist mathematics curriculum have on student engagement as measured by student survey data?” is described. The data collected was analyzed and interpreted to determine if exposing students of color from economically disadvantaged homes to a specific set of antiracist interventions would increase their perception of confidence and competence in their mathematical ability as well as their engagement in their math classes.

Findings

Mathematical Confidence

In order to determine students’ perception of their own mathematical confidence, four sets of data were collected via student surveys. The first two sets came from survey questions which were given to the students who received the antiracist interventions (Target Group) at the beginning of the school year 2021 – 2022 and after the first semester ended. The question, “No one has a growth or a fixed mindset 100% of the time, but if you had to rate your average mindset what would it be?” was considered an indicator of students’ perceived confidence in their mathematical ability. The students had the option of choosing one to five with one representing a “Fixed Mindset” and five a “Growth Mindset”. The responses were then averaged. The average response for the beginning of the first semester was 3.384 and at the end of the semester it was 3.487, representing an increase of 3.07%. In an effort to get a deeper

understanding for the pre and post semester one data, responses were aligned so that each student's individual change in mindset could be compared and quantified. The possible results for each student were their mindset could get worse by three, two or one, not change, or improve by one, two or three. No student thought their mindset went backward by a factor of three, but 5% got worse by two and 18% got worse by one. 52% of the target group thought their mindsets stayed the same, 23% improved by one and 3% improved by two. None thought their mindset improved by three. Looking at the data this way, it can be seen that more students moved forward than back which confirms the average scoring comparisons analysis that students' mindsets improved.

The next two data sets used gauged students' perception of their growth in confidence. It came from 12 survey questions that were given to students that received the antiracist interventions (Target Group) and students from other math teachers' classes that were at the Integrated Two and Three levels (Control Group). The twelve questions asked in order to gauge students' perception of their confidence, were split up into two positive and two negative questions for each perception. Their options were: "Strongly Disagree" which was given a point value of one on positive questions and five on negative ones; "Disagree" which was given a four on positive questions and negatives got a two; both "Neutral" answers got threes; "Agree" was worth four for positive and two for negative; and "Strongly Agree" got either a five or one.

For the category of "Confidence" the Target Group had an average score of 3.391. This alone demonstrates that they believed that they had grown in confidence because it was greater than three which represented a neutral answer. The Control Group also felt like their mathematical confidence had grown since the beginning of the school year as evidenced by an average score of 3.233. For the purpose of answering the research question, the two group

averages were compared. It showed a 4.90% greater perceived increase in mathematical confidence for the Target Group that received the antiracist interventions. Table 4.1 describes the difference in student's confidence measured with a pre and post survey question and Table 4.2 describes the difference in confidence between the Target and Control Groups.

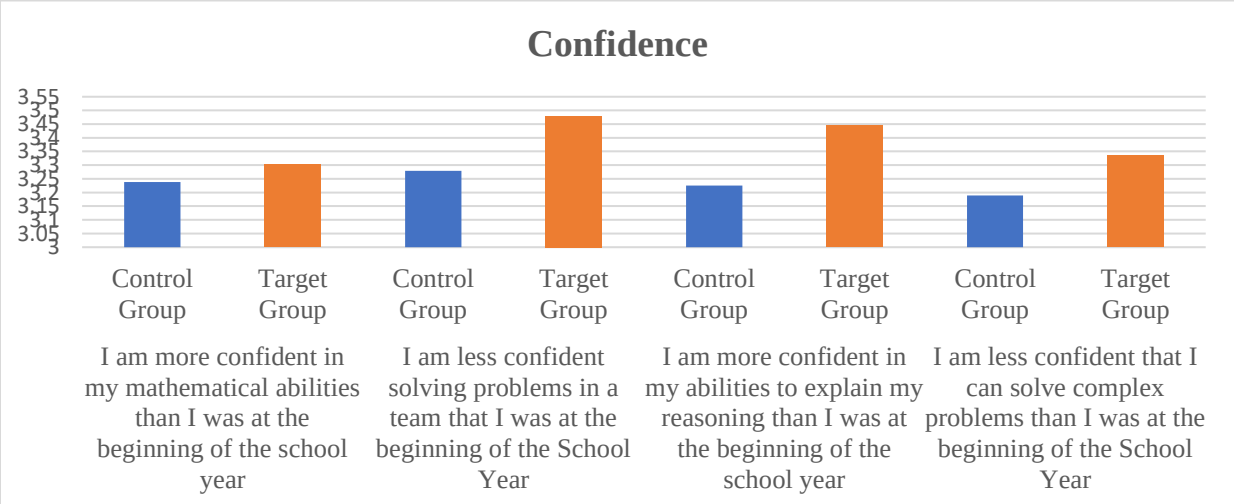
Table 4.1- Target Groups Perception of Growth in "Confidence" based on a 5-point scale, 1 being a fixed mindset to 5 being a growth mindset

Target group before and after Semester 1 question: "No one has a growth or a fixed mindset 100% of the time, but if you had to rate your average mindset what would it be?"	**Pre-Sem 1 Average score**	**Post-Sem 1 Average score**	**% Difference**
Average Scores	**3.384**	**3.487**	**+3.07%**

Table 4.2 -Comparison of Perception of Growth in "Confidence" between Target and Control groups based on a 5 point scale; 1 being Strongly disagree to 5 being Strongly Agree.

Confidence survey comparison between Target and Control groups	**Target group**	**Control group**	**% Difference**
Average scores	**3.391**	**3.233**	**+4.90%**

Figure 4.1 - Comparison of Perception of Growth in "Confidence" between Target and Control



The data indicates that students from the Target Group have an increased confidence in their mathematical abilities after a single semester of antiracist interventions compared to the beginning of the school year and the control group.

Mathematical Competence

In order to gauge students' perception of their mathematical competence, four sets of survey data were collected. The first two data sets came from the Target Group who were asked at the beginning of the first semester and again just after it ended: "Do you have a "Math Brain?" Students had the option of "No" which was given a numerical value of zero, "Maybe" which was assigned a value of one, and "Yes" which was given a two. At the beginning of the year, the average response had a value of .761; at the end of the semester it had a value of 1.00 representing an increase of 31.4%.

The second two sets of data designed to understand students' perceived growth of competence, came from a four-question block, two positive and two negative, that were given to both the target and control groups at the end of the first semester. Their options were: "Strongly Disagree" which was given a point value of one on positive questions and five on negative ones, "Disagree" which was given a four on positive questions and negatives got a two, both "Neutral" answers got threes, "Agree" was worth four for positive and two for negative and "Strongly Agree" got either a five or one. The Target Group had an average response point value of 3.561, demonstrating that they believed that their mathematical competence had grown after a semester of math. The Control Group also felt they had a growth in their mathematical competence with an average score of 3.129. The Control Group's average perceived growth was 13.79% less than the target group. Table 4.3 describes the difference in students' perceived competence measured

with a pre and post survey question and Table 4.4 describes the difference in perceived competence between the Target and Control groups.

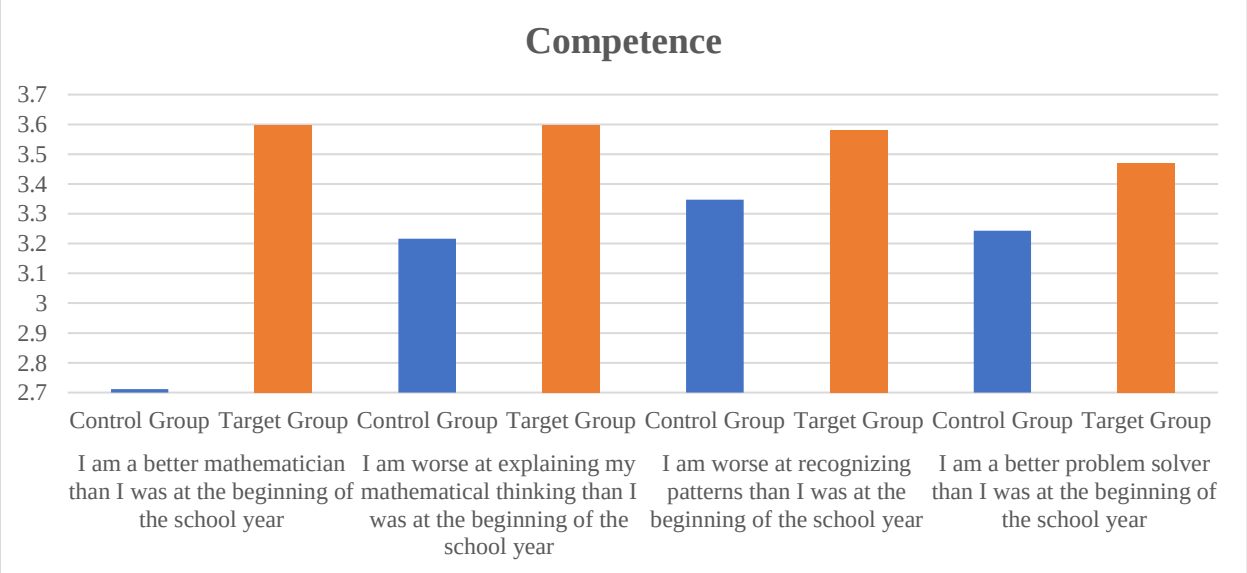
Table 4.3 – Target Group's perception of Growth in "Competence" based on a three-point scale with "No" given a value of zero, "Maybe" was assigned a one and "Yes" assigned a score of two

Target group before and after Semester 1 question: "Do you have a "Math Brain"?"	Pre Sem 1 Average Score	Post Sem 1 Average Score	% Difference
Average scores	**.761**	**1.00**	**+31.4%**

Table 4.4 - Comparison of Perception of Growth in "Competence" between Target and Control groups based on a five-point scale one being Strongly Disagree to five being Strongly Agree.

Competence survey comparison between Target and Control groups	Target Group Average Score	Control Group Average Score	% Difference
Average Scores	**3.561**	**3.129**	**+13.79%**

Figure 4.2 - Comparison of Perception of Growth in "Competence" between Target and Control groups based on a five-point scale one being Strongly Disagree to five being Strongly Agree.



Students in the Target Group's perception of their mathematical competence increased after just one semester of antiracist interventions according to the data from both their pre and post self-evaluations as well as when compared to the Control Group. In an effort to gain a deeper understanding of what students meant by "Do you have a Math Brain?" a follow up survey was conducted of the Target Group.

The follow up question asked students, "Many of you answered that you think you now have more of a math brain. Are there certain things you notice that make you think so?" This time students were allowed to answer in their own words. Their answers were varied but could essentially be classified into four different types of responses. The first and most prevalent type of answer (53%) was "I've gotten better at math since the beginning of the year." For example, one student said, "The activities we're given are engaging, and instead of directly telling students HOW to answer problems, it prompts us to figure it out ourselves, building the skills we need to answer WHY the problems are solved that way. That's really important. Also, the class seems to help students in building confidence, which is very important and very helpful to people with things like anxiety, like me." Another student said, "Certain things that I notice that makes me think I have more of a math brain is I am able to think of more ways to solve problems better than before. As in, I am able to think of more ways of how to solve a problem than before. Although, I do still struggle sometimes on problems, I am able to find a way around it, after a while." A third student expressed, "It is easier for me to comprehend problems and use past techniques, not as before where I would be completely lost."

The second most prevalent answer (20%) was, "I'm naturally good at Math." Examples of this type of answer are "yes like when i look at a problem and i can understand it in my mind", "i am able to execute on my test with the amount of math i know. I think i have a lucky math

brain," and "I believe the idea of having a math brain might just be the ability to quickly understand patterns in numbers. Memorizing the patterns and rules comes a lot easier to some than other and perhaps that's where the idea of math brain comes from."

The third type of answer (19%) was "I don't have a math brain because I'm not good at math" is exemplified by responses like, "I don't have a math brain. :)" and "No, im not really a math brain. When it comes to math solving."

Lastly, a few students (6%) stated that "There is no such thing as a math brain," which they explained, "I think that there is no such thing as a math brain, everyone has their own way of thinking, collaborating, and working." And "Maybe the fact that we've all learned that there's no real "math brain" because everyone has one. It isn't objective. Everyone is capable of growing their intelligence, no matter who they are."

Table 4.5 – Follow up

Follow up question: *"Many of you answered that you think you now have more of a math brain. Are there certain things you notice that make you think so?"*

Type of Response	Student Quotes	Percent of Responses
I've gotten better at math since the beginning of the year.	"The activities we're given are engaging, and instead of directly telling students HOW to answer problems, it prompts us to figure it out ourselves, building the skills we need to answer WHY the problems are solved that way. That's really important. Also, the class seems to help students in building confidence, which is very important and very helpful to people with things like anxiety, like me."	53%
I'm naturally good at Math	"yes like when i look at a problem and i can understand it in my mind" and "No, im not really a math brain. When it comes to math solving."	20%
I don't have a math brain because I'm not good at math	"No, im not really a math brain. When it comes to math solving."	19%

Type of Response	Student Quotes	Percent of Responses
There is no such thing as a math brain	“Maybe the fact that we've all learned that there's no real "math brain" because everyone has one. It isn't objective. Everyone is capable of growing their intelligence, no matter who they are.”	6%

These follow up questions seem to confirm the previous data that most students felt like their competence as mathematicians has increased over the course of the first semester.

Student engagement

In order to answer the second guiding question of this research “What effect does participation in an antiracist mathematics curriculum have on student engagement as measured by student survey data?”, four sets of data were considered. First, the students from the Target Group were asked the question “Do you think working in teams helps you learn more math?” at the beginning of the first semester and again just after the semester ended. The students selected from a from one to five scale. One being “No, I learn less when I work with others” and five being “Yes, I learn more doing math with others.” The response values were averaged for each survey. The responses from the beginning of the year averaged out to 3.423 and at the end of the semester to 3.975, which represented an increase of 16.11%.

The second data point for this question came from a set of four questions on a perception survey that was given to both the Target Group as well as the Control Group. The two positive questions intended to gauge students’ perceived increase in engagement were, “I try harder now in math class than I did at the beginning of the school year” and “I am more likely to continue struggling with complex problems than I was at the beginning of the school year.” Unfortunately, the second question was poorly conceived and gave erroneous results that weren’t consistent with all of the rest indicating negative growth for both groups. Therefore, the results

for this question weren't included in the final calculations, but even when they were, the results were similar. The negative questions were, "I spend less time in doing math in class than I did at the beginning of the school year," and "I enjoy math class less now than I did at the beginning of the school year." The Target Groups average score was 3.513 which was 5.85% greater than the Control Group's average response score of 3.319.

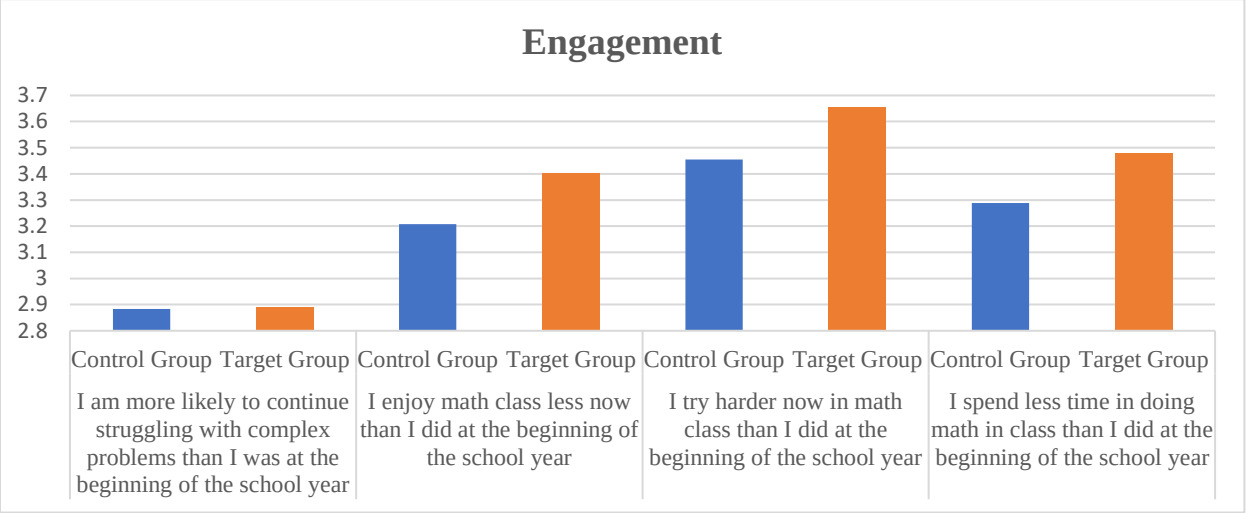
Table 4.5 – Target Groups Perception of Growth in "Engagement" based on a one to five scale. One being "No, I learn less when I work with others" and five being "Yes, I learn more doing math with others."

Target Group before and after Semester 1 question: "Do you think working in teams helps you learn more math?"	**Pre Sem1 Average Score**	**Post Sem1 Average Score**	**% Difference**
Averages	**3.423**	**3.975**	**+16.11%**

Table 4.6 - Perception of growth in "Engagement" based on a 5-point scale 1 being Strongly disagree to 5 being Strongly Agree.

Engagement survey comparison between Target and Control Groups	**Target Group Average Score**	**Control Group Average Score**	**% Difference**
Averages	**3.513**	**3.319**	**+5.85%**

Figure 4.3- Perception of growth in “Engagement” based on a 5-point scale 1 being Strongly disagree to 5 being Strongly Agree.



In order to get a deeper understanding of what students thought about doing math in teams, a follow up question was posed to the Target Group, “Most of you said that doing math in groups made you better math learners. Why do you think doing math in groups helps you?” Students had very similar answers to this question. For example, one student replied, “Being able to interact in group settings are good for communication, knowing that hearing this persons side and my side can help each other.” Another responded, “Doing math in groups helped me become a better math learner because when I dont know something, I get help from my teammates. Also we work together to find the solution to our problems and communicate, which makes math fun and enjoyable.” A third said, “Math groups helps me because I get to listen to what my classmates have to say or learn their way of thinking. Also, if I'm confused, I get to ask them for help if needed.”

The uniformity of the responses only seems to support the previous findings that students in the Target Group are more engaged in doing math as a result of the antiracist interventions. To get a better idea of students’ perceptions on the efficacy of each intervention, students in the

Target Group were asked the following question, “Rank our class starters from most to least helpful, inspiring you as a math learner. (1 being least helpful and 5 being the most).” Over all they found all of them to be helpful as seen in the following table:

Antiracist Intervention Effectiveness

Table 4.7 – Students ratings of the efficacy of each antiracist intervention

Rank our class starters from most to least helpful inspiring you as a math learner. (1 being least helpful and 5 being the most)	Mindset Monday (Videos, Ice Breakers)	Team Building Tuesday	Wild Card Wednesday (Station Race Quizziz)	[Thoughtful Thursdays (Conundrums, What makes it Unique?)	Formative Fridays (Team and Individual Tests)
Mean	3.24	4.02	4.03	3.78	3.79
Mode	3	5	5	5	4
Median	3	4	4	4	4

Figure 4.4 – Student Ranking of Antiracist Intervention Efficacy

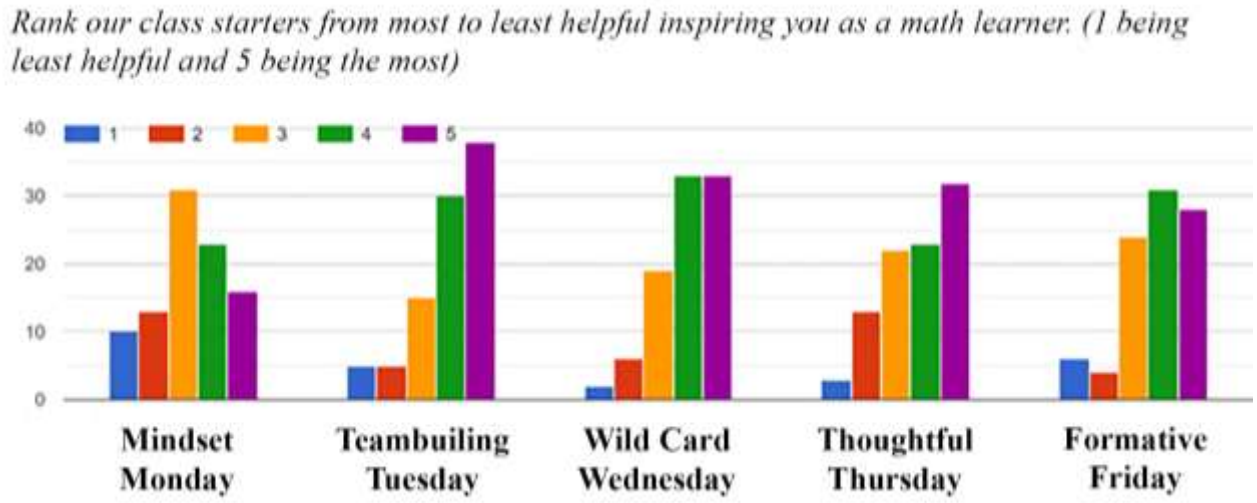
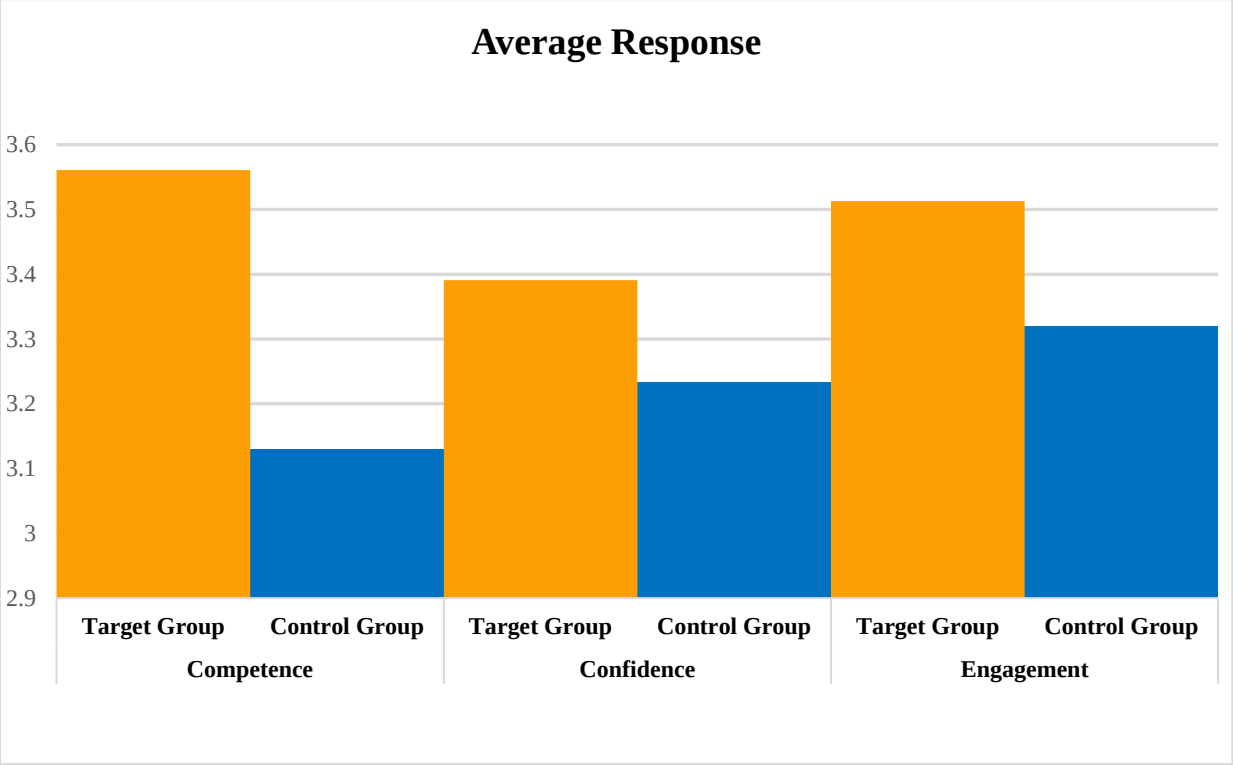


Figure 4.5 – Average responses for Confidence, Competence and Engagement for both the Target and Control Group



Discussion

The inequitable learning outcomes for California's students of color in math were clearly documented in Chapter 2 and shown to be a part of a long pattern of systematic racism going back to even before the thirteen colonies became the United States. The researcher attempted to create a system of interventions to help students of color overcome this oppression at the Integrated Math Three level at a high school in Sacramento, California. In order to assess the efficacy of these interventions, two research questions: "What is the effect of participation in an antiracist mathematics program, consisting of a specific set of interventions, on student perceptions of confidence and competence in mathematics?" and "What effect does participation in an antiracist mathematics curriculum have on student engagement as measured by student survey data?" For the first question, the survey data demonstrated that the interventions had a

positive effect on students' perception of their confidence and competence after a semester of these interventions. This finding was further supported by the follow up survey's responses to the "Math Brain" question where the majority of the target group students thought they had become better mathematicians since the beginning of the school year.

For the second question on student engagement, once again survey data indicated that after a semester of antiracist interventions, students perceived that they were more engaged in their mathematics class. This finding also seemed to be confirmed by the follow up question "Most of you said that you doing math in groups made you better math learners. Why do you think doing math in groups helps you?" with students almost unanimously stating that doing math in teams helped them become better math learners.

Lastly, both research questions seemed to be answered by the Target Group's follow up survey asking them to rank the efficacy of each antiracist intervention. Every intervention had a mean of greater than three which meant that students thought all of them helped them to be better math learners.

Limitations

The interactions of individual and groups of human beings are incredibly complex and thus it is hard to emphatically determine cause and effect from a small single study. That being said the multiple sources of data give a clear indication that students in the classes that received the antiracist interventions are more confident, competent and engaged math learners. Even though the five antiracist elements of the program were all based on documented research, this research cannot definitively determine if the positive learning outcomes in this class are a direct result of any of them.

Chapter 5

Summary and Conclusion

The purpose of this study was to determine the efficacy of five specific antiracist interventions for economically disadvantaged math students of color at a northern California high school. The action research study focused on two research questions: “What is the effect of participation in an antiracist mathematics program, consisting of a specific set of interventions, on student perceptions of confidence and competence in mathematics?” and “What effect does participation in an antiracist mathematics curriculum have on student engagement as measured by student survey data?”

The study began with the start of school year 2021 – 2022 when the five classes who were about to receive antiracist math interventions (Target Group) were surveyed. The students then received an entire semester of math instruction, including all five interventions and were surveyed again at the end of the semester. In addition to the original questions the students were also asked a series of questions designed to determine their perceptions of growth in engagement, confidence and competence in math. The same set of questions were also asked of students at the same school that had not received the interventions (Control Group) for comparison. The data was then quantized for analysis. To get a deeper understanding of the Target Group thoughts a follow up set of questions were asked, including asking them to rank the efficacy of each intervention at inspiring them as math learners.

Conclusions

After analyzing and interpreting all of the data, including the follow up questions, the antiracist interventions seemed to help students feel more confident, competent and engaged in math.

The pre and post semester one survey given to the target group to ascertain their perception of confidence showed a 3.07% gain in confidence. The confidence survey questions between the Target and Control groups showed the Target Group had 4.9% more confidence than the control group.

To determine the effect of the antiracist interventions on students' competence in math the pre and post semester one question of the Target Group "Do you have a Math Brain?" showed a 31.4% increase in confidence. In order to gain a deeper understanding of what students meant by this an open response, follow up question was asked and 53% of students thought that they had gotten better at math since the beginning of the school year. This was exemplified with answers like, "The activities we're given are engaging, and instead of directly telling students HOW to answer problems, it prompts us to figure it out ourselves, building the skills we need to answer WHY the problems are solved that way. That's really important. Also, the class seems to help students in building confidence, which is very important and very helpful to people with things like anxiety, like me," and "Certain things that I notice that makes me think I have more of a math brain is I am able to think of more ways to solve problems better than before. As in, I am able to think of more ways of how to solve a problem than before. Although, I do still struggle sometimes on problems, I am able to find a way around it, after a while." These answers seem to indicate that students believed that they had grown both in mathematical confidence and competence. These findings seemed to be confirmed by the survey questions asked of both the Target Group and the Control Group which were intended to determine students' growth in confidence. They revealed that the Target Group believed they had 13.79% more growth than the Control Group.

In order to help determine if the Target Group had an increase in their perception of the engagement in their math class they were asked pre and post semester one, “Do you think working in teams helps you learn more math?” After a semester of antiracist interventions their answers indicated 16.11% growth. In order to get a better understanding of why they thought so a follow up question “Why do you think that doing math in groups helps you?” Overwhelmingly students responded positively with answers like, “Doing math in groups helped me become a better math learner because when I dont know something, I get help from my teammates. Also we work together to find the solution to our problems and communicate, which makes math fun and enjoyable.” This seems to confirm that the antiracist interventions helped students become more engaged. Further validation comes from the engagement survey questions asked of both the Target and Control Groups which indicated that the Target Group had 5.85% more engagement in their math classes than the Control Group.

The last piece of data to be considered was when the Control Group was asked in a follow up question, “Rank our class starters (Mindset Monday, Team Building Tuesday, Wild Card Wednesday, Thoughtful Thursday and Formative Friday) from most to least helpful, inspiring you as a math learner. (1 being least helpful and 5 being the most).” The average score for each intervention was over three indicating that students believed that every intervention helped inspire them. While this data could be interpreted in a plethora of ways some of the most interesting were the one intervention that didn’t involve working together in their math team, Mindset Monday, had the lowest score. Another interesting take away was Formative Fridays, which is essentially students taking a test every Friday, team test one week and individual the next, had both a Mean and Median score of four. This would indicate that students perceived formative assessments as inspirational.

After all of the data was put together and analyzed it would definitely seem that the five antiracist interventions had a positive effect on students' confidence, competence and engagement in their math learning journey.

Implications for Practice

At the conclusion of this action research project it would definitely seem that the five antiracist interventions had positive effects on the confidence, competence and engagement of economically disadvantaged students of color on their math learning journey. While all of these interventions were created based on existing research and best practices they are all original in their implementation and practice. While I created them and only my students are fully engaged in the complete system of all five practices, teachers across the country at various levels, have begun using various parts in their systems and have begun reporting positive impacts on their students. This would indicate that all of them could and should be implemented to one degree or another and that research should continue.

Implications for Leadership

Leadership has played an important role in this action research study by not forcing me to follow the status quo. During my time developing the program it would be easy for an instructional leader to fall back on the current standard practice of having teachers of the same subject do the same thing at the same time. Forced uniformity would have inhibited the creative process and perpetuated a failed system. By allowing me to try new methods and create new opportunities to help more students learn more math, my administrator truly embraced the spirit the California Professional Standards for Education Leaders (CPSEL) Standard 2: Instructional Leadership. By promoting a culture that allowed me to engage in individual professional learning

in order to continuously improve my program for students, my principal exemplified the standard.

During this action research project, I constantly had the CPSELs in mind which led me to always ask myself, “How could I scale this up? How could I help more teachers help more students?” While CPSEL Two is a useful guide, leadership is all about building relationships, which is exemplified in Dr. Winlock’s Triangle for Leadership. I interpret these pillars (Knowledge, Leadership and Relationship) by always asking myself these questions: “How do I make sure I know enough to know how to help?”, “What must I do to lead my team to success?” and “What must I do to build the trust so that my team will want to follow my lead?” These questions have not only guided me throughout the study, but have also helped me to guide and lead the three first year math teachers and student teacher I’m responsible for this year.

Implications for Further Research

This study was very validating for all of the research that I have been doing the last few years prior to the Pandemic and the work I did during distance learning. It will be interesting to see if my students made as much growth and do as well on California’s annual summative assessment as I think they will. As this is the first time that all of these interventions have been in place for an entire school year there are definitely avenues for more study and improvement. As more teachers within my district and across the nation begin trying these interventions and improving on them, it is my hope that this will lead to greater mathematical gains for economically challenged students of color. It is also my hope that the practice of sharing every aspect of this research for free within educational community will foster a recognition that true innovation comes from teachers in the classroom and not outside paid consultants. If this can be

just the smallest of spark of change for educational leaders to encourage and develop teacher researchers at every level I will consider it to be a great success.

Sharing the Results of the Project

The findings of this study have and will be shared far and wide to stakeholders in our district, across our state and around the world. As a member of many math teacher groups, I have already shared many aspects of this project already, not just via the digital world but by running in person workshops at conferences as well. It is my intent to publish it in various education and math journals as well as sharing it with some of the education leaders within our State that are currently mapping the future path of mathematics education in California.

On Reflection and Visioning

Throughout this study and the building of this system it was important to constantly keep up to date with current research from a variety of sources and think of new ways it can be applied to the teaching and of math. While helping students become more confident, competent and engaged in learning mathematics was the goal of the project, the antiracist interventions were designed more to help students improve their mindsets than anything else. This approach is applicable to every student no matter the subject being taught.

The entire antiracist intervention project is already packaged for workshops and professional learning community implementation. In fact, I have already run workshops on them and teachers across the USA are currently using some or all of them. The key to having a teacher researcher develop activities is that we make them usable. Many interventions, activities or systems created by non-teachers require too much of a teacher’s time and effort to use making them impractical at best. All five antiracist interventions can be introduced in a single 80 min

workshop and Professional Learning Communities can develop three read tests and rubrics that help move their student's mathematical knowledge forward as a team.

Leadership Plan of Action, Proposal of Activities and Timeline for Antiracist Math Interventions

Leadership Plan of Action (LPA) Proposed Activities↓ Timeline→	**Start**	**Finish**	**Sept/ Oct**	**Nov/ Dec**	**Jan/ Feb**	**Mar**	**April**	**May**
	Date	**Date**						
Communicate findings and run initial workshop	**x**							
PLC develops Team and Individual tests and rubrics			**x**					
Review Previous months tests and develop next month's tests and rubrics				**x**				
Review Previous months tests and develop next month's tests and rubrics					**x**			
Review Previous months tests and develop next month's tests and rubrics						**x**		
Review Previous months tests and develop next month's tests and rubrics							**x**	
Review year as a whole and make plans for next year								**x**

Appendix A

REQUEST PERMISSION TO CONDUCT RESEARCH FORM

INFORMATION ABOUT: The Impact of an Antiracist Math program on learning outcomes for students of color

RESPONSIBLE INVESTIGATOR: Matthew Rector

Under the direction of Mary Rountree at National University, the investigator(s) is conducting a research study and is inviting you to participate in it. The purpose of this form is to provide information that may affect your decision about whether or not you will provide permission to conduct this research project at your site. If you choose to approve this research, please sign in the space at the end of this form to record your consent.

Research Project Information

Master's Level Thesis

Research Question(s):

This study will be guided by the following questions:

1. What is the effect of participation in an antiracist mathematics program, consisting of a specific set of interventions, on student perceptions of confidence and competence in mathematics?
2. What effect does participation in an anti-racist mathematics curriculum have on student engagement as measured by student survey data?

Desired Start Date: 1/17/2022

Duration: Two weeks

Participants (indicate all that apply):

• Students in Integrated Math 2 and 3 classes

• Teachers

• Administrators

Brief summary of research design, including procedures for data analysis:

Surveys – Students will be asked to complete an Anonymous survey on their confidence and competence as mathematicians.

Observations – An administrator will do a series of quick, anonymous (to the researcher), snap shot surveys of classes.

Potential Risks: None

Potential Benefits: Improved math learning outcomes

Instruments to be used: Google forms

Additional Information:

WILL IT COST ANYTHING TO PARTICIPATE IN THE STUDY? No

WILL I GET PAID TO PARTICIPATE? Only in good will

WHAT HAPPENS IF THE RESEARCHER GETS NEW INFORMATION DURING THE STUDY? The researcher will contact all participants and site if the researcher learns new information that could change the decision about participating in this study.

HOW WILL THE RESEARCHER PROTECT PARTICIPANTS' CONFIDENTIALITY? The results of the research study will be published, but names or identities will not be revealed.

WHAT HAPPENS IF A PARTICIPANT DOESN'T WANT TO CONTINUE IN THE STUDY? Participation in this study is voluntary. If individuals choose not to participate or if you choose to terminate the study, this may de done at any time. There will be no penalty.

WILL PARTICIPANTS BE COMPENSATED FOR ILLNESS OR INJURY? You are not waiving any of your legal rights if you agree to participate in this study. But no funds have been set aside to compensate you or participants in the event of injury. If anyone suffer harm because due to participation in this research project, please contact the Office of the Institutional Review Board,

National University, 11255 North Torrey Pines Road, La Jolla, CA 92037; Telephone (858) 642-8136.

VOLUNTARY CONSENT By signing this form, you are saying (1) that you have read this form or have had it read to you and (2) that you understand this form, the research study, and its risks and benefits. The researcher will be happy to answer any questions you have about the research. If you have any questions, please feel free to contact (principal investigator) at (phone number). If at any time you feel pressured to participate or if you have any questions about your rights or this form, please call the Office of the Institutional Review Board at (858) 642-8136.

Note: By signing below, you are telling the researcher "Yes" you want to participate in this study. Please keep one copy of this form for your records.

Your Name (please print): _____

Your Signature: _____

Title: _____ Date: _____

INVESTIGATOR'S STATEMENT

I certify that this form includes all information concerning the study relevant to the protection of the rights of the participants, including the nature and purpose of this research, benefits, risks, costs, and any experimental procedures.

I have described the rights and protections afforded to human research participants and have done nothing to pressure, coerce, or falsely entice this person to participate. I am available to answer the participant's questions and have encouraged him or her to ask additional questions at any time during the course of the study.

Investigator's Signature: _____ _____

Investigator's Name: Matthew Rector Date:

Appendix B

Instruments, Timeline and Processes for Data Collection Procedures

Purpose Related to the Study	Data Gathering Method	Data Sources	Timing	Types of Data Collected	Key Questions, Concepts, and Observations
To determine students who received Antiracist interventions perception of the increase in their Confidence, Competence and Engagement in Mathematics	Student survey	Students that received Antiracist interventions	1. The beginning of the school year 2. The end of the first semester	1. Perception of engagement 2. Perception of Confidence 3. Perception of Competence	**Engagement:** Do you think working in teams helps you learn more math? **Confidence:** No one has a growth mindset 100% of the time but if you had to rate your average mindset what would it be? **Competence:** Do you have a "Math Brain"?
To compare the perceived growth in Confidence, Competence and Engagement in Mathematics of students that received antiracist interventions versus students at the same school that did not receive the interventions	Student survey	1.Students that received antiracist interventions 2.Students at the target school that didn't receive antiracist interventions	After one semester of instruction	1. Perception of engagement 2. Perception of Confidence 3. Perception of Competence	Two positive and two negative questions were asked for each area, Engagement, Confidence and Competence

Purpose Related to the Study	**Data Gathering Method**	**Data Sources**	**Timing**	**Types of Data Collected**	**Key Questions, Concepts, and Observations**
To get a deeper understanding of students' previous survey answers	Open ended survey questions	Students that received a semester of antiracist interventions	Three weeks after previous survey was conducted	Short answers	1. Many of you answered that you think you have more of a Math Brain. Are there certain things that make you think so? 2. Why do you think doing math in groups helps you?
Students were asked to rank their perceived efficacy of each antiracist intervention	Student survey	Students that received a semester of antiracist interventions	At the same time as the follow up questions were asked	Likert scale	Rank our class starters from most to least helpful inspiring you as a math learner. (1 being least helpful and 5 being the most)

Appendix C

Target Group Pre and Post Survey

1. What's your first and last name?
2. Period

   Mark only one oval

   - 1
   - 3
   - 4
   - 5
   - 6

3. Do you have a "Math Brain"?

   Mark only one oval.

   - Yes
   - No
   - Maybe

4. Do you think working in teams helps you learn more math?

   Mark only one oval.

   1 No, I learn less when I work with others - 5 Yes, I learn more when doing math with others

   - 1
   - 2
   - 3
   - 4
   - 5

5. No one has a growth or fixed mindset 100% of the time, but if you had to rate your average mindset what would it be?

Mark only one oval.

1=Fixed Mindset to 5 = Growth Mindset

- 1
- 2
- 3
- 4
- 5

Appendix D

Target and Control Group Perception Survey

SY 21-2 Q3 Student Mathematical Mindset Survey

1. I am more confident in my mathematical abilities than I was at the begingin of the school year.

   Mark only one oval.

   - Strongly disagree
   - Disagree
   - Neutral
   - Agree
   - Strongly Agree

2. I am a better mathematician than I was at the beginning of the school year.

   Mark only one oval.

   - Strongly disagree
   - Disagree
   - Neutral
   - Agree
   - Strongly Agree

3. I am more likely to continue struggling with complex problems than I was at the beginning of the school year

   Mark only one oval.

   - Strongly disagree
   - Disagree
   - Neutral
   - Agree
   - Strongly Agree

4. I am less confident that I can solve complex problems than I was at the beginning of the School Year

   Mark only one oval.

   - o Strongly disagree
   - o Disagree
   - o Neutral
   - o Agree
   - o Strongly Agree

5. I am worse at explaining my mathematical thinking than I was at the beginning of the school year

   Mark only one oval.

   - o Strongly disagree
   - o Disagree
   - o Neutral
   - o Agree
   - o Strongly Agree

6. I enjoy math class les now than I did at the beginning of the school year

   Mark only one oval.

   - o Strongly disagree
   - o Disagree
   - o Neutral
   - o Agree
   - o Strongly Agree

7. I am more confident in my abilities to explain my reasoning than I was at the beginning of the school year

   Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

8. I am a better problem solver than I was at the beginning of the school year

   Mark only one oval.

   - Strongly disagree
   - Disagree
   - Neutral
   - Agree
   - Strongly Agree

9. I try harder now in math class than I did at the beginning of the school year

   Mark only one oval.

   - Strongly disagree
   - Disagree
   - Neutral
   - Agree
   - Strongly Agree

10. I am less confident solving problems in a team than I was at the beginning of the school year

    Mark only one oval.

    - Strongly disagree
    - Disagree
    - Neutral
    - Agree
    - Strongly Agree

11. I am worse at recognizing patterns than I was at the beginning of the school year

    Mark only one oval.

    - Strongly disagree
    - Disagree
    - Neutral
    - Agree
    - Strongly Agree

12. I spend less time doing math in class than I did at the beginning of the school year

    Mark only one oval.

    - Strongly disagree
    - Disagree
    - Neutral
    - Agree
    - Strongly Agree

Appendix E

Follow up Survey for Target Group

Follow up survey 2/17/22

1. Many of you answered that you think you now have more of a math brain. Are there certain things you notice that makes you think so?

   Short answer text _____

2. Most of you said that you doing math in groups made you better math learners. Why do you think doing math in groups helps you?

   Short answer text _____

3. Rank our class starters from most to least helpful inspiring you as a math learner. (1 being least helpful and 5 being the most)

	1	2	3	4	5
Mindset Monday (videos, Ice breakers)	◯	◯	◯	◯	◯
Team Building Tuesday	◯	◯	◯	◯	◯
Wild Card Wednesday (station race quizziz)	◯	◯	◯	◯	◯
Thoughtful Thursdays (Conundrums, What makes it Unique?)	◯	◯	◯	◯	◯
Formative Fridays (Team and Individual tests)	◯	◯	◯	◯	◯

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Tables

Table 1

Confidence

	I am more confident in my mathematical abilities than I was at the beginning of the school year		I am less confident solving problems in a team that I was at the beginning of the School Year		I am more confident in my abilities to explain my reasoning than I was at the beginning of the school year		I am less confident that I can solve complex problems than I was at the beginning of the School Year	
	Control Group	Target Group	Control Group	Target Group	Control Group	Target Group	Control Group	Target Group
Mean	3.23874	3.30252	3.27928	3.478992	3.22523	3.445378	3.18919	3.3361

Table 2

Competence

	I am a better mathematician than I was at the beginning of the school year		I am worse at explaining my mathematical thinking than I was at the beginning of the school year		I am worse at recognizing patterns than I was at the beginning of the school year		I am a better problem solver than I was at the beginning of the school year	
	Control Group	Target Group	Control Group	Target Group	Control Group	Target Group	Control Group	Target Group
Mean	2.711712	3.596639	3.216216	3.596639	3.346847	3.579832	3.243243	3.470588

Table 3

Engagement

	I am more likely to continue struggling with complex problems than I was at the beginning of the school year		I enjoy math class less now than I did at the beginning of the school year		I try harder now in math class than I did at the beginning of the school year		I spend less time in doing math in class than I did at the beginning of the school year	
	Control Group	Target Group	Control Group	Target Group	Control Group	Target Group	Control Group	Target Group
Mean	2.882883	2.890756	3.207207	3.403361	3.454955	3.655462	3.288288	3.478992