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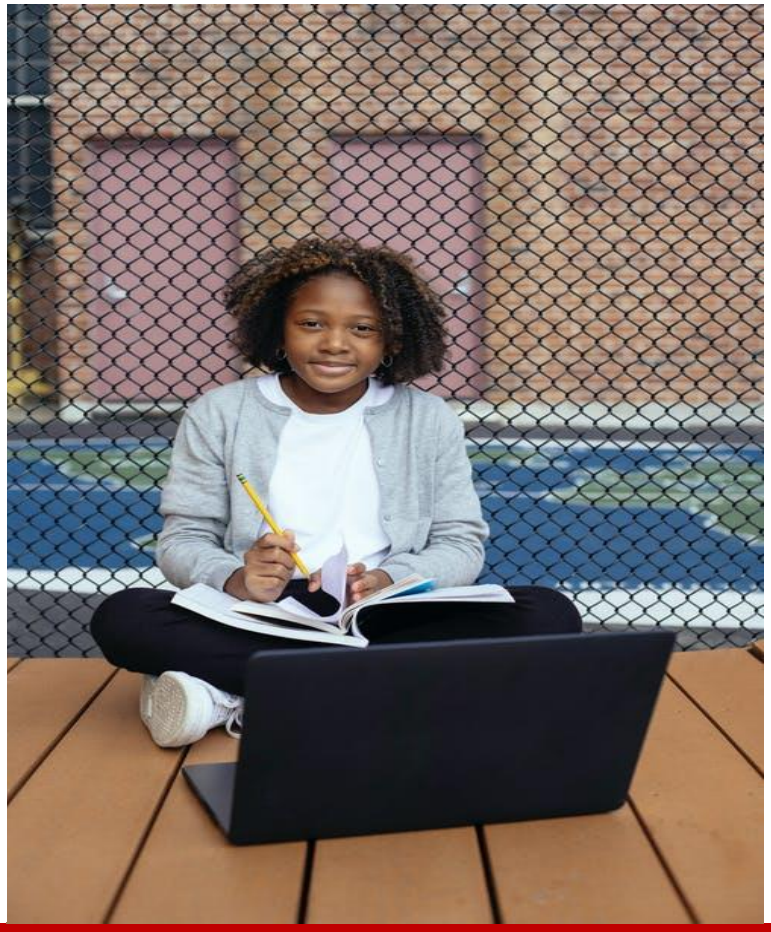
The Lighthouse Almanac

Using Mathematics Education to Revolutionize the World



About *The Lighthouse Almanac*

… "In an era when books of any kind were a luxury found in a few households, almanacs were common. They included scientific information, such as weather forecasts, tide tables, lunar and solar eclipses, and the times of the rising and setting of the sun and moon; they were also infused with mild poems, proverbs, and bits of general information.

What made Banneker's *Almanacs* innovative – aside from the fact that they were produced by a black man in an age when African Americans were considered incapable of scientific, mathematical or literary accomplishment – was the inclusion of commentaries, literature, and fillers that had a political and humanitarian purpose."

(excerpt from PBS' "Africans in America: Benjamin Banneker's *Almanac*" https://www.pbs.org/wgbh/aia/part2/2h68.html)

Following the tradition of Benjamin Banneker's *Almanacs*, this peer-reviewed journal from the Benjamin Banneker Association, Inc, (BBA) is an inclusive periodical written for and by PK-12 educators and administrators, college/university faculty, community leaders and organizers, parents, and anyone invested in the teaching and learning of mathematics for all children, particularly Black children/children of African ancestry.

The Lighthouse Almanac is a journal that is a compendium of knowledge from the lived experiences of those committed to helping children thrive as learners of mathematics.

Through *The Lighthouse Almanac*, BBA demonstrates our long-standing dedication to advocating for equity and access, as we chronicle the research, practices, and collective actions of many individuals committed to this purpose.

We anticipate you will find *The Lighthouse Almanac* to be a valuable resource for guiding your efforts and hope you will consider sharing your experiences with us in an upcoming edition.

~The Lighthouse Almanac Editorial Team

- **Brian R. Lawler**, Editor-In-Chief
- **Brea Ratliff**, Founder of *The Lighthouse Almanac*, Executive Editor, BBA Past President
- **Salandra Grice**, Associate Editor
- **Lisa Lollar**, Associate Editor
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The Benjamin Banneker Association, Inc. would like to express our sincere appreciation to the following individuals who reviewed the submissions for this issue.

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Purpose and Goals of the Association

The purpose of The Benjamin Banneker Association, Inc. are the advancement, stimulation, extension, improvement, and coordination of the learning and teaching of mathematics for *all* students at *all* levels, with special emphasis on students of African ancestry.

The goals of the Association shall be

(a) to serve as advocate for the educational and professional needs of its members,

(b) to serve as advocate for the educational and developmental needs of students of African ancestry, and

(c) to provide educational solutions and policy alternatives to the educational issues which affect the participation and success of students of African ancestry in mathematics learning.

In executing these goals, The Benjamin Banneker Association shall promote and provide opportunities for networking among individuals, institutions, groups, and agencies operating for the betterment of the educational systems of these United States and Territories and promote and provide opportunities for students of African Ancestry to participate and excel in mathematics learning.

Toward this end The Benjamin Banneker Association shall do the following:

- Serve as a resource for The Benjamin Banneker Association membership,
- Develop programs and activities that encourage and support scholarly and professional activities of The Benjamin Banneker Association membership,
- Develop programs and activities that encourage and support participation and excellence in mathematics learning among students of African Ancestry
- Disseminate educational information to The Benjamin Banneker Association membership,
- Identify fiscal and material resources that support The Association's programs and activities and Collaborate with other interest groups when purposeful in seeking the goals of The Association.

Image credit: Freepik.com

Content Plus Culture:

Effective Strategies for Successful Math Teachers of Black Girls

By Salandra Grice, M.Ed.

Dorothy Lavinia Brown, Rebecca Lee Crumpler, Dr. Marie M. Daly, and Katherine Johnson are only a few of the phenomenal Black, female hidden figures in the fields of math and science (Women of Color in STEM, 2020). Although many of their accomplishments have gone unrecognized and unnoticed, their contributions to the medical, chemistry and aeronautics industries are nonetheless important and play a special part in influencing the role that future Black, female scientists and mathematicians may play in forthcoming advancements. Although these accomplishments are unprecedented and Black women continue to remain the most educated group in the U.S. (Katz, 2020); they are also underrepresented in STEM-related fields at a lowly 7% among all other groups (U.S. Department of Education, as cited in Campbell, 2012). Increasing the presence of Black girls in math and science fields continues to remain an important goal in STEM education.

Although many organizations have undertaken the task of encouraging more Black girls and women to enter into STEM fields such as Girls Who Code, Girlstart, and the National Girls Collaborative, there are still barriers keeping many Black girls from traveling up the STEM pipeline in schools. Outside of the many systemic and institutionalized barriers such as historical discrimination and oppression (Francis, 2012), Black girls also face interpersonal barriers in the form of a lack of positive attitudes and perceptions of Black girls' math abilities, and lower recommendations for advanced math classes from the very people who should be encouraging them: their teachers (Campbell, 2020). Consequently, teachers play a significant role in increasing the visibility of Black girls in STEM education. With contributing factors such as a teachers' ability to be culturally responsive, build positive relationships, self-reflect, hold high expectations, and provide social interaction and collective learning opportunities for Black girls; without these elements, many Black girls will continue to experience negative and deficit thinking from their math educators and miss the opportunity to become future math history makers.

Me, Myself, and Math

As I continue, I'd like to be completely honest; math is not my jam. However, my aversion to all things mathematical didn't begin in the early grades as I felt perfectly capable and happy to perform and engage in mathematical scenarios in elementary school. Instead, this uneasy and uncomfortable feeling about math did not develop until my middle/high school years. However, this part will not be written from the point of view of someone who hated math because they were not good at it, but instead, my aversion to math mostly stems from the way math concepts were presented to me and the teachers who presented them. In short, my mathematical career in school looked a lot like this: If I liked the teacher, I did well; if I didn't, I did poorly. In the same fashion, if I felt like the teacher liked me, I did well; if not…you get the picture.

One may think that my experiences as a math student were atypical or only reflective of my willingness to learn or general math ability. After all, we all have come to believe the idea that some people are "math people," and some aren't (Kimball et al., 2013). This false assumption

about my inherent genetic math inability helped me to sleep at night, too. Unfortunately, many students perform poorly in many subjects not because they are "not good" at them, but their success or failure ultimately rested on the effectiveness of the teacher instructing them and the relationship between that instructor and themselves (Booker & Lim, 2018). As a Black and female student, my relationships with many of my former math teachers seemed volatile at most and indifferent at best. It wasn't until I later became an educator that I realized these negative experiences weren't wholly the result of my deficiencies, but also due to the educational neglect of those in charge of my instruction.

For myself and many young, adolescent Black girls, the relationship between their math instructors and themselves is a significant factor in their math success; as the presence of positive, welcoming, and inclusive classroom environments are essential for high-level math achievement (Diemer et al., 2016). Truth be told, it's vital to ALL students' success. For Black girls in the math classroom, experiencing negative, discriminatory, and unresponsive classroom environments (and teachers) often lead to disengagement, behavior problems, and academic underachievement (Morton, 2014). Unfortunately, many of my past instructors missed the memo on building positive and supportive classroom environments. However, today's social media savvy and professional development overloaded teachers have fewer excuses for this lack of best practice knowledge. Today, if teachers want to encourage more math-minded and successful Black female math students, they must utilize more culturally responsive practices, hold positive and high expectations of them, build positive relationships with them, and provide more collective and social learning opportunities during math instruction (Newhouse, 2020).

Image Credit: Freepik.com

Culture is Central to Learning.

In a nation that is becoming more linguistically and ethnically diverse, it has become imperative that all school educators acquire the knowledge and skills necessary to effectively teach and interact with culturally and linguistically diverse students (Pang, 2018). Culturally responsive practices such as culturally responsive pedagogy, authentic pedagogy, and equity pedagogy seek to eliminate current achievement gaps and provide more equitable and positive school outcomes for all students (Booker & Lim, 2018; Gay, 2010, Jackson, 2013). Teachers' understanding of these responsive pedagogical practices is essential to increasing mathematics achievement for their Black female students. As culturally responsive teaching uses the "cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning encounters more relevant to and effective for them" (Gay, 2010, p. 31); teacher

knowledge of culturally responsive practices, cultural competence, and growth in critical consciousness are an essential knowledge basis for success (Jackson, 2013). Teachers with critical knowledge of the connections between culture and academic performance are more successful in teaching their Black girls when they incorporate these practices in their everyday math teaching (Jackson, 2013).

Teacher Perceptions Matter

However, culturally responsive pedagogy in math is not the only effective practice for increasing positive perceptions and abilities in math for Black girls. Teachers not only need to know their students culturally and individually, but they also need to know themselves. Teachers knowing themselves means teachers must spend more time stopping and thinking about who they are and the unexamined assumptions and beliefs they come into the classroom with (Gay & Kirkland, 2003). Teachers need to have ample opportunity to examine how their own racial, ethnic, socioeconomic, gender, religious, or political beliefs influence their beliefs about what a good math student looks like, acts like, sounds like, and thinks like. They need to check their assumptions about their diverse students' math capabilities as many teachers hold deficit views about Black students and their readiness to perform high-level math tasks and operations (Davis & Martin, 2018). As a result, those students,

Image Credit: pch.vector

who initially may have felt like a competent and capable math student, sense their teacher's apathy or lack of care regarding their academic success, and enter into a self-fulfilling prophecy and perform accordingly (Jett, 2013). Just as I performed poorly for teachers, I deemed unresponsive and uncaring, many of our students today are doing to same. Critical self-reflection among math educators is essential in helping teachers become familiar with their privileges, issues, and experiences that have shaped them and their math teaching practices. It is also essential in overturning harmful math classroom environments and creating positive and supportive ones capable of holding high expectations of all students.

What Do Black Girls Want/Need from Their Math Teachers?

For teachers to create these positive math environments for Black girls, they also need to take into consideration what Black girls are saying they need from their math teachers. Research conducted by Vanderbilt University professor Dr. Nicole Joseph (Joseph et al., 2019) shed light on this as her study found that Black girls crave social interaction and want to build positive relationships with their teachers. She suggests teachers utilize this knowledge by taking time to get to know their Black female students through autobiography assignments and regularly asking students about their lives. She notes that this simple strategy's effectiveness works because when students feel cared for, they become motivated to work harder (Joseph et al., 2019).

Her study also found that Black girls also valued collaborative learning in their math classrooms (Joseph et al., 2019). Allowing Black girls to work together with other students in partnerships or small groups increased their chances of success in math classrooms. Combining these techniques with culturally responsive teaching and communicating high expectations creates a winning scenario for Black girls to succeed. Ultimately, these practices work together to humanize the math experiences for Black girls that are often missing and much-needed in math classrooms at large.

Teachers Must "Be the Change."

Ultimately, teachers have the power to reverse the trends of underachievement in mathematics instruction for their Black female students (NAEP, 2019). With the help of culturally responsive practices, high expectations, social interactions, and collaborative learning experiences, teachers can help their Black students flourish in the math classroom (Johnson et al., 2019; Minor, 2016). Maybe if I had more consistent, positive, and culturally responsive educators during my secondary career, my math aversions of today could have been avoided. Thankfully, there is still time for the young Black girls in the classrooms of today.

Today, the underrepresentation of Black women in science, technology, engineering, and math fields (STEM) can be reversed as teachers begin to recognize and cultivate the math genius in ALL students (Jett, 2013). Hopefully, the educators in today's multiracial schools know that every student deserves the opportunity to feel welcomed, valued, and inspired by their educational experiences. Today's teachers can begin to share the responsibility of

encouraging the next generation of Black female mathematicians, scientists, and engineers. In this new shared accountability, the current and constant rates of underachievement of young Black girls in math will become a thing of the past as teachers' math practices will finally decide to move in the direction that best fits the needs of all students, not just the ones society says are worthy of achievement.

Salandra Grice, M.Ed. is a former elementary school teacher, the author of The Conscious Educator, and the founder and lead consultant of Conscious Education Consulting, LLC. She focuses on providing high-quality and transformative professional development and coaching experiences for educators in culturally responsive, equity-focused, and anti-bias/anti-racist practices.

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Flag Designs of African Countries:

Enriching the Graphing of Linear Equations and Inequalities in Algebra

By Kelly Wamser Remijan

A mathematical investigation of the flags of Africa can open opportunities for students to recognize the continent of Africa as the birthplace of mathematics (AncientAfricanHistory.org, n.d.) and become more globally aware. Furthermore, students of African ancestry can experience their interests and cultures centered in their mathematics class. A study of flags can also open students' eyes to recognize there are many and diverse countries that make up the continent of Africa.

As many flag designs can be modeled using linear equations or inequalities bounded by a discrete domain and range, this article provides teachers with examples of how they can promote diverse cultures through the integration of African flags in activities that engage students in the graphing of linear equations and inequalities, as well as build geometric extensions related to aspect ratio.

When teachers integrate flag design into the Algebra classroom, students have the opportunity to engage in activities that reinforce mathematical concepts, enrich mathematical connections, utilize technology, and encourage mathematical extension and creativity. Additionally, flag-based activities provide math teachers with the opportunity to reference diverse cultures and promote discussion through connections related to art, history, and geography. While I have integrated flag designs of various countries from around the world into both algebra and geometry curriculum (Remijan, 2020a, 2020b), and recommend that flags from various regions of the world be represented to promote global awareness, this article provides teachers with a starting point involving two examples of "Student Worksheets" integrating African flags into algebra classes. Following the two sample worksheets, teachers will acquire ideas for discussion and recommendations for an extension.

Mathematical Concepts/Objectives:

- Write equations or inequalities of a given flag graphed on a coordinate plane with a certain domain and range.
- Graph linear functions and inequalities to model the flag of a given country.
- Apply the concept of aspect ratio to model or re-imagine the flag of a country.

Connections and Extensions:

- Utilize graphing technology such as Desmos as a tool to check solutions or to create the design of a flag using mathematical concepts.
- Research and discuss flag design, history, and geography of various countries.
- Imagination and Creativity:
- Re-imagine a flag design for a country.
- Re-create a new flag for a country.

Figure 1. Student working with the flag of the Republic of the Congo

Exploring Flags of Africa with Linear Equations: Eswatini and the Democratic Republic of the Congo

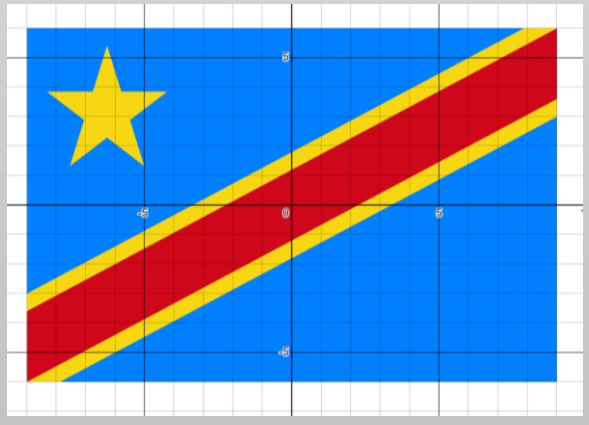
Introduction. The continent of Africa is considered to be the cradle of civilization as well as the birthplace of mathematics. As such, the oldest mathematical instrument, believed to be 35,000 years old, was a measuring device in the form of a baboon bone found in the southern part of Africa in what is now the Kingdom of Eswatini (formerly known as Swaziland). Additionally, the earliest form of advanced mathematics, dated to be 20,000 years old, also utilized baboon bones but was found in the central part of Africa in what is now the country of the Democratic Republic of Congo (formerly known as Zaire). Source: http://www.taneter.org/math.html

Reinforcement of Mathematical Concepts

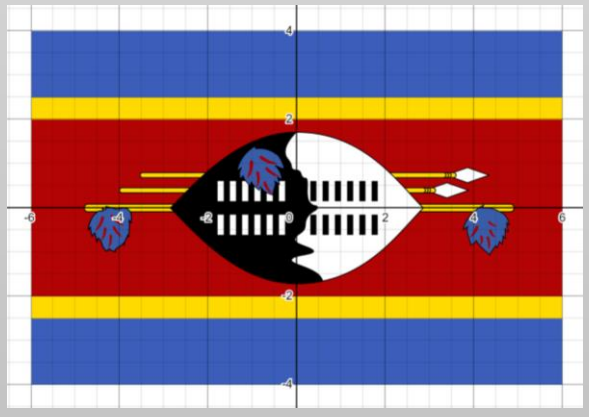
a. What are the dimensions of each flag? What is the aspect ratio for each flag?
b. Model the upper, lower, left, and right borders of each flag with linear equations restricted by a discrete domain or range.
c. Model the lines that create the red region of each flag with linear equations restricted by a discrete domain or range.
d. Test your equations and restrictions using technology:
   - Kingdom of Eswatini: use https://www.desmos.com/calculator/6ukmnbdgda
   - The Democratic Republic of the Congo: use https://www.desmos.com/calculator/xpfutri2de

Research of the History, Geography, and Significance of the Flag Design

a. When were these flags adopted?
b. What ocean borders these countries?
c. How many countries border these countries?
d. What do the colors and symbols of the two flag designs represent?



Flag of the Democratic Republic of the Congo graphed on a coordinate plane.



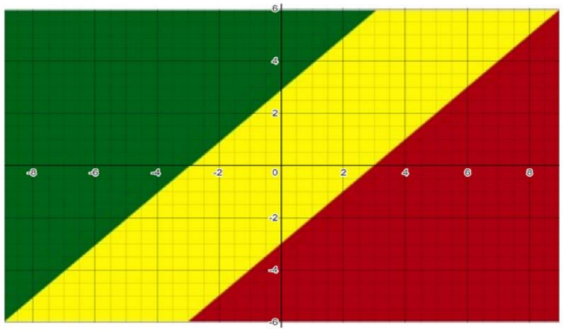
Flag of the Kingdom of Eswatini graphed on a coordinate plane.

Exploring Flags of Africa with Linear Inequalities:
Republic of the Congo and Nigeria

Exploration #1

Introduction. The Democratic Republic of the Congo and the Republic of the Congo, former colonies of Belgium and France respectively, and are two different countries located in central Africa named after the Congo River which serves as a partial border separating the two countries. Source: https://youtu.be/yA4uvWhvmHw

From a global perspective, the colors of the flag for the Republic of the Congo, also known as Congo-Brazzaville, are representative of Pan-African colors used as a sign of admiration and solidarity by several African countries in recognition of Ethiopia's flag and the country's ability to remain primarily independent during colonial times. From a national perspective, the green portion of the flag symbolizes the agriculture and forest of the country, yellow symbolizes the friendship and nobility of the people, and red is unexplained. Source: www.britannica.com/topic/flag-of-the-Republic-of-the-Congo



Flag of the Republic of the Congo graphed on a coordinate plane.

Mathematical Connections

a. Model the green region of the flag with a linear inequality restricted by a discrete domain & range.

b. Model the red region of the flag with a linear inequality restricted by a discrete domain & range.

c. Test your inequalities and restrictions: https://www.desmos.com/calculator/cve9mtcwmm

Pan-African colors can refer to two different sets of colors: (1) green, yellow, and red inspired by Ethiopia and its ability to remain independent during colonial times or (2) red, black, and green

defined as Pan-African colors in 1920 by the Universal Negro Improvement Association and African Communities League (UNIA-ACL) in response to a racist song.

d. With Desmos not offering yellow as a color option, reimagine the flag for the Republic of the Congo as a design containing a black diagonal instead of a yellow diagonal. Model the black region with a compound inequality restricted by a discrete domain & range, then continue to test your compound inequality on the graph that was used earlier in part c.

Besides defining Pan-African colors to be red to represent the blood that unites all the people of African ancestry, black to represent black people, and green to represent the abundant natural wealth of the land of Africa, the UNIA-ACL created a flag with these three colors that is now considered the "Pan-African Flag." Sources: https://www.fox10phoenix.com/news/the-pan-african-flag-started-as-response-to-bigotry-it-became-an-enduring-symbol

e. Using an aspect ratio of 2:3, hand-sketch the "Pan-African Flag" containing three equal horizontal bands of red, black, and green.

f. Model the red, black, and green regions using various inequalities and restrictions.

g. Graph your inequalities and restrictions using https://www.desmos.com/calculator.

Exploration #2

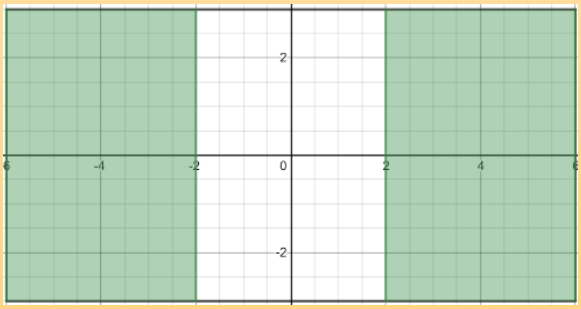
Introduction. Nigeria, located in West Africa along the Gulf of Guinea, is a former British protectorate that received independence in 1960. The current flag of Nigeria, also adopted in 1960, was designed by a Nigerian student whose creation was selected from among 3,000 submissions. The flag, with a 1:2 aspect ratio, contains two green vertical bars representing agriculture and one white vertical bar representing peace and unity. Source: www.britannica.com/topic/flag-of-Nigeria

Mathematical Connections

a. Model the upper, lower, left, and right borders of the Nigerian flag with linear equations restricted by a discrete domain or range.

b. Model the green regions using linear inequalities and a discrete domain and/or range.

c. Graph your linear inequalities and restrictions using www.desmos.com/calculator



Flag of Nigeria modeled by inequalities bounded by a discrete domain and range.

Exploration #3

Introduction. As the current flag of Nigeria is a simple design created by a Nigerian student who took part in a flag design competition, you are invited to take part in a flag design competition where you can pursue the mathematical replication or reimagination of a flag for a country of your choice that speaks to your culture, ancestry, or interest.

Mathematical Extension

a. Identify the name of your selected country.
b. Where is your country located?
c. Write the equations and/or inequalities as well as restrictions on domain and range that would model your flag.
d. Graph your equations and/or inequalities as well as restrictions using Desmos.
e. Explain your rationale behind the selected aspect ratio, design, color choices, etc.

Discussion

The "Student Worksheets" showcased in this manuscript can be used as an exploration tool as well as an extension and discussion springboard. Before the exploration of African flags using Desmos, however, students should have the opportunity to become familiar with Desmos as a graphing tool and should be aware that restrictions on domain and range can be added to the end of an equation or inequality using braces as shown in Figure 2.

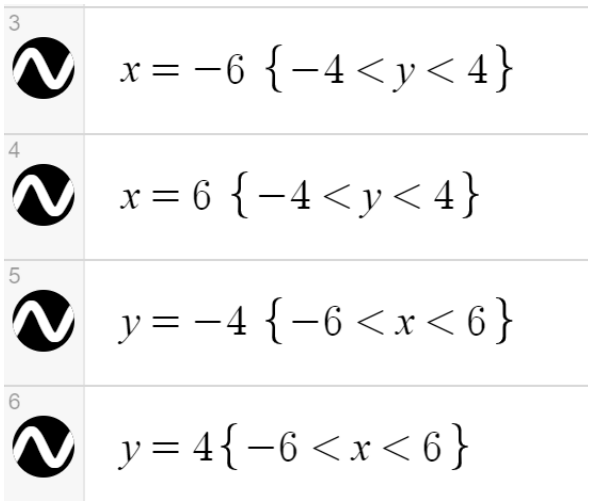


Figure 2. Linear equations and restriction on the domain and range for the left, right, lower, and upper boundaries that make up the flag for the Kingdom of Eswatini.

The explorations described in these worksheets help guide students in ensuring that the mathematical learning objectives are achieved. Additionally, extensions involving the creation of re-imagined flags provide students the ability to be creative and show mastery of the concept.

Each exploration offers an opportunity for further discussion to occur regarding the history, geography, or culture of the country connected to the flag, and, depending on the comfort level of the teacher, teachers could promote discussion on topics beyond the scope of the tasks. For instance, after reading the background information about Nigeria and after replicating the flag, a discussion could lead to the topic of Nigeria being the site of where the Transatlantic Slave Trade began in the 15th century (Religious Literacy Project, n.d.). Common ideas that slavery may have profited

not only Europeans but also some African tribes could be discussed, specifically the have different perceptions of slavery held by Europeans and Africans, where the former practiced chattel slavery in which people were thought of as property and the latter viewed a captured man or woman as working to earn freedom back.

With a history of diverse tribes fighting among each other to acquire war captives to turn into slave captives (Religion and Public Life, n.d.), the white portion of the flag for present-day Nigeria could be discussed as representing peace and unity among all groups throughout the country (Smith, 2001). Furthermore, with the green portions of the flag symbolizing the importance of agriculture to the country, with 70% of the population economically dependent on the agricultural sector (Odetola & Etumnu, 2013), a discussion could occur on how the stability of a country's economy can often determine whether a country will remain unified and peaceful.

Conclusion

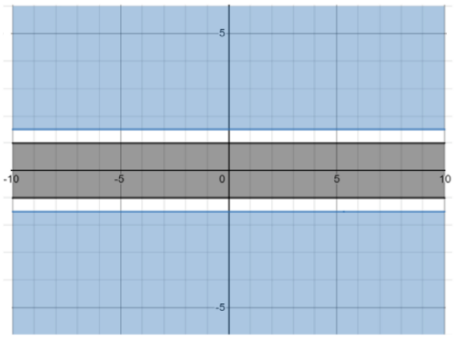


Figure 3. A graph of the flag of Botswana


Figure 4. The flag of Eritrea

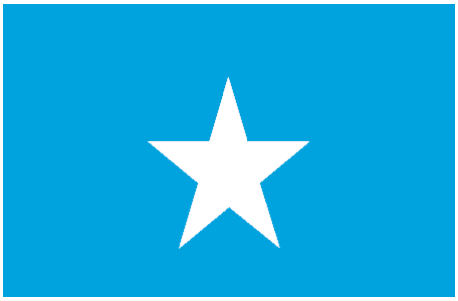


Figure 5. The flag of Somalia

While Desmos was highlighted in all explorations, it is important to note that GeoGebra could also be used as an alternative. Additionally, flags could be graphed by hand; however, the use of technology can assist the student as a checking tool which helps support student learning of mathematical concepts.

There are numerous flags of countries throughout Africa that could be explored to enrich the graphing of linear equations and inequalities. Flags such as Botswana (Figure 3) provide flag designs involving only colored regions subdivided by line segments, but other African flags containing emblems (Figure 4) or stars (Figure 5) should also be considered. Flags containing symbols can be used either by disregarding the emblem when writing the equations or inequalities or by focusing on the symbol such as writing the equations that make the various segments forming a star.

High-quality mathematics experiences are those that engage students through the reinforcement of mathematical concepts, the enrichment of mathematical connections that utilize technology, and the encouragement of mathematical extension and creativity. As such, algebra teachers should consider utilizing African flags, along with flags of other countries, to engage students in the graphing of linear equations and inequalities bounded by a discrete domain and range. Whether students are learning in a classroom or learning in a remote setting, activities with flag connections that integrate technology with mathematics, as well as other subjects, provide students with the opportunity to extend their learning and problem-solving skills. Such experiences, in turn, help to make the learning and reinforcement of mathematics concepts more interesting and more meaningful.

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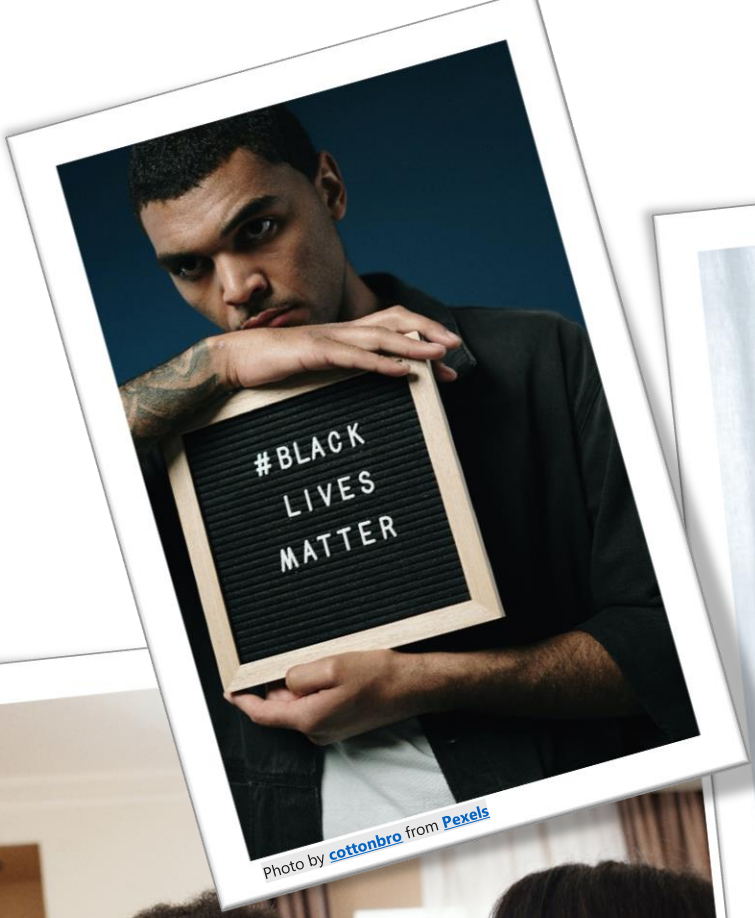

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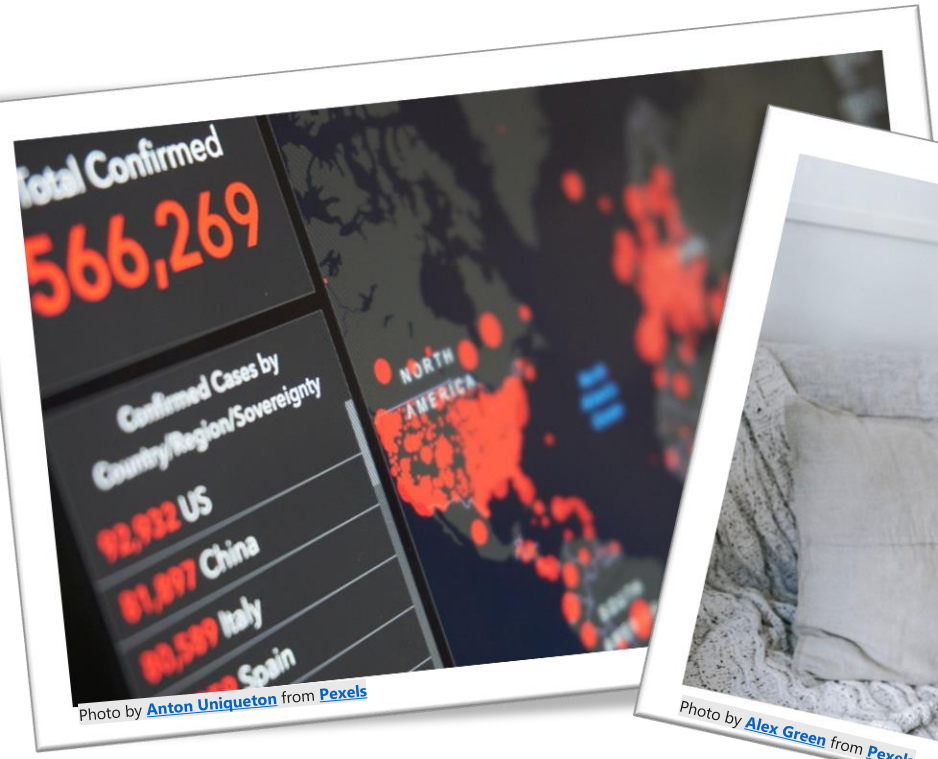

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COVID-19 and its Disparate Impact on Black Families

By Debasmita Basu and Hong Nguyen

In the year 2020, we have seen COVID-19 bring the entire world to a halt, upending stability in families, communities, and economies all over the globe. If we take a closer look, though the impacts have been global in scale, data suggests that the virus has disproportionately affected people belonging to racial or ethnic minority groups (Price-Haywood et al.,2020; Stokes et al., 2020). In the United States, though African Americans comprise only 13% of the country's population, as of June 2020 about 30% of the COVID-19 cases in the US were African Americans, whereas their White counterparts accounted for only 9% of the total number of cases, as reported by the Centers of Disease Control and Prevention (Poteat et al., 2020).

Furthermore, there exists a stark difference between the mortality rate of the African American community and the White community. According to the APM Research Lab (2020), as of July 22, 2020, for every 100,000 Americans, about 74 back people died due to COVID-19 compared to 32 Whites, thus indicating that the mortality rate of the African Americans significantly stands taller than the mortality rate of White Americans.

COVID-19 has widely exposed economic and social disparities that have dug their trenches in our society long ago. It often takes adversity to bear the absolute truth and in 2020, COVID-19 is that stark adversity that did so.

In the US, most of the low-income jobs are held by people of color. Usually, these low paying jobs, which include jobs in retail, hospitality, and childcare, have limited opportunity to work remotely (Brown, 2020). According to the Bureau of Labor Statistics, before COVID 19 only 19.7% of the jobs held by African Americans were fit for remote operation, compared to 30% of the jobs held by White people (Gould & Shierholz, 2020). Furthermore, people of color working in low-income jobs have limited access to health insurance, due to which they are at higher risk in matters of health (getting timely as well as quality healthcare), and are thus more vulnerable to the virus causing COVID-19 due to the necessity for in-person attendance at their essential jobs.

Another factor leading to a disproportionate number of African American people being affected by COVID-19 is the stark wealth disparity between the White and the Black families. According to the US Census Bureau report, in 2018 where only 8% of White people lived under the poverty line, the percentage of African American people living under the poverty line was 21% (Semega et al., 2019). According to the Racial Wealth Divide Report (Collins et al., 2018)., the median White household has 41 times more

"COVID-19 has widely exposed economic and social disparities that have dug their trenches in our society long ago. It often takes adversity to bear the absolute truth and in 2020, COVID-19 is that stark adversity that did so."

Lesson: Racial Earning Inequality

This lesson is designed to engage students in a discussion around the disproportionate impact of COVID-19 on the African American community. Students will apply their prior knowledge of plotting ordered pairs and percentages to explore and compare the real median earnings of White males, White females, Black males, and Black females from 2007 to 2017. Hopefully, the lesson will enable students to reflect on how earning inequality across the different ethnic/racial groups left one more vulnerable to the pandemic over the others. Further, students will use their critical thinking skills and problem-solving strategies as they apply and attain mathematical content knowledge. Teachers are invited to modify the lesson based on the anticipation of their students' prior knowledge and experience.

Resources and Materials (In order of their appearance during the lesson)

- Video: COVID-19 Pandemic: Why are African Americans more affected by the virus? https://www.youtube.com/watch?v=dhP1fdrBjrQ
- Grouping Guidelines
- Worksheet 1, Real median earnings of full-time, full-year White male workers, 2007–2017 (For students belonging to group 1)
- Worksheet 2, Real median earnings of full-time, full-year Black male workers, 2007–2017 (For students belonging to group 2)
- Worksheet 3, Real median earnings of full-time, full-year White female workers, 2007–2017 (For students belonging to group 3)
- Worksheet 4, Real median earnings of full-time, full-year Black female workers, 2007–2017 (For students belonging to group 4)
- Graph paper (1 piece per student)
- Stationary: Pencils, rulers, colored pens, erasers.
- A-4 size papers for creating flyers.

as the sum of assets held by a family minus total household debt) than the median Black family, thus keeping the latter less prepared for unprecedented situations such as COVID-19. A sudden stoppage in income can have more drastic impacts on the ones below the poverty line as compared to the ones who benefit from higher levels of income. People working in lower-paying and less stable jobs have limited options to take time off of their work and are at a higher risk of exposure to the virus causing COVID-19. It certainly raises the ugly questions on survival versus making oneself available for the jobs, and no option to stay away from exposing themselves to the virus. The Benjamin Banneker Association, Inc. (BBA) defined social justice curriculum as lessons that would "facilitate students' critical examination of the world and critical consumption of information and engage the larger community beyond the classroom walls" (2017, p. 2). They further added, "When students are taught mathematics through the thoughtful implementation of a social justice curriculum, they have learned not only mathematics concepts and skills, but more importantly they… are empowered to apply this knowledge and other skills to examine additional cultural and societal phenomena" (BBA, 2017, p. 5). Consistent with BBA's position statement, the lesson we share here, targeted at upper elementary or lower middle grades, was developed to examine the issue of income inequality across the different ethnic/ racial groups, especially African Americans and the Whites, that left one group more vulnerable to the pandemic over the others.

The lesson will focus on the real median earnings of White males, White females, Black males, and Black females from 2007-2017

Launch (20 minutes)

1. Show students the video COVID-19 Pandemic: Why are African Americans more affected by the virus? The video shows how COVID-19 has disproportionately affected the African American community.
2. Ask students to note down what they notice and wonder while watching the video.
3. Facilitate a whole-class discussion asking students to share what they noticed in the video. Teachers might like to ask the following questions to guide the discussion:
    a. *What is the video all about?*
    b. *What did you find most compelling about the video?*
    c. *What are some of the reasons because of which African American people are disproportionately affected by COVID 19?*

Explore (90 minutes)

Part 1. Divide the students into four groups: Group 1, Group 2, Group 3, Group 4.

1. Give each student a worksheet and a graph paper.
    a. *Give worksheet 1 to Group 1: real median earnings of full-time, full-year White male workers, 2007–2017*
    b. *Give worksheet 2 to group 2: real median earnings of full-time, full-year Black male workers, 2007–2017*
    c. *Give worksheet 3 to group 3: real median earnings of full-time, full-year White female workers, 2007–2017*
    d. *Give worksheet 4 to group 4: real median earnings of full-time, full-year Black female workers, 2007–2017*

and examine (1) how the real median earnings of the each group changed over the years (horizontal analysis) (2) at any given point of time, how the real median earnings of one group, say White males, has different from the real median earnings of the other group, say Black females (vertical analysis). The lesson would demand students to analyze the patterns in a given set of data and mathematical graphs, examine the connections between them and reflect on how people belonging to certain racial/ ethnic groups are victims of deep-rooted systemic inequities and unfair practices, over the others (Frankenstein, 1999; Gutstein, 2005). We hope that as students would engage deeply in this research, they would identify themselves in the data, see a neighbor, an acquaintance, or two in it, and would initiate an interesting and provocative conversation around income inequality and its longstanding impact on people's health and social lives.

Although we have not yet had the opportunity to implement this lesson, we are hopeful that it will help students to develop a shared understanding of the disparate impact of COVID-19 on the African American community and the causes behind it. The introductory video will straightaway introduce students to the topic and provide them an opportunity to reflect on the different factors that might make African American people working in low-income jobs more vulnerable to the virus compared to the others. To develop a data-driven argument on the topic, students will apply their mathematical reasoning of graphs and percentages and compare the real median earnings of White and Black males and females over the past ten years. We hope that the mathematical activity would provide students a platform to identify the long-lasting social issue of earning inequality and recognize its connection to the present unprecedented situation.

2. Ask students belonging to each group to check the real median earnings of their corresponding population, from 2007 to 2017, and plot the year-real median earning ordered pairs on the graph paper.
3. Next, ask students to focus on the graphs and analyze how the real median earnings of their corresponding population have changed from 2007 to 2017.
4. As each group analyzes the graph, ask them to consider the following guiding questions:
    a. *How the earnings of your population changed from 2007 to 2017?*
    b. *Look at the graph and identify the time (in years) when the change in real median earnings of your population is maximum.*
    c. *Calculate the (maximum) percentage of change in real median earnings of your population.*
    d. *What is the percentage of change in real median earnings from 2007 to 2017?*

Part 2. After the first part of the exploration is complete, regroup the students in the following manner:

Group A: Put students from group 1 and group 2 together. If the group size is too big, split Group A into two subgroups. Make sure that students from group 1 and group 2 are evenly represented. Students belonging to both the subgroups would do the same work.

Group B: Put students from group 3 and group 4 together. If the group size is too big, split Group B into two subgroups. Make sure that students from group 3 and group 4 are evenly represented. Students belonging to both the subgroups would do the same work.

Ask the students belonging to Group A to keep the graphs side by side (real median earnings of a full-time, full-year White male; real median earnings of a full-time, full-year Black male) and compare them. If students want, they can re-plot the income of both the groups one below the other using different colors.

Ask the students belonging to Group B to keep the graphs side by side (real median earnings of a full-time, full-year White female; real median earnings of a full-time, full-year Black female) and compare them. If students want, they can re-plot the income of both the groups one below the other using different colors.

As the groups analyze the graphs, ask them to consider the following guiding questions, and talk about their opinion with each other:

1. What do you observe?
2. <u>To Group A:</u>
    a. Examine the graphs and compare (in terms of percentage) the change in median earnings of White males and Black males from 2009 to 2010? (Justice 12, 13)
    b. In 2017, by what percentage the real median earnings of White males exceeded the real median earnings of Black males? (Justice 12, 13)
3. <u>To Group B:</u>
    a. Examine the graphs and compare (in terms of percentage) the change in median earnings of White females and Black females from 2009 to 2010? (Justice 12, 13)
    b. In 2017, by what percentage the real median earnings of White females exceeded the real median earnings of Black females? (Justice 12, 13)

Part 3. After the second part of the exploration is complete, regroup the students again in the following manner: each group will contain one student from group 1, group 2, group 3, and group 4. If any student is extra, the teacher can assign the student with another group as per their discretion.

Ask the students belonging to each group to keep all the four graphs side by side and compare them. If students want, they can re-plot the incomes of all the groups one below the other using different colors.

As each group analyzes the graphs, ask them to consider the following guiding questions:

1. What did you observe?
2. Looking at the shapes of the graphs, how would you interpret the change of median earnings for White males, Black males, White females, and Black females from 2007 to 2017? Explain your answer.
3. How are the earnings of Black males different from the income of White females? (Justice 12, 13)
4. How are the earnings of White males different from the income of Black females? (Justice 12, 13)
5. Compare the percentage of change of real median earnings of White males with the percentage of change of real median earnings of Black females. (Justice 12, 13)
6. Did any of the findings surprise you?

Summary and Taking Action (20 Minutes)

1. Facilitate a whole-class discussion prompting students to reflect on long-lasting systemic health and social inequalities, and the impact of the lesson on their understanding of systemic racial discrimination. Teachers might consider the following questions to guide the discussion:
    a. Based on your exploration of the real median earnings of people of different colors and genders, how would you relate income inequality to different people's vulnerability to COVID 19 or similar pandemic situations? (Justice 12 and 13)
    b. How does this lesson impact your understanding of systemic racial discrimination? (Action 17)
2. Ask the students to create a small poster/ flyer, containing information about the potential factors that might put African American people at an increased risk of contracting COVID (Action 17). Teachers might consider the following lines as part of the instruction:
3. Create a flyer that you might like to distribute amongst your friends and family members to make them aware of the disparate influence of COVID 19 on African American people. Include all the factors that might have contributed to such an unjust condition. Be creative, make the flyer brief yet informational.

Worksheet 1

Real median earnings of full-time, full-year White male workers, 2007–2017

Plot the real median earnings of the White male workers from 2007 to 2017 and discuss in your group the following questions:

1. *How the earnings of White male workers changed from 2007 to 2017?*
2. *Look at the graph and identify the time (in years) when the change in real median earnings of White male workers is maximum.*
3. *Calculate the (maximum) percentage of change in real median earnings of the White male workers.*
4. *What is the percentage of change in real median earnings from 2007 to 2017?*

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Real median Earning	59,649	58,469	58,874	58,544	57,146	56,193	57,250	57,493	59,188	59,171	60,388

Source: https://www.epi.org/blog/black-workers-have-made-no-progress-in-closing-earnings-gaps-with-white-men-since-2000/

Worksheet 2

Real median earnings of full-time, full-year Black male workers, 2007–2017

Plot the real median earnings of the Black male workers from 2007 to 2017 and discuss in your group the following questions:

1. *How the earnings of Black male workers changed from 2007 to 2017?*
2. *Look at the graph and identify the time (in years) when the change in real median earnings of Black male workers is maximum.*
3. *Calculate the (maximum) percentage of change in real median earnings of the Black male workers.*
4. *What is the percentage of change in real median earnings from 2007 to 2017?*

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Real median Earning	42,746	42,583	42,944	41,513	43,127	41,197	42,160	42,204	42,530	42,181	42,076

Source: https://www.epi.org/blog/black-workers-have-made-no-progress-in-closing-earnings-gaps-with-white-men-since-2000/

Worksheet 3

Real median earnings of full-time, full-year White female workers, 2007–2017

Plot the real median earnings of the White female workers from 2007 to 2017 and discuss in your group the following questions:

1. *How the earnings of White female workers changed from 2007 to 2017?*
2. *Look at the graph and identify the time (in years) when the change in real median earnings of White female workers is maximum.*
3. *Calculate the (maximum) percentage of change in real median earnings of the White female workers.*
4. *What is the percentage of change in real median earnings from 2007 to 2017?*

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Real median Earning	43,549	42,673	44,132	45,392	44,057	43,761	43,549	43,347	44,556	46,725	46,513

Source: https://www.epi.org/blog/black-workers-have-made-no-progress-in-closing-earnings-gaps-with-white-men-since-2000/

Worksheet 4

Real median earnings of full-time, full-year Black female workers, 2007–2017

Plot the real median earnings of the Black female workers from 2007 to 2017 and discuss in your group the following questions:

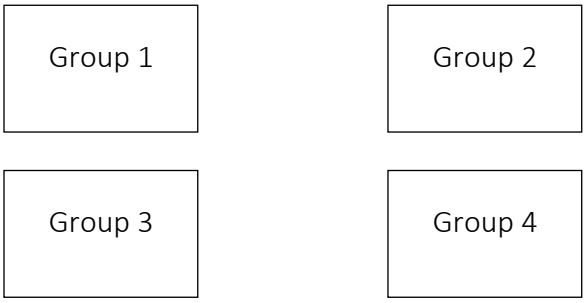
1. *How the earnings of Black female workers changed from 2007 to 2017?*
2. *Look at the graph and identify the time (in years) when the change in real median earnings of Black female workers is maximum.*
3. *Calculate the (maximum) percentage of change in real median earnings of the Black female workers.*
4. *What is the percentage of change in real median earnings from 2007 to 2017?*

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Real median Earning	36,751	35,939	36,448	36,396	36,593	36,244	35,069	34,756	37,459	37,006	36,735

Source: https://www.epi.org/blog/black-workers-have-made-no-progress-in-closing-earnings-gaps-with-white-men-since-2000/

Grouping Guidelines

Part 1



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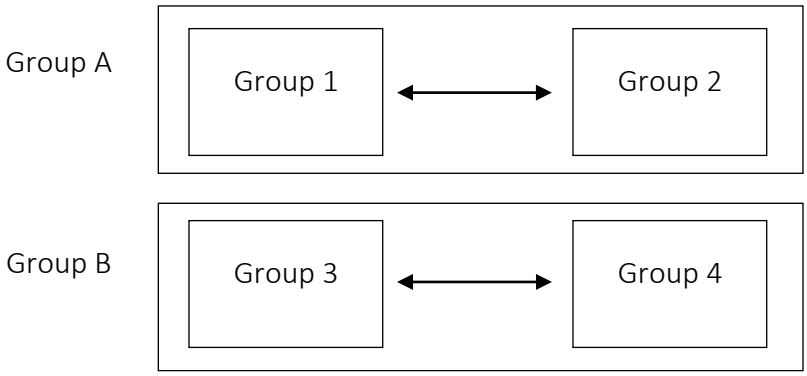

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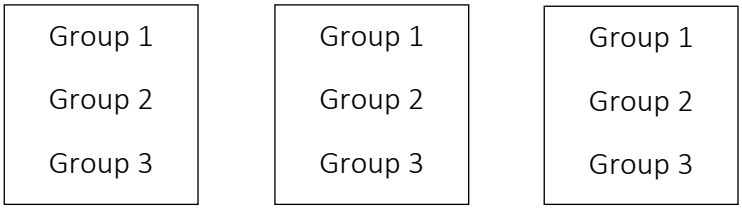

Standards

Social Justice Anchor Standards and Outcomes (Teaching Tolerance, 2016)

- ***Justice 12.*** *Students will recognize unfairness on the individual level (e.g., biased speech) and injustice at the institutional or systemic level (e.g., discrimination).* The activity will allow students to recognize how African American people, especially women, have been systematically deprived of equal pay, thus leaving them more economically insecure and less prepared for any unprecedented situations such as COVID.
- ***Justice 13.*** *Students will analyze the harmful impact of bias and injustice on the world, historically and today*. The lesson will not only help students identify the disproportionate impact of COVID-19 on the African American community over the others but will generate within them a wider consciousness about the long-standing inequalities in areas such as the economy and healthcare. Students will recognize, the pandemic has not initiated the social disparity, but has just emphasized the disparities that already existed in every strata of society for a long time.
- ***Action 17.*** *Students will recognize their own responsibility to stand up to exclusion, prejudice, and injustice.* As the closing part of the lesson, students will engage in conversation around the possible agency they can take to address the issue. Students might spark a conversation with their family and friends and build a data-driven argument to make them aware of the reality of the pandemic. They might also interview African American COVID-19 survivors, learning about their personal experiences, and create some social media posts or podcasts to share their knowledge with the community.

Mathematical Content Standards

- ***CCSS.MATH.CONTENT.5.G.A.1.*** Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., *x*-axis and *x*-coordinate, *y*-axis and *y*-coordinate).
- ***CCSS.MATH.CONTENT.5.G.A.2.*** Represent real-world and mathematical problems by graphing points in the first quadrant of the coordinate plane and interpret coordinate values of points in the context of the situation.
- ***CCSS.MATH.CONTENT.6.RP.A.3.C.*** Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.

Mathematical Practice Standards

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.

Supplementary Resources

Some supplementary resources on COVID 19 and income inequality are included below. Teachers might like to read or watch some of them to learn more about the issue and redesign part of the lesson.

1. Health Equity Considerations and Racial and Ethnic Minority Groups:
2. African Americans Disproportionately Affected by COVID-19: How Healthcare Professionals Can Help Black Patients Protect Themselves
3. Racial Economic Inequality
4. CDC COVID-19 Response Promising Practices in Health Equality II

Debasmita Basu is an Assistant Professor of Mathematics and Quantitative Reasoning at Eugene Lang College of Liberal Arts, The New School, New York City. Before pursuing her doctoral studies in the United States, Debasmita was a high school mathematics teacher in India for four years. As a teacher, she realized that students often consider mathematics as a set of rules and formulae, with little to no connection with their lives. Hence, with the greater goal to bring a change in school mathematics education, she aims to design mathematical activities that cultivate students' critical consciousness towards various social and environmental justice issues and help them realize the power and value of mathematics.

Hong Nguyen was born and raised in Vietnam. She received her BS in Psychology from Manhattan College and is currently a master's student at The New School for Social Research (NSSR). Her interest in the role that culture plays in our emotional lives stems from her living experience in different cultural contexts (she grew up in Communist Vietnam but has lived in the United States for the past five years). Her current research address how failure influences one's motivation to achieve in a cross-cultural context. Hong is interested in social justice topics such as street harassment and stereotypical threats and believes in the power of mathematics and statistics to understand and raise awareness about these issues.

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Teaching Mathematics About, With, and For Social Justice

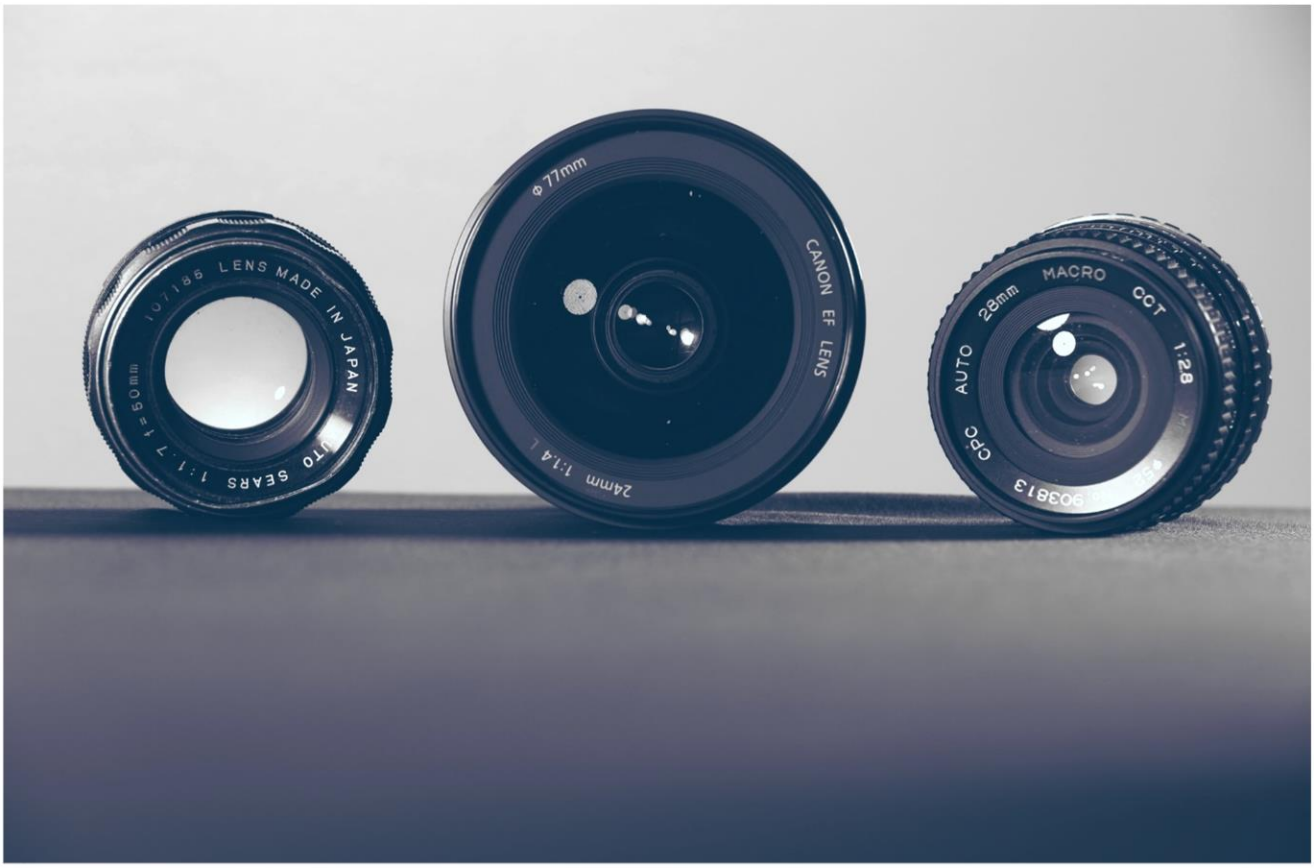


Photo by Evan Wise from StockSnap

by Robert Q. Berry III, Basil M. Conway IV, Brian R. Lawler, & John W. Staley

During 2020 many schools in the United States, and worldwide, experienced interruption due to the Coronavirus pandemic. Here in the United States, the pandemic brought to light many of the injustices suffered by individuals based on race, immigration status, social class, and gender identity. Issues of injustice and racial tensions have become even more complicated with the recent murders of Black men and women, setting off protests and the need for America and Americans to recognize and acknowledge that Black Lives Matter.

The Benjamin Banneker Association, Inc. (BBA) has been a long-time advocate for the education of Black children and sounded a wakeup call in 2017 for all stakeholders in this commitment when they released their position statement Implementing a Social Justice Curriculum: Practices to Support the Participation and Success of African-American Students in Mathematics (BBA, 2017). The position statement advocated for social justice in the mathematics classroom. It established that "a primary goal of a social justice curriculum should be to facilitate authentic, meaningful relationships between African-American students and those who are responsible for their education." BBA viewed the concept of social justice in the mathematics classroom through the following lenses:

- **With** social justice: the demeanor of classroom interactions, where the teacher uses various instructional practices that encourage equal participation and status.
- **About** social justice: planning a lesson to look at serious or even provocative issues using mathematics.
- **For** social justice: practices founded on the belief that mathematics is the tool to challenge the status quo, one that is adversely impacted by the lack of social justice.

In this article, the authors of High School Mathematics Lessons to Explore, Understand, and Respond to Social Injustice (Berry et al., 2020) unpack "with," "about," and "for" social justice so that you may be better equipped to "move from the sidewalk to the streets" (Gutstein, 2020) in your actions towards the injustices in your classroom and community.

Building your foundation for teaching mathematics "with" social justice

Teaching mathematics for social justice (TMSJ) provides opportunities to use mathematics to critique the world, understand the connections between social and cultural issues that impact people's lives, and advocate for social changes (Berry et al., 2020). Before engaging in TMSJ, teachers must first appreciate their students' cultures, understand the development of knowledge within students' cultural frameworks, and recognize that the interpretation of information and mathematics happens within students' cultural and experiential frameworks (Rubel, 2017). TMSJ goes beyond merely stating the importance of connecting mathematics teaching and learning to lived experiences and interests; it positions students as actors in their world. TMSJ is critical for four reasons:

- **Builds an informed society.** Mathematics serves a role to inform teachers and students about the lives of people, contexts, and conditions that may be different from their own (Ladson-Billings & Tate, 1995).
- **Connects mathematics with students' cultural and community histories.** TMSJ creates opportunities for deepening mathematical knowledge by connecting mathematics teaching and learning to cultural and communal histories (Ladson-Billings & Tate, 1995).

- **Empowers students to confront and solve real-world challenges they face.** This requires identifying issues that are unjust and using mathematics as a tool to analyze, critique, and confront unjust issues (Ladson-Billings & Tate, 1995).
- **Helps students learn to use mathematics as a tool for social change.** When we use mathematics to explore, understand, and respond to social injustices, we learn to use mathematics as a tool to transform inequities and create social change (Ladson-Billings & Tate, 1995).

There is much work required of teachers when planning learning opportunities that shape students' mathematical experiences, such as the decisions they make and when and how to incorporate instructional practices appropriate for their contexts. Samatha Fletcher stated:

> I would advise educators to be very detailed in planning out how these lessons [social justice mathematics lessons] are rich in math concepts. If a social justice lesson is very tied to the mathematics that we are required to teach in our classrooms, then there is never any question that it is relevant and useful. (Berry et al., 2020; p. 245).

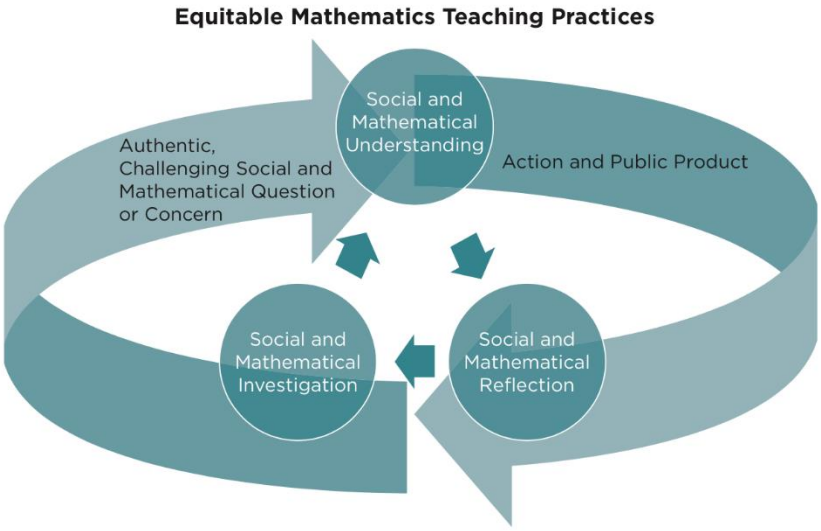
Consequently, TMSJ includes not only NCTM's (2014) eight effective mathematics teaching practices but also requires educators to understand and demonstrate pedagogies associated with four bodies of work in a nested relationship (Picha, 2019) having to do with equitable mathematics teaching (Figure 1): Standards-Based Mathematics Instruction (see NCTM, 2014), Complex Instruction (see Featherstone et al., 2011; Horn, 2012), Culturally Relevant Pedagogy (see Ladson-Billings, 1994), and Critical Mathematics Education (see Frankenstein, 1983; Freire, 2000; Powell, 1995; Skovsmose, 1995).

- Standards-Based Mathematics Instruction: SBMI emphasizes learning mathematics for understanding over attending primarily to fluency with algorithms and facts.
- Complex Instruction: A key feature of CI is valuing many different ways of being mathematically "smart."
- Culturally Relevant Pedagogy: CRP reminds us that to ensure that equitable instruction must draw on students' cultural practices, experiences, and assets, to build both academic excellence and critical consciousness.
- Critical Mathematics Education: CME extends the tenet of critical consciousness from CRP to explicitly attend to issues of power, fairness, and social justice (Freire, 2000).

Figure 1

Equity-driven Mathematics Teaching Frameworks—A Nested Relationship

Figure 2
Equitable Mathematics Teaching Practices (Berry et al., 2020)



Creating Lessons for Teaching Mathematics "About" Social Justice

SBMI, CI, CRP, CME, and TMSJ form a foundation for achieving the BBA's (2017) curriculum elements: self-love and knowledge, respect, issues of social injustice, and awareness-raising and social action in the mathematics classroom. Teachers can have their students explore, understand, and respond to issues of social injustice during classroom lessons. Students who value and respect others' lived experiences are more likely to pose relevant, authentic, and challenging social concerns and mathematical questions that promote social justice for all people. Teachers make this happen by valuing and amplifying students' social, political, and mathematical voices in the classroom. Andrew Reardon stated,

> I intentionally try to do this lesson [Culturally Relevant Income Inequality] as early in the year as possible. Every time I've done this lesson, I've left at the end of that week feeling like my students were more connected to each other. I feel that this work really deepens trust, especially across different racial and ethnic groups in an integrated classroom. It allows for the sharing of stories and experiences that allow students of all backgrounds either windows or mirrors into those truths. When we drive toward a solution to such a large social problem, the answer almost has to be "together," and I don't think this truth is lost on students. Without exception, students never fail to motivate me with their solutions and belief that they can change the world. (Berry et al., 2020; p. 241).

The teacher plays a critical role in students' educational experience by bringing forward important mathematics and social issues to be learned. The way student voices are elevated in the classroom is critical to implementing a social justice mathematics lesson (SJML). The intersection of these experiences and questions begin the traditional teaching process for an SJML, as seen in the circular diagram (Figure 2).

Often, the "challenging social and mathematical question or concern" generated by students, along with the "action and public product," extends outside the classroom into the school community and continues to evolve based on previous actions and students' power to respond to the injustice. However, during the classroom teaching episode, the teacher can create opportunities that deepen students' mathematical and social understanding through purposeful investigations that encourage reflection to develop their critical consciousness.

As students complete an SJML, it is important to note that three inner elements seen in Figure 2 are not mutually exclusive, likely realized throughout a lesson at different points for different students. Allowing students to grapple with the lesson's social and mathematical goals simultaneously is important and should be handled with care. While some students may be wrestling to make sense of data or understand a mathematical analysis, another may be confronted with data or mathematics that dispels a former belief. Allyson Lam stated,

> For some students, looking at data about our under-resourced neighborhood was, initially, extremely discouraging. They didn't need another reminder that our school was considered "low performing" or that our ZIP code was poorer than those surrounding ours. I had to be intentional about how I framed our lesson [Do Postal Codes Predict Test Scores?] so that, through our conversation and analysis, students could be engaged, equipped, and empowered by the math, and not weighed down by the statistics that often reinforce negative stereotypes about our school and neighborhood. (Berry et al., 2020; p. 243).

Teachers should be attentive to the intersection of mathematics and social injustice and establish and attend to goals specific to each domain—math and social justice (cf. Teaching Tolerance, 2016). A teacher may consider using a two-way table while teaching an SJML to help in purposefully anticipating, monitoring, selecting, sequencing, and connecting (Smith & Stein, 2011) the mathematical and social justice goals of the lesson (Figure 3). In individual cells, teachers may jot down notes to help facilitate productive discourse during the teaching episode that values students' voices, deepens mathematical/social understanding, and builds positive mathematical/social identities. In the example provided below taken from Berry et al. (2020), the teacher anticipated and took notes of students' mathematical solution pathways while noting their immigration experiences.

Some cells contain a parenthetical notation to identify an order; these ideas will be facilitated by the teacher for inclusion in whole group discussion. This lesson's leftmost vertical column was divided to include the different mathematical goals for the lesson or potential solution pathways. The horizontal top row was created by the teacher anticipating potential experiences and perspectives from the class. Individual specifics for groups and students were then recorded in each cell of the monitoring chart. The inside of the table was completed by the teacher while teaching the lesson.

Notes in this monitoring sheet highlighted the teacher's purposeful intent to sequence and connect the social justice and mathematical goals both separately and collectively. They asked Cheikhouna to present first, establishing an opportunity to connect students with the closeness of immigration in their classroom while also connecting to the effects of the geography on deaths. Moving from Cheikhouna to Micah, the teacher purposefully drew the students' focus towards immigration. The teacher may have allowed Micah to tell his own story of the difficulties of immigration and how they relate to mortality rates. The teacher then planned to sequence the discussion back towards the mathematics presented by calling on a specific student, Michael, to revoice that mathematics presented, which may have been highlighted more deeply in Micah's story. When we use monitoring sheets when teaching mathematics with, for, and about social justice, we allow time for student voices and experiences to be valued and drawn upon to make a deeper sense of the mathematics.

Enacting a Vision of Teaching Mathematics "For" Social Justice

The third lens (BBA, 2017) for incorporating social justice in the mathematics

classroom for a teacher's practices and students' responses are "founded on the belief that mathematics is the tool to be used to challenge the status quo that is adversely impacted by the lack of social justice" (p. 1). This can and should be the natural cycle of SJML, a process launched by student's authentic and rich question or concern about their school, community, or world (lives) that through mathematization—investigation, understanding, and reflection—they are compelled to take action or create a public product (Figure 2; Berry et al., 2020). Laura Gorrin stated,

> On the first day of school this year, I mentioned this activity to my new students as the kind of math I was passionate about. One student, who is repeating the class I'm teaching, wrote to me that that kind of lesson ["BBQ Becky," Policing, and Racial Justice] was what made her care about math. After another lesson, a parent told me about her son debating minimum wage from the back seat of the car. (Berry et al., 2020; p. 247).

Once students have mathematized and investigated a social injustice, more in-depth understanding and awareness is a personal growth outcome that might be expressed in the way an individual interacts with others through deeper learning about identity, diversity, and justice (Berry et al., 2020):

- **Identity**—how we view ourselves;
- **Diversity**—how we view others and their perspectives; and
- **Justice**—how we view fairness and unfairness, unequal power relations, and the impact of bias.

However, unless some form of action is included in a lesson, the work to teach mathematics for social justice misses a key component—for students to see themselves as able to have an impact on their world, as both "an actor and author of history" (Garcia, 1974, p. 16).

Figure 3

Sample Monitoring Sheet for both Mathematical and Social Justice Goals for a Lesson on Immigration

Monitoring Sheet					
	Social Story and Perspective				
Mathematical Strategies or Exploration		**Student Immigrant**	**Family Who Are Immigrants**	**Support of Immigrants**	**Other**
	Geographical Location of Deaths	Cheikhouna from group A investigated deaths in region and is an immigrant from Africa (1)	Kara's mother is an unauthorized immigrant and afraid of sharing out	. . .	Check for Michael's understanding during presentation in group A (3)
	Data Summaries of Asphyxia	Jose was separated from his parents and is unsure of their current health and whereabouts	Micah from group B—his family immigrated from Israel (2)	. . .	John—present boxplots of asphyxia data; highlight differences in mean and median (4)
	Data Summaries of Exposure	. . .	. . .	Natalie from group C volunteers at a local homeless shelter servicing a large number of immigrants (6)	Isabella—present from group C on differing death rates for exposure and asphyxia (5)
	Other	. . .	. . .	. . .	. . .

Figure 4

Anchor Standards from Teaching Tolerance (2016) in the "Action" Domain

Teaching Tolerance – Social Justice Standards Anchor Standards in the Action Domain	
16	Students will express empathy when they are excluded or mistreated because of their identities and concern when they themselves experience bias.
17	Students will recognize their responsibility to stand up to exclusion, prejudice, and injustice.
18	Students will speak with courage and respect when they or someone else has been hurt or wronged by bias.
19	Students will make principled decisions about when and how to stand against bias and injustice in their everyday lives and do so despite negative peer or group pressure.
20	Students will plan and carry out collective action against bias and injustice globally and evaluate the most effective strategies.

impact on their world, as both "an actor and author of history" (Garcia, 1974, p. 16).

The Social Justice standards developed by Teaching Tolerance (2016) provide age-appropriate learning outcomes in four domains—identify, diversity, justice, and action. Figure 4 provides an overview of the anchoring standards for these age-appropriate learning outcomes for the fourth domain, action. These anchor standards can help you as a teacher provide some framework and guidance to students' ideas about what to do with their mathematical analysis and a more in-depth understanding of the social injustice being studied. Samples of actions identified in teacher-contributed lessons (Berry et al., 2020):

- Develop and present an infographic
- Design and post informative social media posts
- Begin an informational campaign, including a variety of public service announcements (posters, flyers, other creative media)
- Organize a letter-writing campaign
- Present to a school council meeting or school board meeting
- Invite a panel of community members to discuss the topic in a public forum
- Start a community-based reading club.
- Conduct a household inventory/analysis
- Arrange a meeting with a local, county, or state government representative

An SJML must ensure the opportunity for reflection and action. As you design your lesson, consider what options you might provide for students to reflect on what they've learned and to discuss possible actions they can take to make the first steps toward addressing an injustice. How might your students share what they have learned about social injustice? How might their use of mathematics bring greater insight into the issue and position the students as an expert? Mary Candance Raygoza stated,

> "I feel motivated to want to learn more about this and make a change knowing that no one else would do it, but the ones that care. I feel like we can really make a change as long as we keep on trying." – a ninth grader's words. (Berry et al., 2020; p. 247).

Mathematics has great potential to empower students, not only to analyze complex situations but also to develop an internal confidence/positive identity. Others also view it as a powerful tool used by intelligent people. The steps of taking action and engaging in social justice curricular experiences empower students with strong

identities and agency. Through doing so in the context of your mathematics lesson, students will be equipped to stand up to the exclusion, prejudice, and bias in many contexts of their lives. By supporting them in deciding upon and designing an appropriate and effective response to social injustice, grounded in a mathematical rationale, they are rehearsing their future work as uniquely empowered activists against social injustice.

Time for Action

As teachers, parents, and students begin the new academic school year; it is paramount to make sense of the current context with a particular focus on Black Lives Matter (BLM). The BLM movement is a call to action in response to violence and anti-Black racism. Whether a teacher has all Black learners or no Black learners in their class, BLM is a context for teaching our students to explore, understand, and respond to social injustice. Teachers should create space for students to learn and explore how anti-Black policies and practices have impacted Black communities socially, economically, and politically. For example, students can use algebra, statistics, and geometry to unpack issues such as redlining in housing policy and its multigenerational impact on families and communities' economies. The BLM movement has pushed us to consider how systemic anti-Black practices and policies are still at play today. Mathematics plays an important role in acknowledging that Black Lives Matter.

Mathematics teachers should provide space for students to make sense of the current contexts of social injustice with special love and consideration for Black students' experiences. We must allow our students to teach us about the content being studied and seek feedback about the impact of our curricular choices and instructional decisions. By inviting our students to name the topics in their lives they wish to learn more about, be positioned as learners and teachers, and include "narratives of joy and resistance" (p. 50), we can avoid the dangers of enacting a curricular violence (Jones, 2020) in the name of TMSJ. Teaching Tolerance (n.d.) offers numerous instructional strategies that can help us navigate the challenging topics of injustices our students experience.

We would be remiss if we did not conclude this article with a call to action for the readers of The Lighthouse Almanac, a public action each of us might commit to that will hold us accountable for genuinely attempting to infuse social justice into our mathematics classrooms. Now is the time for each of us to step back and determine how we will teach mathematics about, with, and for social justice so that the goal of facilitating "authentic, meaningful relationships between African-American students… and those who are responsible for their education" (BBA, 2017, p. 1) becomes a lived reality.

First, commit to read or reread the following position papers. Reflect on how they inform your understanding of social justice in the mathematics classroom and what questions or wonderings you might need to explore further.

- TODOS: Mathematics for ALL. (2020). The mo(ve)ment to prioritize antiracist mathematics: Planning for this and every school year. https://www.todos-math.org/statements
- Benjamin Banneker Association, Inc. (2017). Implementing a social justice curriculum: Practices to support the participation and success of African-American students in mathematics. http://bbamath.org/wp-content/uploads/2017/11/BBA-Social-Justice-Position-Paper_Final.pdf
- National Council of Supervisors of Mathematics & TODOS: Mathematics for ALL. (2016). Mathematics education through the lens of social justice: Acknowledgment, actions, and accountability. https://www.todos-math.org/socialjustice

Next, consider the three lenses: about social justice, with social justice, and for social justice discussed in this article and the BBA (2017) position statement, and determine a starting point by envisioning what a classroom may look like and sound like that is ready to tackle the injustices of students' lives. Now identify a goal and list the steps you will take the next 3-, 6-, and 12-months to make the vision become a reality.

Finally, find at least one person to share your vision and invite them to hold you accountable, and walk with you as you bring social justice to your mathematics classroom (Staley, 2018). Reflect on the words of civil-rights leader Congressman John Lewis (2018):

> Do not get lost in a sea of despair. Be hopeful, be optimistic. Our struggle is not the struggle of a day, a week, a month, or a year; it is the struggle of a lifetime. Never, ever be afraid to make some noise and get in good trouble, necessary trouble.

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