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Los Angeles

Teaching About Economic Inequality in United States Secondary Mathematics Classrooms

A dissertation submitted in partial satisfaction of the  
requirements for the degree Doctor of Philosophy  
in Education

by

Mary Candace Raygoza

2017

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## ABSTRACT OF THE DISSERTATION

Teaching About Economic Inequality in United States Secondary Mathematics Classrooms

by

Mary Candace Raygoza

Doctor of Philosophy in Education

University of California, Los Angeles, 2017

Professor Megan Loef Franke, Co-Chair

Professor John S. Rogers, Co-Chair

Education has always been touted as a great equalizer, yet socioeconomic intergenerational mobility remains unlikely (Chetty et. al, 2014), with schools reproducing economic inequality as a “de facto socioeconomic sorting mechanism” (Duncan-Andrade & Morrell, 2008, p. 2). Young people are the next generation of civic actors who will decide how to respond to economic inequality. But do they learn about it in school? At the secondary level, while social studies courses may be a natural fit for teaching about economic inequality, mathematical knowledge and ways of thinking are essential to collecting and analyzing data about inequality as well as constructing and critiquing its representations (Gutstein, 2003).

This dissertation research examines to what extent a broad range of mathematics teachers from various backgrounds and who teach in various school contexts think about and teach about economic inequality. This mixed methods investigation draws on a representative nationwide



survey of public school secondary mathematics teachers as well as in-depth, phenomenological interviews with mathematics teachers who reported teaching about economic inequality.

A majority of teachers surveyed reported addressing economic inequality in their classrooms, predicted by factors such as teachers' level of political engagement. In interviews, teachers discussed how teaching about inequality can fulfill mathematical goals and goals of increasing students' awareness of inequality. Teachers see economic inequality lessons fitting into different mathematics courses, most notably statistics courses. They most often discussed teaching about economic inequality during particular curricular moments, with many discussing addressing economic inequality as current events arise or in relation to financial literacy.

Drawing on Ernest's (2009) framework on the nature of mathematics and Westheimer and Kahne's (2004) civic education framework, I found that how mathematics teachers approach teaching about economic inequality is shaped by how they think about the kind of mathematician and the kind of informed civic actor they hope students will become.

The study findings point to possible directions in teacher education for preparing future mathematics teachers to teach about social and political issues such as economic inequality and build students' *quantitative civic literacy*.

The dissertation of Mary Candace Raygoza is approved.

Tyrone C. Howard

Teresa L. McCarty

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2017

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## CHAPTER ONE: INTRODUCTION

*“Apart from inquiry, apart from praxis, individuals cannot be truly human. Knowledge emerges only through invention and re-invention, through the restless, impatient, continuing, hopeful inquiry human beings pursue in the world, with the world, and with each other.” - Paulo Freire*

### **Teaching about Inequality in an East Los Angeles Algebra 1 Classroom**

Before pursuing a Ph.D., I taught mathematics in a public school in East Los Angeles, a community home to the Chicano Power Movement. I sought to engage my students in lessons about societal inequality, rooted in my belief that my students can use mathematics as a tool to understand and challenge inequality. In Algebra 1 when we studied slope, students analyzed the linear relationship between family income and SAT scores. When we studied mathematical inequalities, students interrogated graphical representations of societal inequalities, such as the prevalence of child poverty before and after economic recessions in the United States. As a mathematics teacher, I sought to develop a critical pedagogy to support students to think about inequality and ultimately to transform their school, community, and world (Freire, 1970), which I recount in an article with the *Journal of Urban Mathematics Education* (Raygoza, 2016).

One of the most compelling reasons for my choice to embark on this goal was solidified in my first few weeks as a teacher. At the beginning of the school year, I asked students to write a “math autobiography” assignment (as Peterson writes about in Gutstein & Peterson, Eds., 2013). The students wrote me a letter telling me about their mathematical journeys. I structured the assignment with many questions about their past experiences with school in general and mathematics specifically and why they feel mathematics is important to learn. Most students wrote that we need mathematics to make sure we get the correct change at the grocery store.

After seeing their responses, I really wanted to expose my students to how powerful mathematics is for understanding various real-world contexts. Certainly mathematics is essential for everyday calculations, but I firmly believed my students had the power to use mathematics in ways that connected more deeply to their lives and would enable them to develop as social change agents.

Towards the end of the school year, I engaged students in a Youth Participatory Action Research unit. In this project, the students conducted a quantitative study on their chosen topic of school food injustice, after they came to know that the food served in the cafeteria at their school was vastly different from the food served at schools like Beverly Hills High School, a nearby school serving students from much more affluent and otherwise privileged backgrounds. One day working on this project in particular stands out to me as a teacher. My students were excitedly entering data from their school-wide student survey on the school food. They were still learning how to use data software when one student noticed that a column for data entry was missing. I showed her how to insert a new column. She titled it, paused, and then said, “This column is a variable, right? Yeah, yeah, *that’s a variable.*” Her tone was as if something spinning around in her mind for a while, or perhaps since she first took Algebra 1 the year prior as an eighth grader (and “failed,” as many students do), just settled into place. This moment encouraged me to conclude class that day with a discussion of the meaning of a variable, something that the students, instead of only saying “a letter that represents a number,” now attached real-world significance to as they were defining, measuring, representing, and making claims about variables related to an issue of social justice in their lives. Students had the right to voice their concerns about the healthiness and quantity of school food, but beyond those goals, I hoped students would learn about ways in which they can participate in society to make change, using mathematics.

My experiences as a classroom teacher inform my research. For my dissertation, I sought to learn how a range of mathematics teachers from across the country - teachers from various backgrounds who teach students of various backgrounds - think about teaching about inequality. Specifically, I focus on how, why, and in what ways mathematics teachers strive to teach about economic inequality because, as I began to see as a teacher myself, there are tremendous opportunities for thinking mathematically in lessons about economic inequality, and because the magnitude of economic inequality in the United States is profound.

### **Statement of the Problem**

Associate Supreme Court Justice Louis Brandeis said, “We may have democracy, or we may have wealth concentrated in the hands of a few, but we can’t have both” (reprinted in Dilliard, 1941). Economic inequality is growing in the United States (Saez, 2012). If income inequality levels were as they were forty years ago, people in the bottom eighty percent of the income distribution would be making \$11,000 more per year today (Bui, 2015). Now, the four hundred wealthiest people in the U.S. have more money than half of the population of the entire country combined (Chaiken, Dungan, & Kornbluth, 2013). Furthermore, since the recession, wealth inequality is increasing across racial lines (Kochhair & Fry, 2014) and continues to disproportionately impact women (American Association of University Women, 2015). With growing economic inequality, the majority of U.S. public school students are now eligible for free or reduced-price lunch (Layton, 2015). In California, almost one-quarter of children live in poverty; the rate is higher for Latina/o children at 31.2% and African American children at 33.4% (Bohn & Levin, 2013).

Education has always been touted as a great equalizer, yet socioeconomic intergenerational mobility remains unlikely (Chetty et. al, 2014), and schools reproduce

economic inequality as a “de facto socioeconomic sorting mechanism” (Duncan-Andrade & Morrell, 2008, p. 2). To make matters worse, educational reformers increasingly claim that being at the bottom of the economic ladder is an “excuse” for poor performance in school as they attack schools; blame teachers, students, and families; and raise the stakes of standardized tests (Kumashiro, 2012; Noguera, 2011), despite educational and sociological research pointing to the contrary (Wolf, 2007; Berliner, 2006; Lareau, 2003). Children do not enter the school gate on equal terms. Children from working class families tend to have far less access to academic supports than those from middle and upper class families (Lareau, 2003). Beyond academic supports, a lack of access to health care, dental care, early childhood education, and stable housing affect the way children develop and achieve (Noguera, 2011). Economic inequality is profound, and it has a profound impact on young people’s lives (Rogers & Westheimer, 2013).

While current political and educational leaders must address inequality at national, state, district, and school levels, young people are the next generation who will decide how to respond to inequality. A paradox of inequality manifesting in education is that school is a place where societal inequality can be studied and challenged (Duncan-Andrade & Morrell, 2008). But is it? Presently, we do not know the extent to which inequality is taught about in school (Rogers & Westheimer, 2013). While the role of critical pedagogy in educating for a more just world has been explored theoretically and with particular teachers and programs (Freire, 1970; Darder et. al, 2003; McLaren & Kincheloe, 2007; Kincheloe, 2005; Duncan-Andrade & Morrell, 2008), what teachers across the country teach about inequality is underexplored.

Schools are “a key site of civic engagement” in which students can learn about inequality (Rogers, 2014, p. 1). In 2015, the Annenberg Institute for School Reform released a set of equity-minded indicators that schools, districts, and states may utilize to evaluate schools.

One of the twenty-four indicators is “Civic Life: To what extent are students building the knowledge and skills they need to positively shape their communities? How are they affecting social change in their communities?” (AISR). While theoretical and practice-based claims assert there is great potential for academic learning and civic empowerment in lessons about inequality, we know little about what teachers believe and what opportunities students are actually presented with (Rogers & Westheimer, 2013).

It is critical to investigate what teachers teach about economic inequality in particular because most people are unaware of the magnitude of it. Norton and Ariely (2011) found that United States citizens believe there is far less wealth inequality than actually exists. When asked how much more a CEO tends to make than their workers, people dramatically underestimate the gap (Kiatpongsan & Norton, 2014). When college undergraduates were asked to predict how much of the United States population has the income to support basic living standards, the real data revealed a much smaller proportion than they guessed (Leclerc et. al, 2009).

Young people have ideas about inequality, informed by school, family, the media, and other sources. When it comes to explaining economic inequality, adolescents tend to believe that individual or fatalist causes, as opposed to structural forces, explain the economic status of a person (Flanagan, 2013; Mistry et. al, 2011; Seider, 2011; Weinger, 2000). Since young people attend school throughout childhood and adolescence at their most impressionable ages, this begs the question: What messages, arguments, and ideas do schools convey to students about the causes and consequences of economic inequality? (Chafel, 1997; Rogers & Franke, 2016). Where in school *do* young people learn about inequality?

At the secondary level, while social studies courses are certainly a natural fit to address the topic of economic inequality, mathematics education is fertile ground as a space where



students may build critical literacies to more deeply understand and challenge inequality. Mathematical knowledge and ways of thinking are essential to collecting and analyzing data about inequality as well as constructing and critiquing its representations (Gutstein, 2003). Teachers and students cannot explore inequality without mathematics. Economic inequality implies quantitative difference in income, wealth, the distribution of resources, and more. In mathematics, students can study the numbers behind poverty and economic disparity at the global, national, state, or even neighborhood level. Reports on inequality often include data representations that tell a story about justice and fairness, or a lack thereof. Mathematics presents tremendous opportunities to engage students in examinations of inequality, which are often complex and require mathematical debate (Gutstein & Peterson, 2013; Wager & Stinson, 2012).

As an example, the 2014 *Quartz* article, “Painfully, American families are learning the differences between median and mean” could inspire a lesson. Through exploring graphs of the mean and median of United States family income and net worth over time, as well as multiple other sources, students could engage in learning about how representations can show change over time, the difference between income and wealth and how they are calculated, the difference between mean and median, and the relationship between mean and median income and wealth over time. Data on income and wealth by race and gender could further add to the exploration.

What I seek to understand through this dissertation research is how mathematics teachers across the country think about exploration of economic inequality as mathematical exploration, and I am particularly interested in how they think about teaching about economic inequality in relation to their ideas about developing students as mathematicians and civic actors. Teaching about inequality in mathematics can, in addition to educating young people about a pressing issue all people living in a democracy must learn about, make the academic subject more

interesting and relevant. In mathematics classrooms everywhere, students often ask, “Why do we need to learn this?” or “Will I ever use this in life?” (Cohen, 2001). A challenge of mathematics education is to make mathematical learning interesting, engaging, and relevant for young people, especially at a time of increasing standardization, testing, and tracking that reproduces inequalities in mathematics education (Gregson, 2013).

### **Explanation and Aims of the Study**

To advance knowledge in mathematics education, this study aims to understand to what extent a broad range of mathematics teachers from various backgrounds and who teach in various school contexts think about and teach about economic inequality. This mixed methods investigation draws on a nationwide survey with a cross section of public school secondary mathematics teachers as well as in-depth, phenomenological interviews with mathematics teachers who reported teaching about economic inequality. The study reveals the prevalence of teaching about economic inequality in mathematics and the kinds of opportunities offered to secondary mathematics students to engage with economic inequality. What distinguishes this investigation from prior scholarship is that this study is one of the first to empirically examine whether and what secondary mathematics teachers are teaching about inequality. Furthermore, the participants of this study hold a range of views about inequality and the teaching of it. The research questions and sub-questions guiding this investigation are:

- 1) To what extent do secondary mathematics teachers in the United States report teaching about economic inequality in their classrooms? What rationales do they articulate for why they do or not teach about economic inequality? Across teacher, school, and community characteristics, what factors are related to whether and how frequently teachers teach about economic inequality?
- 2) In lessons about economic inequality: what mathematics content do they address, what aspects of economic inequality do they address, and how does mathematics and economic

inequality content relate? How do they strive to teach about economic inequality in the mathematics classroom?

- 3) How do mathematics teachers think about the role of mathematics education in preparing students to engage civically in issues of inequality?

The first set of questions address *who* and *why*. Posing these questions aims to provide an understanding of whether, and with what frequency, mathematics teachers reports teaching about economic inequality; what predicts this (e.g. demographics and characteristics of secondary mathematics teachers, mathematics course type and level, school type, and school and community demographics); and the rationales teachers provide for why they do or do not teach about it. The second set of questions address *what* and *how*. Posing these questions allows me to explore the kinds of curricula mathematics teachers draw on or design, including what economic inequality content they teach (e.g. wealth distribution) and what mathematical content they teach (e.g. significance testing), and how they strive to teach about economic inequality. There are many different content areas that can be addressed in teaching about economic inequality in mathematics, and there is an array of possible strategies teachers could use to address aspects of economic inequality. The third question seeks to make sense of how mathematics teachers think about teaching about economic inequality in relation to their conceptions of mathematics and civic action. What does it mean to develop a “good mathematician” who grapples with issues of economic inequality? What does it mean to develop a “good citizen” who grapples with issues of economic inequality?

### **Educational Significance**

This study contributes to the field of mathematics education by uncovering who in the mathematics teaching profession is addressing issues of economic inequality, what kinds of opportunities they offer to the students to engage with the issues, and why they feel it is

important to teach about economic inequality. This dissertation research nuances existing frameworks on mathematics education and democratic education to understand teaching about inequality in mathematics, opening a window to look at the intersection of mathematics and civic action for mathematics teachers. By uncovering mathematics teachers' narratives about teaching about inequality, we can more deeply understand present frameworks for democracy in mathematics education and continue to re-imagine how mathematics curriculum and mathematics teacher education can be improved for more authentically teaching democratically *and* teaching that prepares students to participate in a democracy. Understanding teachers' perspectives on mathematics and civic action is essential in working towards enhancing efforts in teacher education to teach about pedagogical practices and curricula that address inequality. This research reveals the conditions that support mathematics teachers in bringing inequality into their teaching and ones that make it challenging, which teacher educators may take into consideration as they prepare future mathematics teacher to navigate the complexities of developing and enacting curricula.

This research is especially timely and significant for three primary reasons. First, the Common Core State Standards for Mathematics include statements such as “Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace” (Council of Chief State School Officers, 2010). This national mathematics standard opens up spaces for teachers to address real-world problems in mathematics about inequality. It is critical to understand the ways in which teachers currently strive to do this so that we may further support teachers as they implement the Common Core State Standards. Second, this work is timely because of the increasing availability of large data sets and data representations (see *Teaching the Next Generation of Statistics Students to “Think*

*With Data*” by Horton and Hardin, 2015) as well as increasing spaces for young people to learn about and engage with data about inequality online. Finally, investigating how young people learn about inequality is essential to explore in times of growing inequality, because we need to prepare young people to address it. In addition to understanding inequality itself, young people also need to make sense of resistance to growing inequality, such as the Occupy Movement, and think about the ways in which *they* want to participate as civic actors and what their own theory of change is for improving society.

## CHAPTER TWO: LITERATURE REVIEW

### Literature Review Road Map

This review of relevant literature begins with situating my research in mathematics education scholarship; in particular, more recent social and sociopolitical turns in mathematics education research - which foreground issues of identity, power, equity, access, and agency - guide this investigation.

I then turn attention to how scholarship addresses teaching quantitative literacy to prepare citizens in a democracy. Since this literature, in large part, does not address teaching about inequality as part of quantitative literacy, I then look to what we know from scholarship on teaching about inequality using mathematical investigation, focusing on two different domains where extant research has examined this work - outside of secondary mathematics classrooms (e.g. in undergraduate Sociology courses) and within secondary mathematics classrooms. I discuss the ways in which studies reveal the promise of such teaching and argue that because of this promise we need to better understand the extent to which a broad range of mathematics teachers do or do not engage with it and how. I highlight the ways in which this study will uncover new understandings of how mathematics teachers think about the teaching of inequality.

I then argue that, to look at why, how, and to what extent mathematics teachers teach about economic inequality, I must do so through a lens of how they conceptualize developing students as civic actors and through a lens of how they think about what it means to do mathematics. My argument stems from epistemological views about how mathematics education can empower young people to improve society. I identify two frameworks that I will draw on. The first framework argues that, through curriculum and pedagogy, teachers advance a vision of

what kind of citizen they want young people to become, and that this vision is rooted in different beliefs about inequality and how it should be challenged (Westheimer & Kahne, 2004). I seek to nuance this framework, designed to describe civics education programs, to mathematics education, asserting that, in teaching about economic inequality, mathematics teachers put forth views about the kind of citizens they hope their students will become. The second framework argues that people have different conceptualizations of what it means to do mathematics (e.g. doing mathematics means undertaking an objective area of study with particular procedures and one correct answer, as opposed to participating in a socially constructed discipline to name and explore unsolved problems with no right answer) (Ernest, 2009). I argue that how mathematics teachers think about the nature of mathematics opens up different interpretations for teaching about economic inequality in the mathematics classroom.

### **Situating the Study in Mathematics Education Research**

As I investigate how mathematics teachers think about and teach about economic inequality, I assume sociocultural and sociopolitical understandings of how young people and their teachers engage in mathematics. Stinson and Bullock (2012) identify four historical “moments” in mathematics education that do not occur in a linear progression, as each has not phased out: 1) The “process-product moment” (beginning around the 1970s) quantifies learning and teaching using statistical study to connect instruction with student outcomes, such as in linking teacher instructional behavior with student outcomes on pre and post-tests in a treatment and control group; 2) The “interpretivist– constructivist moment” (beginning around the 1980s) shifts to understand the interactions between students and mathematics teachers and among students; 3) The “social-turn moment” (beginning around the mid-1980s) positions mathematics teaching and learning as social activity shaped by the contexts of students, teachers, and

mathematics and integrates sociocultural learning theories; and 4) The “sociopolitical-turn moment” (beginning in the 2000s) builds on the social turn to include a more explicit focus on issues of power and identity (Gutierrez, 2010).

The sociopolitical turn emphasizes that teaching and learning are “inherently situated in broader contexts of power and access within society” (Nasir & Hand, 2006, p. 468). Scholarship on teaching about inequality in mathematics emerges from this “turn.” This study addresses power explicitly by looking at the ways in which mathematics teachers offer opportunities for their students to use mathematics to pose questions about and construct arguments about economic power and distribution. Felton and Koestler (2015) argue: “Connecting mathematics to the sociopolitical world involves making a connection to topics that are positioned by the learner as overtly political, problematic, controversial, and/or related to an injustice” (p. 263). Additionally, I seek to understand how, in teaching their students about economic inequality, mathematics teachers think about what it means for their students to develop mathematical power and civic power. Students can learn *about* power and learn to *be* powerful (Oakes & Rogers, 2006). In lessons about economic inequality, learning about power can happen in different ways and to different extents, and there are different interpretations of what it means to be powerful as a mathematician and as a citizen. This study addresses mathematics teachers’ conceptualizations of teaching about inequality, mathematics, and citizenship.

### **Adding Quantitative Literacy and Civic Action**

*Quantitative literacy* (also referred to, sometimes interchangeably, as mathematical literacy, mathemacy, numeracy, data literacy, and statistical literacy) is one of the predominant bodies of literature that makes an argument about the relationship between mathematics education and preparing students as citizens of a democracy. In the oft-cited text *Mathematics*



*and democracy: The case for quantitative literacy*, the National Council on Education and the Disciplines (2001) argues:

Quantitatively literate citizens need to know more than formulas and equations. They need a predisposition to look at the world through mathematical eyes, to see the benefits (and risks) of thinking quantitatively about commonplace issues, and to approach complex problems with confidence in the value of careful reasoning. Quantitative literacy empowers people by giving them tools to think for themselves, to ask intelligent questions of experts, and to confront authority confidently. These are skills required to thrive in the modern world. (p. 2)

Quantitative literacy is positioned in scholarship as analogous to the reading and writing we need to navigate the world, but involving mathematical thinking that is inseparable from social contexts (Gittens, 2015; Jaafar, 2012).

Scholarship on quantitative literacy contends that mathematics education does not prepare people to sufficiently engage with numbers, data, and mathematical thinking that they need to engage in the real-world, including everyday situations, in one's career, and as a citizen (Crowe, 2010; NCED, 2001; Porter, 1997; Pollak, 1997; Wiest et. al, 2007). There is great concern that "laypersons may be relatively powerless" without quantitative literacy, that "innumerate individuals" fall victim to political or marketing arguments without quantitative literacy (Wiest, 2007). Orrill (2001) asks, "If we permit this kind of innumeracy to persist, do we not thereby undermine the very ground and being of government of, by, and for the people?" Wadsworth (1997) asks, "In what ways does our collective innumeracy impede civic discourse?" Civic issues, such as health care and tax cuts, are framed as "out of the intellectual reach of citizens who have depended on public education" (Cobb, 1997, p. 89). While discussions of quantitative literacy are within the context of a grand narrative on preparing people as citizens of a democracy, oftentimes such discussions do not acknowledge the role that systemic inequality plays in keeping people economically marginalized and instead blames people for their own

marginalization. One example is from more of the most prolific scholars on quantitative literacy.

Steen (1997) argues:

Innumeracy also perpetuates welfare, harms health, and weakens families. Without requisite quantitative skills, individuals will find it very difficult to make a transition from welfare to work. Without critical skills to assess medical claims, individuals will often fall victim to false claims and questionable treatments. Without the skills to manage a household budget, many become victims of easy credit or consumer fraud. (pp. xxvi-xxvii)

Similarly, as Baron (2015) describes a quantitative literacy program she designed for "low-income" parents entitled *Count on Yourself* - a name that directly implies personal responsibility - she argues this work is necessary because lack of financial knowledge and skills prohibits people being able to save money, that "a strong link has been shown between citizens' basic numerical or mathematical abilities and their financial prosperity and civic engagement" (Baron, 2005 citing Human Resources and Skills Development Canada, 2012, p. 83). She positions the financial literacy program for families as a Freireian approach but does not address that the program supported participants to understand and challenge inequality, which is central to Freire's (1970) philosophy of education. Both examples reveal deficit views of economically marginalized people and do not acknowledge structural explanations of inequality.

Quantitative literacy is often positioned as important for economic access or success but less often as "a key ingredient in the formation of an informed and engaged citizen in contemporary democratic society" (Root, 2009). The following excerpt from *Mathematics and democracy: The case for quantitative literacy* (NCED, 2001) represents common ways in which quantitative literacy for citizenship is represented:

Citizenship:

Virtually every major public issue—from health care to social security, from international economics to welfare reform—depends on data, projections, inferences, and the kind of systematic thinking that is at the heart of quantitative literacy. Examples:

- Understanding how resampling and statistical estimates can improve the accuracy of a census
- Understanding how different voting procedures (e.g., runoff, approval, plurality, preferential) can influence the results of elections
- Understanding comparative magnitudes of risk and the significance of very small numbers (e.g., 10 ppm or 250 ppb)
- Understanding that unusual events (such as cancer clusters) can easily occur by chance alone
- Analyzing economic and demographic data to support or oppose policy proposals
- Understanding the difference between rates and changes in rates, for example, a decline in prices compared with a decline in the rate of growth of prices
- Understanding the behavior of weighted averages used in ranking colleges, cities, products, investments, and sports teams
- Appreciating common sources of bias in surveys such as poor wording of questions, volunteer response, and socially desirable answers
- Understanding how small samples can accurately predict public opinion, how sampling errors can limit reliability, and how sampling bias can influence results
- Recognizing how apparent bias in hiring or promotion may be an artifact of how data are aggregated
- Understanding quantitative arguments made in voter information pamphlets (e.g., about school budgets or tax proposals)
- Understanding student test results given in percentages and percentiles and interpreting what these data mean with respect to the quality of schools (pp. 10-11)

While such examples capture crucial civic quantitative skills, none of the examples call attention to inequality. “Analyzing economic and demographic data to support or oppose policy proposals” could include understanding economic inequality, but this is not explicit. The example “Recognizing how apparent bias in hiring or promotion may be an artifact of how data are aggregated” implies that bias or discrimination can be proven untrue. Of all the ways the text could have included an example about interpersonal or systemic discrimination related to economic inequality, the one that is included suggests bias may not really be a problem. The examples of quantitative literacy for citizenship do not recognize the existence of societal inequality and that quantitative ways of thinking and communicating can help to understand inequality. Furthermore, the examples do not imply the ways in which students can be prepared,

with mathematics, to address inequality in society. None of the examples imply that mathematics can be used to inform or advance collective action.

Quantitative literacy scholarship argues that it is a crisis that people do not have the quantitative literacy to participate as a citizen of a democracy; however, that people are not learning about inequality as part of quantitative civic literacy is not framed as a crisis. This scholarship does not address the ways in which students can be prepared, in mathematics, to solve social problems, like Kahne and Westheimer (2014) argue is central for how we conceive of preparing young people as citizens in a democracy: “If democracy is to be effective at improving society, people need to exert power over issues that affect their lives” (p. 358). What is not explicitly interrogated is that there are different ways to conceptualize quantitative literacy as a tool for civic activity, especially in response to inequality.

What mathematics and mathematical ways of thinking are necessary to develop as an active participant in a democracy in which there is great societal inequality? What kinds of mathematics and mathematical thinking does the “good citizen” need to have to address social problems? There are “quantitative demands of contemporary life” (NCED, 2001), but which quantitative demands are prioritized in schools? In what ways can the mathematics classroom be a space in which students become better prepared to participate in a democracy? As Allen (2011) notes we rarely ask: What is the responsibility of mathematics teachers to prepare students for a democracy? Such questions are political in nature.

Despite the way quantitative literacy is framed, other areas of scholarship discuss courses, curricula, and pedagogies that are dedicated to engaging students in quantitative literacy that calls on them to investigate inequality, which I explore in subsequent sections.

## **Teaching About Inequality Using Mathematical Investigation**

### **Outside the Secondary Mathematics Classroom**

The literature discussed in this section reveals what is taught about economic inequality using mathematical investigation, how it is taught, and why it is taught, in contexts outside of secondary mathematics, as there are scholars and educators thinking about what this looks like in disciplines other than mathematics. To address my research questions, it is helpful for me to understand a range of possibilities for curriculum and instruction about mathematical investigation of economic inequality. Although often not explicitly attended to, there are different extents to which this teaching is thought about as being in service of preparing students as citizens.

Social science professional organizations emphasize the importance of students developing the analytical skills required to understand and work with data early on (Sweet & Strand, 2006; American Psychological Association, 2002). Sociology is not often taught as a course at the high school level. In the United States, we do very little to support young people in K-12 education to think sociologically, which is necessary to understanding structured inequality in society, such as racism, classism, and sexism, and ultimately to address local and global inequalities. Scholarship on teaching Sociology is an important place to understand teaching about inequality using mathematics because the nature of the field calls for quantitative analysis of social stratification. The structural nature of economic inequality and its root causes are examined. The causes and consequences of economic inequality, the extent of it, and what has been and can be done to address it are explored in Sociology. Several studies examining the teaching of inequality in Sociology courses in higher education, while they do not explicitly state

implications for K-12 mathematics, offer insight into potential for what can be done in K-12 mathematics education.

There is a prevailing view that students enter college social science courses with mathematics and statistics “anxiety” (DeCesare, 2007) and that they “lack the competence needed to consider the numbers in tables within a research context” (Wills & Atkinson, 2007, p. 255). To address this, engaging students with local data to “understand social relationships in their own communities” can spark student interest in the power of mathematics (Sweet et. al, 2008, p. 1). In a Sociology course, Sweet and colleagues exposed students to quantitative data on student and faculty racial and gender demographics at their university during the first week of the term, which they believed challenged students’ perceptions of quantitative data being intimidating to work with, showed students how quantitative data is necessary for understanding an important part of their social world, and compelled students to think about structural barriers to mobility. In another assignment, the instructors taught students how to access U.S. Census data to investigate the income distribution across the U.S. and income distributions in different geographic areas within the U.S. that different degrees of racial segregation. Sociologically speaking, students built foundational knowledge about inequality and opportunity. Mathematically, the authors argue that the unit supported students to learn about accessing data, rationalizing the recoding of data, constructing graphs, and converting numbers into prose and presentation that describes the extent of inequality.

Other scholarship explores teaching students about social stratification through simulations based off the game Monopoly (Jessup, 2001; Coghlan & Huggins, 2004). While students report gaining a deeper understanding of the challenge of overcoming structural barriers to upward class mobility because they start off with money representative of different income

quintiles and throughout the game the wealthier players can more easily accumulate property and assets and money (Coghlan & Huggins, 2004), these simulations do not take into account the actual class, race, gender, and other backgrounds of the instructors and participants and how students may make sense of playing a game about economic status. In another study, Sweet and Baker (2011) discuss teaching about pay inequality by race and class by asking students to explore data for their intended career choice. They found that students were not surprised by inequalities but were surprised about the magnitude of them. While the authors claim that this more student-centered approach relates to their own students' lived realities, what is not explored in the lesson is what can be done to challenge inequality, thus potentially leaving students to feel that there is little they can do to make change as they enter a profession where they are likely to receive advantages or disadvantages based on their race and gender.

Literature about Sociology teaching that incorporates lessons on inequality and mathematics mostly does not explicitly frame mathematics as a tool for civic activity, but rather, understandably, it is positioned as a helpful tool for better understanding the field of Sociology. However, exploring root causes and the structural nature of inequality is associated with a social justice-oriented view of citizenship (Westheimer & Kahne, 2004).

It is common for universities to require a breadth course in mathematics or quantitative literacy. Oftentimes, students who are not majoring in a field requiring extensive mathematics coursework take a more general course to fulfill the quantitative course requirement. In contrast to Sociology courses, these are often framed as courses that prepare students as citizens equipped with important quantitative ways of thinking. Dewar et. al (2011) and Jaafar (2012) address drawing on the Science Education for New Civic Engagements and Responsibilities (SENCER) project model, which seeks to expand students' basic mathematics and science learning as they

explore complex, unsolved public issues. They have the goal of building students' civic engagement through undergraduate quantitative literacy courses. To develop curriculum, Dewar and colleagues, the instructors of the course, first surveyed college students about civic issues they would be passionate doing quantitative group projects on. While most project options ultimately offered to students did not call on them to address inequality, one of the options asked students to evaluate Social Security programs and how they would change according to proposed changes by President Bush (in 2005-2006). One of the most significant findings for Dewar et. al (2011) was that students became more aware of the usefulness of mathematics when they explored open-ended problems about local issues as a team. Jaafar (2012) describes a SENCER lesson she implemented at a community college on interest rates, debt, and student loans. On the surface, it may seem that these topics may only address individual financial literacy as opposed to economic inequality. However, Jaafar asked her students to examine student debt of those who attended for-profit colleges and those who did not and then asked them to construct arguments, backed in part by mathematics, about if for-profit colleges should receive federal aid. She concludes that projects such as this one "can help students develop quantitative reasoning and critical thinking skills, build confidence in estimating quantities, synthesize, reflect on what they learned and use mathematical arguments and logical thinking to defend a decision" (p. 90). Both SENCER projects assert that education should teaching the "whole person" and empower people to think critically and make decisions to improve their own lives and the lives of others in society.

Economics is another field we can learn from about the teaching of economic inequality using mathematical investigation. The Curriculum Open-access Resources in Economics (CORE) Project (2015), based out of University College London, released an open-access interactive ebook course aimed at educating people on economics that is especially relevant to



today's problems in the world. The course was generated out of concern that growing economic inequality is not being taught well but that we must teach economics "as if the last three decades happened." In a chapter on economic inequality, almost every page contains various graphical representations of economic inequality and it begins with a section on how economic inequality is measured. Even though this interactive ebook course is not designed for secondary mathematics explicitly, and it is actually being piloted at the higher education level at universities around the world, understanding its contents is important for my study because so much of the mathematics would be accessible to and applicable for secondary mathematics students. Students could be prepared in mathematics to understand and pose questions about graphs, such as the one described in the CORE book chapter on economic inequality:

Organisational and technological changes, political transformations within nations, and world trade have all resulted in global patterns of income inequality captured in Figure 1. This chart depicts income around the world (the height of each bar) on two axes: the first, from the front to the back of the figure, shows the distribution of income from poor to rich within each country; the second is a ranking of countries from the poorest in gross domestic income per capita (the Democratic Republic of Congo) on the left of the figure to the richest (Norway) on the right. The width of each country's bars represents the population of the country. The distance marked  $x$  on the left of the figure equals a population of 200 million. For example, you can estimate that the US has a population of around 300 million. The skyscrapers (the highest columns) at the back of the right-hand side of the figure represent the income of the richest 10% in the richest countries. The tallest skyscraper is the richest 10% in the US. This exclusive group has gross domestic income per capita of just over \$125,000. Although Norway has the highest gross domestic income per capita and is therefore the country at the right-hand end of the figure, it does not have a particularly tall skyscraper for the richest 10% (our view is almost entirely blocked by the US skyscraper) because income is more evenly distributed in Norway than in some other rich countries (pp. 4-5).

Students need knowledge of economics to understand the graph, but also need to be supported to think mathematically in several different ways. While the graph has multiple dimensions and may be more complex than what students often encounter in secondary school, they can access all of the mathematical ideas present in the representation.

Across bodies of scholarship that address teaching about economic inequality using mathematical investigation in higher education, I argue that students can and should be prepared to do the kinds of mathematics those activities call for when they are in secondary school. They are capable of having conversations these curricula address. Furthermore, across the board, these studies address how students come to the classes in higher education with limited understandings of social stratification, and in particular the extent of economic inequality in society and its causes and consequences (Coghlan & Huggins, 2004). This can and should be taught earlier in students' education because these ideas are important for young people to understand and inform their action within the democracy we live in. Social sciences can take on this teaching, but there is a great deal of mathematics involved in teaching about inequality that this begs us to consider the responsibility of mathematics education in preparing young people to investigate inequality.

While I have addressed how scholarship in particular disciplines has addressed teaching about economic inequality using mathematical investigation, it is important to acknowledge recent efforts to call for greater interdisciplinary teaching across all levels of education. Liman and Salleh (2013) focus explicitly on the intersection of Sociology and mathematics, and they coined the term *sociological mathematical values* to refer to “those values of openness and mystery of mathematical knowledge in relation to societal needs” (p. 193). They call on educators to consider the question: What can mathematics offer to the overall living standard of individuals and society? McGee and Hostetler (2014) argue that interdisciplinary approaches of teaching mathematics and social studies is under-explored, especially pertaining to teaching about societal inequalities. Students can develop deeper understandings of societal inequality and various subject matters when lessons are taught with an interdisciplinary approach because teaching mathematics and social studies separately “can keep hidden their critical context and

content intersections, intersections that could provide a holistic and dynamic portrayal of both fields” (p. 209). Interdisciplinary approaches of teaching mathematics and social studies illuminate mathematical concepts and social issues in ways that could not be achieved without the other discipline. Furthermore, in interdisciplinary learning, both students and their teachers can gain greater sociopolitical understandings of the world, especially intersections of race, class, and gender, which is instrumental for critiquing social contexts and social positioning (McGee & Hostetler, 2014 citing Ladson-Billings, 2005). McGee and Hostetler do not address teaching about inequality from an interdisciplinary stance in practice, but they provide several examples of what lessons could look like, including mathematical and social science goals for lessons on the transatlantic slave trade, the war on drugs, and voter disenfranchisement.

Interdisciplinary teaching about inequality using mathematical investigation has been explored at the primary level. Peterson (2013) designed his elementary classroom to include powerful interdisciplinary units that call on students to use mathematics to investigate inequality. He raises the question of why it is assumed writing should be taught across the curriculum but not mathematics, as historian Patricia Cohen (2001) argues. In his classroom during the months of October and November when discussions arose about hunger and poverty related to the upcoming Thanksgiving holiday, Peterson used simulations to teach students about wealth disparity in the United States and globally as well as news articles about racial disparities in local employment. Mathematically, he sought to engage students in working with percentages and graphs. In elementary school, there may appear to be more immediate opportunities to teach mathematics across subjects because students are often with the same teacher all day, but we can do more to think about interdisciplinary instruction at the secondary level. The following section

explores extant literature that addresses teaching about inequality within the secondary mathematics classroom.

### **Inside the Secondary Mathematics Classroom**

A growing body of scholarship that addresses teaching about inequality in secondary mathematics is *teaching mathematics for social justice* (TMSJ). TMSJ literature takes a stance on why inequality should be taught in mathematics and, sometimes explicitly and sometimes implicitly, takes a stance about the nature of mathematics and the role of mathematics education in preparing students as citizens of a democracy. TMSJ literature does not shed light on a range of perspectives from mathematics teachers about: why inequality should be taught about in mathematics, their views of the nature of mathematics, and how they think about preparing students as citizens. However, this scholarship explicitly examines what about inequality can be taught and how it can be taught, in the secondary mathematics classroom. In this section, I first briefly address *teaching for social justice* and then turn specifically to TMSJ.

Teaching for social justice embodies a variety of pedagogies, practices, and social actions by teachers in the name of challenging societal inequality and working towards equity, liberation, and humanization for all people through education (Freire, 1970; Katsarou, Picower, & Stovall, 2010). Teaching for social justice scholarship takes the stance that the purpose of schooling should not be to prepare young people to live in the world as it is, but to imagine and create a more just world; in the classroom, young people can creatively imagine new possibilities and directions for resisting social crisis (Freire, 1970; Kumashiro, 2001). In this way, teaching for social justice takes the stance that teaching about inequality should be for the purpose of preparing youth as social justice-oriented citizens who challenge the status quo. Students are “actors in the struggle for justice” (Gutstein, 2007, p. 424). Teaching about inequality is

positioned as creating learning opportunities for students to explicitly address power in society (Sleeter, 2015) and “to hold structural and material inequities up to the light of inquiry” (Duncan-Andrade & Morrell, 2008, p 10). Central to teaching for social justice is teaching about the structural nature of inequality. In this sense, investigating inequality is fundamentally about exploring its root causes. These perspectives about teaching for social justice across disciplines hold for TMSJ scholarship.

In mathematics, teaching for social justice (also referred to as “critical mathematics” and “reading and writing the world with mathematics”) seeks to empower students as mathematicians and social justice-oriented citizens as they make connections between mathematical concepts and social-historical-political understandings of their own lives and the world around them (Gutstein, 2007; Gutiérrez, 2010). Bringing critical theory and critical pedagogy, specifically Freire’s (1970) problem-posing pedagogy to doing “real world” critical mathematics, Frankenstein (1983) argues that an understanding of mathematics and statistics is important for gaining power in our society – particularly for control over economic, political, and social structures. She reinvents Freire’s (1970) critical education theory in a mathematics context, as she argues that struggle for liberatory social change requires mathematical literacy.

Frankenstein theorizes mathematical literacy differently than how quantitative literacy scholarship (discussed above) addresses the mathematics needed for citizenship, because she asserts that learning about inequality and power should be done in mathematics. As Tate (1995) examines a case study of one mathematics teacher using a culturally relevant approach to mathematics with African American middle school students, he notes how the teacher’s overarching goal is to “develop students into active participants in the democracy” (p. 170), which includes connecting mathematics to social issues – or social issues to mathematics, rather,

as she first asked students to think about what was negatively impacting their community, how they can research the problem, and what they can do about it. As a result of their mathematical learning, the students presented data to their city council to challenge the disproportionate number of liquor stores in their neighborhood. In *Rethinking Mathematics*, Gutstein and Peterson (2013) explain, “as students develop deeper understandings of social and ecological problems that we face, they also often recognize the importance of acting on their beliefs. This notion of nurturing what Henry Giroux has called “civic courage” - acting as if we live in a democracy - should be part of all educational settings, including mathematics classroom” (p. 4). They go on to give more examples of student activism informed by or including mathematics, such as students writing letters to a social studies textbook company after doing a mathematical analysis of slaveholding presidents and noticing their textbook did not address this part of history, and students speaking out in public forums after doing a mathematical analysis of overcrowding at their school.

Gutstein (2006) refers to how students take action during *or* following mathematical lessons about inequality as *writing the world with mathematics*, borrowing from Freire’s (1970) notion of reading and writing the world. He argues that students come to take action, not just within the context of the mathematics class, but over time. For students, he hopes they develop a *sense of social agency*. His choice of the world social is deliberate because he does not imply that he hopes students will only develop self efficacy - while important - but that students will feel that they are “capable of contributing to historic processes” (p. 27). This perspective implies preparing students as civic actors who partake not just in individual acts of kindness or good will, but in collective action to effect change, whether it be within established systems or in resistance to established systems.

Doing mathematics is often positioned in TMSJ scholarship as a socially constructed human activity, as opposed to particular procedures. Mathematics and statistics are not only for “experts,” and they are not value-free, an argument about the nature of mathematics (Frankenstein, 1983). Tate (1995) argues a daily pattern of whole class instruction where students follow along passively, copying problems the teacher solves, and then working on a set of similar problems alone following the lecture must be challenged; here Tate takes a stance on what doing mathematics should look like. Tate challenges us to critique how people often think about what it means to engage in academic study in the mathematics classroom, as he argues, “it is within the context of social change and community problem solving that “traditional” academic subjects emerge” (p. 171). This reflects a stance that the real-world, as opposed to particular mathematics topics, should drive what happens in the mathematics classroom. TMSJ literature implies a stance on what it means to do mathematics: “a text-driven, teacher-centered approach does not foster the kind of questioning and reflection that should take place in all classrooms, including those where math is studied” (Gutstein & Peterson, 2013, p. 4). Through mathematical lessons about economic inequality, Gutstein (2006) argues that a goal should be to “change one’s orientation to mathematics” (p. 30). By this, he means that students can come to see mathematics as “a powerful and relevant tool for understanding complicated, real-world phenomena” as opposed to “a series of disconnected, rote rules to be memorized and regurgitated” (p. 30). Approaches to teaching mathematics that include students collecting and analyzing real-world data can develop students’ *conscientizacao* (sociopolitical consciousness), allowing them to see “humanity behind the numbers” (Gutiérrez, 2010, p. 5).

The first volume of *Rethinking Mathematics* was published in 2005 and a second volume in 2013, in which teachers as well as university professors and teacher educators share

curriculum they have taught in their own classrooms and schools – lessons, units, projects, and other innovations such as a “social justice data fair” that connect mathematics with real-world social justice issues (Gutstein & Peterson, Eds.). These volumes serve not only as concrete examples for classroom teachers to use and modify themselves, but as models so that pre-service and in-service teachers can learn about what is possible and develop their own curricula. In the preface of *Rethinking Mathematics*, Gutstein and Peterson (2013) push back on common misconceptions about TMSJ as it has become a part of greater discourse in mathematics education – that social justice mathematics should only be taught to marginalized students (all students should develop a social consciousness in school), that social justice mathematics is watered down mathematics (while not easy, the intent of TMSJ is to thoughtfully and thoroughly integrate the social issues and the mathematics), and that social justice mathematics asserts that marginalized students cannot learn math without this kind of teaching (on the contrary, students are capable, and mathematics should tap into who people are and the world around them). The “Creating Balance in an Unjust World” social justice and mathematics conference hosted in New York City, San Francisco, and Los Angeles during the last decade has also provided a space for educators to come together to discuss various issues related to mathematics and equity, including teaching social issue-related curricula. Especially over the last ten years, examples of TMSJ are surfacing, but they are not represented in mainstream curricular documents.

Social justice mathematics scholarship includes examples of teaching about economic inequality, oftentimes as it intersects with other forms of inequality. For example, Rubel et. al (2016) discuss a curricular module designed to engage secondary mathematics students in a critical examination of the lottery, alongside a spatial analysis of neighborhoods in New York City. They engaged students in participatory mapping, so that they were co-creators of digital



maps that included data they collected on people's experiences and ideas about the lottery as compared to median household income, lottery spending, and net losses to neighborhoods. The students developed nuanced mathematical knowledge of probability and developed a critical stance towards the lottery as targeting low-income people in an economically unjust society. Another example of a curricular unit involving economic inequality is detailed in the book *Rethinking Mathematics*. Entitled the "Geometry of Inequality," this lesson calls on students to investigate the inequitable distributions of parks, community centers, grocery stores, liquor stores and other institutions across different neighborhoods in a city (Brantlinger in Gutstein & Peterson, Eds., 2013). Students discovered that within a certain radius of their own school, they have differential access to resources as students who live in more or less affluent neighborhoods. This dissertation study will help uncover how common it is for mathematics teachers to develop lessons that address economic inequality and what types of lessons they create.

While TMSJ has not examined how mathematics teachers think about mathematics as a tool for social inquiry about issues of inequality, a case study investigation by Brelias (2015) examined how secondary mathematics students taking either a mathematics modeling class or statistics class dedicated to studying issues of inequality in society reflected on mathematics as a tool for social inquiry. She found that, while almost all students reported it was their first time applying mathematics to understanding societal issues, they felt that mathematics is a necessary tool for social inquiry because "(a) mathematics furnishes evidence that supports (or challenges) assertions, (b) mathematics is an objective tool, and (c) mathematics provides a compelling justification for individual and societal beliefs and actions" (p. 5). On the other hand, while expressing perspectives that mathematics is incredibly important for understanding and challenging inequality, students also expressed that mathematical proof and thinking is not

sufficient as a tool for social inquiry, as they addressed that: “(a) it is reductive and impersonal, (b) it provides inadequate explanations for problems, (c) it is irrelevant for moral arguments, and (d) it is inaccessible to the general public.” (p. 7). While this study does not examine student perspectives, it is clear that how students think about learning about inequality using mathematical investigation is related to their ideas about what it means to do mathematics.

Simic-Muller et. al (2015) investigated what pre-service mathematics teachers think about teaching real world issues. They found that pre-service mathematics teachers provided three different rationales for why it is important to teach about real world issues in mathematics - for career and everyday preparedness, for valuing students’ backgrounds, and for engaging in social justice. While the study captures ways that future mathematics teachers anticipate they will engage students with real world issues in the mathematics classroom, the findings reveal that how mathematics teachers think about engaging students in relevant mathematics varies. They found that pre-service mathematics teachers, from their analytical perspective, are mostly ambivalent about teaching about injustice or controversial issues and when they were asked to give examples of real-world mathematics problems, they mostly shared problems about food or money which did “not highlight how to use mathematics to solve or to investigate a genuine problem, but simply uses a familiar context to illustrate a mathematical concept.” The present study seeks to examine practicing mathematics teachers’ conceptualizations and does not address how they think about real-world contexts generally but specifically how they think about inequality. Still, it is interesting (and likely not surprising to most) that pre-service teachers tended to not have strong conceptions of what it would mean to teach about issues of inequality in mathematics.

Literature on teaching about inequality using mathematical investigation highlights several barriers that secondary teachers and university instructors face, which could shed light for me on potential reasons teachers will report or discuss not teaching about inequality or teaching about it minimally. First, literature suggests that mathematics teachers tend to not have preparation in engaging students with social, political, economic issues. Because mathematics is often assumed to be removed from the social, political, and economic world (a perspective on what it means to do mathematics), teaching about these issues tends not to be included in mathematics teacher preparation and professional development. However, topics about inequality cannot be addressed without situating them from historical and sociological perspectives. Bartell (2011) and Garii and Appoyoa (2013), in separate studies, found that, in teaching teachers about social justice mathematics, they tended to focus more on the social justice aspects of the curriculum - although oftentimes coming from deficit perspectives about students - and that it was difficult for teachers to navigate social justice goals and mathematical goals. It is not surprising that this work is challenging for future teachers who have never taught mathematics or social issues before separately, let alone together. There is not sufficient research to claim that teachers struggle TMSJ because of their own deficits (Gregson, 2013). Esmonde (2014) found, for affluent students learning about wealth disparities in mathematics class, “a mathematical analysis of social justice issues can still reinforce harmful stereotypes” (p. 386); therefore, “TMSJ should be seen as a long-term project in which mathematical, geographical, historical, and other forms of learning are interconnected” (p. 387). The mathematics classroom is rarely an interdisciplinary learning space. Pedagogically, it is challenging for teachers to talk with their students and foster dialogue in their classes about power and social pain, especially in ways that center their and their students’ identities. This can be particularly challenging for

mathematics teachers who are not prepared to create space for this dialogue. It is often assumed that mathematics is not a tool for civic activity around issues of inequality, which reflects beliefs about the role of mathematics in preparing citizens to improve society.

Second, in professional development on TMSJ and in case studies of classroom teachers who strive to teach mathematics for social justice, mathematics teachers tend to report that teaching about societal inequality is challenging because of time - both the time to find and develop curriculum, which is not widely or readily available, and the time to implement curriculum because there is so much mathematics content that teachers are expected to cover. It is often assumed that extensive mathematical content cannot be addressed in real-world lessons about inequality, which reflects teachers' conceptualizations of what it means to do mathematics. Brantlinger (2013) concludes that there are "serious barriers" making it next-to-impossible to engage students in social justice mathematics at the high school level and that the effort it takes to create social issue-related math lessons is unrealistic, because he shares he spent over 120 hours preparing the lessons for a Geometry course he could not cover all the Geometry content for. However, the study does not leave room for the possibility that teachers with pedagogical strengths other than the author or teachers in differing schooling contexts over time could successfully implement this approach. Bacon (2012) and Gregson (2013) discuss barriers but did not discount TMSJ as Brantlinger does. Bacon (2012) details his challenges TMSJ in a standards-based era. He had to prepare students for quarterly benchmark tests and felt pressured to cover material before each test, thus presenting a challenge to him to include social justice issues that can sometimes take longer as lessons or units to implement than curriculum devoid of social context. However, he offers that drawing on project-based learning can open more room for social justice curriculum, and it is possible to review for exams while giving social context to

mathematics problems. Gregson (2013) studies one mathematics teacher's conception of TMSJ, the tension in that teacher's work, and how the teacher negotiates them. She found that dominant mathematics was both a necessity and an obstacle for TMSJ, but argues that this can be a place for growth. She also found that the teacher's need to focus on high stakes testing did not necessarily help students master mathematics concepts or build social justice understandings. Gregson suggests that teachers form inquiry groups to further explore TMSJ together and reminds us that TMSJ is a long-term endeavor, not a short-term goal. Gonzalez (2009) engaged teachers from a mathematics department at one urban high school in a "community of practice" with teachers who committed themselves to TMSJ as worthwhile, even though it was a challenge to try to teach in this way with rigid pacing plans and standardized tests.

I close my discussion of TMSJ with how Wager and Stinson (2012) distinguish teaching mathematics *about*, *with*, and *for* social justice:

Teaching math *about* social justice refers to the context of lessons that explore critical (and oftentimes controversial) social issues using math. Teaching math *with* social justice refers to the pedagogical practices that encourage a co-created classroom and provides a classroom culture that encourages opportunities for equal participation and status. And teaching math *for* social justice is the underlying belief that math can and should be taught in a way that supports students in using math to challenge injustices of the status quo as they learn to read and write their world. (p. 6)

Relating my research to these ideas, I argue that mathematics teachers can teach *about* inequality and can have different perspectives on what it means to do mathematics (e.g. if and how it is a co-created endeavor) and what teaching about inequality is *for*. It is possible to teach about societal inequality in the mathematics classroom without coming from the perspective that developing students as civic agents means supporting them to examine and challenge the root causes of inequality, as in the description above of teaching *for* social justice. What TMSJ

literature does not offer is the extent to which a broad range of mathematics teachers teach about inequality and, for those who do, how they conceive of citizenship and mathematics.

### **What Kind of Citizen?**

Scholarship on quantitative literacy and on teaching about inequality using mathematical investigation puts forth various perspectives about what it means to prepare young people to participate as citizens of a democracy, using mathematics. There is not a singular way of conceiving what it means to develop students' civic power in the context of learning about inequality in the mathematics classroom. Therefore, to understand how mathematics teachers think about teaching about economic inequality, I must draw on a conceptual framing of citizenship education.

Preparing young people to participate in a democracy has long been explored as part of the purpose of education (Dewey, 1916). An education system that “arms people with an intelligence capable of free and independent thought” and “helps people to build common ground across diverse experiences and ideas” (Darling-Hammond, 1996, p. 5) is central to a democratic society. Various curricular frameworks, programs, and pedagogies state such goals. The ways in which schools are designed, as well as curricular and pedagogical decisions made by teachers, advances a vision of which kind of democratic citizen young people should develop into. Westheimer and Kahne (2004) bring attention to how schools and teachers conceptualize young people as citizens of a democracy. They argue that different visions of citizenship are political, in that they include different perspectives on societal inequality and how people should improve society.

**Table 1: Kinds of Citizens, from Westheimer and Kahne (2004), p. 240**

<b>Personally responsible citizen</b>	<b>Participatory citizen</b>	<b>Justice-oriented citizen</b>
<b>Description</b> Acts responsibly in his/her community Works and pays taxes Obeys laws Recycles, gives blood Volunteers to lend a hand in times of crisis	Active member of community organizations and/or improvement efforts Organizes community efforts to care for those in need, promote economic development, or clean up the environment Knows how government agencies work Knows strategies for accomplishing collective tasks	Critically assesses social, political, and economic structures to see beyond surface causes Seeks out and addresses areas of injustice Knows about democratic social movements and how to effect systemic change
<b>Sample action</b> Contributes food to a food drive	Helps to organize a food drive	Explores why people are hungry and acts to solve root causes
<b>Core assumptions</b> To solve social problems and improve society, citizens must have good character; they must be honest, responsible, and law-abiding members of the community.	To solve social problems and improve society, citizens must actively participate and take leadership positions within established systems and community structures.	To solve social problems and improve society, citizens must question, debate, and change established systems and structures that reproduce patterns of injustice over time.

More conservative conceptions of citizenship tend to view societal problems as caused by personal deficits; therefore, being a good citizen means having good character. On the other hand, societal problems can be viewed as largely structural in nature; therefore, being a good citizen requires critical perspectives that call for structural change. While asserting these categories are neither exhaustive nor static nor a hierarchy, Westheimer and Kahne identify three over-arching conceptualizations of citizenship based on theoretical perspectives and their own empirical research on civics education programs: the *personally responsible citizen*, the *participatory citizen*, and the *social justice-oriented citizen*.<sup>1</sup> Table 1 summarizes their framework.

The personally responsible citizen acts responsibly in their neighborhood or community by abiding laws and treating others with respect (i.e. having good character). To solve social problems, the personally responsible citizen engages in charitable acts, such as donating to a

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<sup>1</sup> In their 2004 article, Westheimer and Kahne refer to the last conceptualization of citizenship as “justice-oriented” but since refer to it as “social justice-oriented,” so as not to be interpreted to refer to the criminal justice system.

food drive or giving blood, or participates in community service such as picking up trash. Another example Westheimer and Kahne provide for the personally responsible citizen that is particularly relevant for my research, because of the explicit mathematical connections underlying it, is “staying out of debt.” As discussed previously, Baron’s (2015) *Count on Yourself* program, designed to teach students and parents the mathematics behind financial literacy, operates from the perspective that if students and their parents have greater mathematical abilities, they will be more financially prosperous *and* more civically engaged. According to the personally responsible view of citizenship, mathematics could be understood as a tool for those with little economic means to be good citizens by working hard to learn mathematics and apply it in ways that pull themselves up by the bootstraps financially.

Westheimer and Kahne found that, in civics education programs, the personally responsible citizen often emerges as the most predominant view of developing young people as citizens. In a more recent 2008 study of elementary and secondary social studies teacher education students’ perspectives on citizenship, Martin found that they tend to emphasize community service over political engagement, that a good citizen obeys laws and helps others through individual acts. While Westheimer and Kahne argue it is undoubtedly important to teach honesty, integrity, and loyalty, they find such emphasis on the personally responsible citizen “an inadequate response to the challenges of educating a democratic citizenry” (p. 243) - that, for example, “a focus on loyalty or obedience (common components of character education as well) works against the kind of critical reflection and action that many assume are essential in a democratic society” (p. 244). The other two conceptions of citizenship focus on collective action, as opposed to individual acts. Westheimer and Kahne argue that a combination of characteristics



of the participatory citizen and social justice-oriented, both detailed below, are required to prepare people to participate in a democracy.

Participatory citizens “actively participate in the civic affairs and the social life of the community at the local, state, or national level” (p. 241). They participate and take leadership in the government or community organizations - existing systems (as opposed to ones that challenge established systems) - to seek to advance change as a collective. They know how government or other community organizational leadership works and have strategies for working together. As Westheimer and Kahne describe the Madison County Youth in Public Service program, a program they argue largely fits within the participatory citizen perspective, they do not explicitly address the role of mathematics in preparing the participatory citizen (this is not their goal) but they do mention that students collected and analyzed data. For example, in their discussion of the limits of the participatory citizen perspective, they reference a survey students conducted and hint at mathematical thinking underlying analysis:

We found a similarly limited focus when a group of students examined their county's tax structure to identify possible ways to finance needed school construction and conducted a survey to determine residents' preferences. They found that 108 of 121 residents said no to the idea of a local income tax. The students did not discuss the reasons that so many residents opposed a local income tax or examine issues of equity when considering alternative options for taxation (p. 253).

Mathematics could be viewed through this lens of citizenship, as a tool to inform voters on policies relevant to economic inequality such as taxation, social security, etc. Another example of how mathematics can be used to address economic inequality through a participatory citizen lens is “participatory budgeting,” a process through which citizens exert control over governmental budgets (Pateman, 2012).

Finally, the social justice-oriented view of citizenship believes that “citizens must question, debate, and change established systems and structures that reproduce patterns of injustice over time” (Westheimer & Kahne, 2004, p. 240). This involves understanding the intersection of social, political, and economic structures. Whereas a personally responsible citizen would donate to a food drive and a participatory citizen would organize it, the social justice-oriented citizen would identify and challenge the root causes of hunger, Westheimer and Kahne argue. Key to preparing a social justice-oriented citizen is exploring the role of social movement and grassroots organizing to challenge systemic injustice, as opposed to the role of being charitable or volunteering to help those in need. Westheimer and Kahne also hint at mathematical thinking being a part of the social justice-oriented citizen’s learning and action as they share data from the Bayside Students for Justice program: “In one classroom activity, students compared demographic data on per capita income broken down by neighborhood with data on the prevalence of violent crime, also broken down by neighborhood” (p. 257). Embedded in TMSJ scholarship, described above in my literature review, largely puts forth a social justice-oriented vision of how young people can use mathematics for civic activity in a democracy. At the heart of TMSJ, rooted in Freire’s (1970) critical pedagogical theory, is supporting students to critique the inequitable status quo. Teaching about economic inequality in mathematics from the social justice-oriented citizen perspective could include wrestling with questions on wealth distribution, such as how much the “1%” has can be represented and how it is represented and discussed in different contexts (e.g. the mathematics behind the Occupy Movement and media coverage of it).

Westheimer and Kahne’s (2004) framework is informed by their examination of social studies programs aimed at promoting democracy and has since been utilized in numerous studies

of social studies classrooms, civics education, and youth civic participation (for example, see: Dudley & Gitelson, 2002; Johnson & Morriss, 2010). Swalwell (2013) draws on the “What Kind of Citizen” framework to analyze how affluent, privileged students respond to social studies pedagogy and curriculum aimed at developing them as justice-oriented citizens. She found that even though students considered themselves to be justice-oriented, there was “a disconnect between students’ conceptions of social justice and the principles undergirding a social-justice education” (p. 1). While we must continue to question how democracy is taught in social studies classrooms and how students take up ideas about civic action, we need to seriously consider how we develop students as democratic citizens who will address society’s most challenging problems not just within classes designated as responsible for teaching civics, but in every facet of school, including looking across academic subjects and within various school programs (Mendel-Reyes, 1998). As Morrell (2015) develops a theory of critical literacy, for example, he argues that Westheimer and Kahne’s framework should be extended and nuanced across content areas. For each academic discipline, we need to ask what role that discipline can play in shaping young people in a democracy. What is mathematics education’s role?

The present study seeks to draw on and nuance Westheimer and Kahne’s framework through an exploration of the ways in which mathematics teachers think about preparing their students, in the mathematics classroom, to develop various forms of civic action in relation to economic inequality. Brelias (2015) argues:

If schools are truly places where students are prepared for citizenship, then mathematics classrooms must be places where students learn about the role of mathematics in society. Activities should engage them in reflection about the benefits and limitations of using mathematics to address societal problems and on the impact of mathematics applications on our lives. Engaging them in more activities where they experience the use of mathematics as an instrument of social change is another way to better prepare students for informed and active citizenship (pp. 9-10).

In this way, the teaching of mathematics is a political endeavor, because there are different ways mathematics teachers can seek to prepare students for informed and active citizenship. The extent to which mathematics teachers teach about economic inequality and how they strive to teach about it in relation to preparing students as citizens is political. Central to Westheimer and Kahne's argument about different conceptualizations of citizenship is the political nature of them.

I hypothesize that mathematics teachers may think about citizenship in relation to mathematics and economic inequality in different ways, such as: developing the mathematics required for the individual to learn financial literacy (the personally responsible mathematics citizen), using mathematics and understandings of data and representations to participate in politics or established community organizations (the participatory mathematics citizen), or bringing mathematical thinking to uncovering, communicating, and addressing the root causes of economic inequality (the social justice-oriented mathematics citizen). While the three categories will serve as a guiding framework for my exploration, I anticipate that I will need to further adapt them from being centered on civics education to being centered on mathematics education. For example, in mathematics teachers' lessons, civic connections for any of the "types of citizens" could range from very direct or quite loose, whereas in civic programs they would likely be more explicit (e.g. The connection could be loose if the lesson is much more about the mathematics than civic preparedness, although present). Gutstein (2006) argues that in mathematics lessons about inequality, even if action does not take place within the lesson, it can develop students' *sense of social* agency, so I can look for the sense of civic agency that mathematics teachers seek to develop, if they do not speak to developing it very directly. I also anticipate that the categories may blend in interesting ways; for example, there are ways of

teaching individual financial literacy that also attend to structural critiques, such as teaching young people about predatory lending and who is disproportionately targeted by race and class (see Rubel et. al, 2015). Finally, I think that capturing how mathematics teachers talk about their vision of civic power may need to capture how they perceive their students to be positioned as having power in society. I will not approach capturing how teachers think about citizenship in relation to teaching about economic inequality from the perspective that categorizations are static or exhaustive - I think it may be common for teachers to think across conceptions of citizenship but, like Westheimer and Kahne, I seek to uncover overarching perspectives that prevail.

In lessons about economic inequality, students can become better prepared to engage in voicing their perspectives, supported by arguments and evidence, on critical social issues all citizens of a democracy must be prepared to engage in. In mathematics education, what views prevail among teachers about what it means for young people to develop as citizens of a democracy?

### **What Kind of Mathematician?**

In addition to analyzing how mathematics teachers teach about economic inequality from a lens of civic development for democratic participation, I will also look at how mathematics teachers teach about economic inequality in relation to their ideas about what it means to *do* mathematics. Ernest (2009) draws comparisons on contrasting philosophical perspectives of mathematics or what he refers to as “academic philosophies of mathematics” (see Table 2) to the ways in which the public conceives of what mathematics is and how people participate in it or what he refers to as “images of mathematics” (see Table 3).

In traditional philosophies of mathematics (including realism, Platonism, formalism, and logicism), Ernest describes, “the certainty of mathematical knowledge is ascribed to its timeless,

superhuman objectivity” (p. 43). In contrast “newer approaches to the philosophy of mathematics [including fallibilism, quasi-empiricism, humanism, and social constructivism] have engaged in what Restivo (1993) has aptly termed *the Promethean task of bringing mathematics to earth*; that is, accounting for mathematics in terms of the shared social, cultural, and material reality inhabited by human beings, not looking for answers in some alternative universe” (p. 43).

Traditional philosophies view mathematics as in search of truth that is asocial, acultural, and apolitical and isolated from other knowledge areas, whereas new philosophies view mathematics as socially and culturally constructed and politically situated and inseparable from other knowledge areas. Ernest argues that, from the perspective of newer philosophies, mathematics is effective for modeling real-world problems precisely because the invention of mathematics is inspired by people in the world. He points out that traditionally excluded from views of mathematics are dimensions such as culture, values, and social responsibility. As he makes this point, he cites Skovsmose (1994), an early researcher in the field of critical mathematics, who argues that mathematical study should include investigation of societal inequality.<sup>2</sup> In Table 2, Ernest contrasts traditional and new philosophies because they have differences according to: their positions on mathematical knowledge, the nature of mathematics, the relations of knowledge areas, values and mathematics, the relationship between mathematics and reality, the nature of mathematical objectives, and the structure of knowledge in mathematics.

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<sup>2</sup> The term critical mathematics is often used outside of the United States to refer to what many United States scholars refer to as teaching mathematics for social justice.

**Table 2: Positions in the Philosophy of Mathematics, from Ernest (2009), p. 46**

<b>Aspect</b>	<b>Traditional (Absolutist) Philosophies of Mathematics</b>	<b>New (Fallibilist) Philosophies of Mathematics</b>
<b>Mathematical knowledge</b>	Certain truth; Objective, super-human, asocial, acultural, apolitical, and absolute	Socially, culturally constructed and politically situated; Corrigible and eternally revisable knowledge (since humans are its makers and validators)
<b>Nature of mathematics</b>	Body of abstract knowledge	Knowledge, inquiry and the underlying human institutions. (Both the processes and products of human inquiry)
<b>Relations of knowledge areas</b>	Isolated and discrete knowledge, different in kind from all others ( <i>analytic a priori</i> knowledge)	Joined up with and inseparable from other areas of knowledge
<b>Values position</b>	Neutral and value-free, Context independent	Value-laden but in 'objectivised' form, Context dependent
<b>Relationship between mathematics and reality</b>	Truths from an ideal objective realm that are unreasonably (miraculously) effective in applications to empirical reality	Constructed systems and models inspired by and abstracted from human practices and problem situations (hence highly applicable)
<b>Nature of mathematical objectives</b>	Abstract objects in Platonic realm of Ideals	Socially constructed signs with social and individual meanings
<b>Structure of knowledge in mathematics</b>	Rigid, fixed hierarchy (metaphors: skyscraper, Eiffel Tower)	Fluid structures, forming and reforming (metaphors: icebergs, forest)

This dissertation research does not study academic philosophies of mathematics; rather, I look at mathematics teachers' *images* of mathematics, which, for Ernest, map on closely to philosophies (see Table 3). Ernest defines an image of mathematics as "a view, perception, or informal account of mathematics as a discipline and area of enquiry [...] partly made up of tacit inferences, assumptions, and beliefs about the nature of mathematics (p. 46).

If someone holds a traditional image of mathematics, they believe that mathematics is a challenging, impersonal, abstract field that follows fixed rules to reveal a single solution, an objective fact. Mathematics is value-free; problems calls for particular procedures and have one correct answer. By and large, this image of mathematics prevails in society, by those in and out of schools, and by youth and adults alike. Most often in mathematics classrooms, students are tasked with doing *exercises* rather than *problems* (Herr, Johnson, & Piraro, 2001), meaning that students are often asked to repeat procedures multiple times rather than engaging with open-

ended, real-world problems that do not have an answer. According to the traditional image, doing mathematics is thought of as mastering a wide range of content and procedures, as opposed to ways of thinking, dialoguing, questioning, and creating. Ernest takes a stance:

The traditional school image of mathematics as something fixed with only one right answer, right method, or preferred model cannot be sustained when the tentative, socially constructed nature of mathematics is acknowledged [...] recognizing that mathematical concepts and methods have been created to solve real and pressing problems [...] requires that mathematics be taught in context [...] Reducing school mathematics to nothing but algorithmic thinking represents a major falsification of the nature of mathematics. And as Lakatos says, it supports unreasoning authoritarianism, rather than developing critical, independent, and yes - even democratic - ways of thinking and being (p. 53)

In this way, Ernest links a traditional image of mathematics to conflicting with democratic “ways of thinking and being” in the mathematics classroom.

**Table 3: Contrasting Popular Images of Maths, from Ernest (2009), p. 47**

<b>Aspect</b>	<b>Traditional Image</b>	<b>Humanistic Image</b>
<b>Approachability</b>	Difficult, forbidding	Approachable and accessible
<b>Human dimension</b>	Cold, neutral, abstract, and impersonal	Human and personal
<b>Social context</b>	Abstract tools applied in advanced societies	Concepts and methods embedded in all of human history and societies
<b>Key elements</b>	Theoretical abstract theories	Practical problem solving and conceptual tools
<b>Applications</b>	Not part of ‘real’ (pure) mathematics. Applications work by coincidence or because mathematics describes the necessary structure of universe	Mathematics is grounded in applications providing both inspiration for its concepts and utility through modeling
<b>Procedures and methods</b>	Ultra-rational, strictly following fixed rules	Creative and flexible uses of knowledge to solve problems
<b>Focus</b>	Only interested in right answers and objective facts	Concerned with processes of personal inquiry and understanding
<b>Problem solutions</b>	Only one right answer exists for each task	Problems have multiple solution methods and multiple answers
<b>Source of correctness</b>	Experts have all the answers	Anyone should be able to solve problems and check answers
<b>Ownership</b>	Accessible only to gifted, stereotypically male, minority	Accessible to all and responsible to all

If someone holds a humanistic image of mathematics, they believe that mathematics is constructed by people and requires creative, flexible processes of inquiry to understand problems that matter to people. Multiple methods may be used and multiple solutions may result.



Mathematics belongs to the people as human activity. Ernest argues that the humanistic image includes acknowledgment of the pan-human origins of mathematics from around the globe, as opposed to only European men. Whereas a traditional image of mathematics conceals the role the people play in creating it, the humanistic image sees how “even the most rigorous and objectively presented results of mathematics embody a set of values and a cultural perspective” (p. 57). Therefore, mathematics “needs to be recognized as a socially responsible discipline” (p. 58). It follows from the humanistic image of mathematics that students should be presented with opportunities to think mathematically in ways that are relevant to their lives, communities, and the world because “the contexts students meet, in mathematics classrooms and assessments, contribute to their understanding of mathematics and the world and the relationship between the two” (Boaler, 2009, p. 138). As discussed above, TMSJ literature largely argues that mathematics education should move from positioning mathematics as traditional to be more humanistic.

Ernest notes that studies have been done to capture how the public perceives of mathematics (such as Cockcroft, 1982; Lim, 1999; Renssa, 2006; and Sewell, 1981). What is under-explored is how mathematics teachers view mathematics, especially in relation to how they view teaching about inequality in society. As I investigate how mathematics teachers discuss what, why, and how they teach about economic inequality, I seek to understand their conceptions of what it means to do mathematics and, by extension, what it means for students to develop mathematical power. In previous work, Ernest (1991) argues that teachers’ images of mathematics are complex because they are in relation to other areas; in my research, I look at their images in relation to their conceptions of teaching about economic inequality and their conceptions of citizenship.

Ernest's framework will guide me to explore how teachers think about: the approachability of mathematics, if mathematics has a human dimension, the social context of mathematics, what it means to apply mathematics, what it means to use mathematical methods, what the focus of doing mathematics should be, what it means to solve a mathematics problem, where correctness lies in mathematics, and where ownership of mathematics lies. Getting at teachers' perspectives of these aspects of mathematics will allow me to, in part, address my final research question. The following areas will open up opportunities for teachers to discuss these aspects: what it means for their students to think and problem solve mathematically; what it means for students to develop mathematical power; what it means to be a "good" mathematics student; who should guide mathematics in the classroom; and, specific to when studying issues of economic inequality, when they think mathematical learning happens (before and/or during the lesson) and if they think it makes sense for students to think about or talk about their own, or their community's, economic status.

I hypothesize that, like with the *What Kind of Citizen* framework, my analysis will reveal that this framework of *What Kind of Mathematician* (as I am referring to it as), must be further nuanced to understand how mathematics teachers think about doing mathematics in relation to learning about economic inequality. I do not think teachers will strictly speak to a traditional image of mathematics or a humanistic image of mathematics. Ernest argues that the model he describes, nor any other model that extends on it, can capture categories of people or set ways of thinking because how teachers think about mathematics is incredibly complex. I hypothesize teachers will speak across images of mathematics. I do not seek to categorize teachers but, rather, reveal prevailing conceptions of mathematics by teachers who teach about economic inequality.

## Conclusion

Darling-Hammond (1996) distinguishes between education *for* democracy and education *as* democracy. Teaching about economic inequality in mathematics has the potential to achieve both of these. In lessons about inequality, students can take individual and collective ownership over mathematics *and* use mathematics as a tool for civic action, becoming better prepared to engage in voicing their perspectives, supported by arguments and evidence, on critical issues all citizens of a democracy must be prepared to engage in.

Little is presently known about mathematics teachers' perspectives on what it means to teach mathematics for democracy and to what extent they teach about social and political issues, particularly inequality, in the mathematics classroom. It may not be surprising that extant work does not examine such topics when studying large samples of mathematics teachers, given that state mathematics standards as well as the Common Core State Standards do not explicitly call on teachers to teach about such topics (Council of Chief State School Officers, 2010). Similarly, problems about societal inequality are largely absent from mathematics textbooks and other curricular frameworks.

While TMSJ scholarship uncovers the promise and challenges of teaching about inequality in mathematics, this work examines case studies of a small number of teachers committed to TMSJ and efforts of teacher educators to engage prospective or practicing teachers in learning about TMSJ. TMSJ scholarship and practice puts forth stances about citizenship and mathematics. This research seeks to understand how a broad range of mathematics teachers who strive to engage their students in issues of economic inequality think about civic participation and what it means to do mathematics, as teachers have a range of views about these ideas that inform their notions of what it means to teach about inequality in mathematics. This intersection

is the new terrain my research will explore. Because the sample of teacher participants in this study is a cross section of mathematics teachers from across the country, I am able to grapple with questions of how the mathematics teaching profession thinks about teaching about inequality in mathematics that prior scholarship does not address.

## **CHAPTER THREE: METHODS**

In this chapter, I begin by briefly addressing my positionality as a researcher embarking on this study, as I believe that my identity and experiences, particularly as a former secondary mathematics teacher, inform the study. I then introduce the data sources I will draw on, followed by how data analysis of these sources allowed me to address my research questions. I address how posing questions to mathematics teachers about their teaching of economic inequality allows me to understand the extent to which, why, and how they strive to teach about it. Furthermore, asking about their teaching of economic inequality opened up direct opportunities for them to talk both about their ideas of what it means to do mathematics (learning about economic inequality demands mathematical thinking about concepts such as distribution) in relation to their ideas about civic action (fundamental to exploring economic inequality is grappling with what people can do about it), allowing me to draw conclusions about all three sets of my research questions.

### **Researcher Positionality**

As a former secondary mathematics teacher who strived to teach mathematics about societal inequality in Algebra 1 and Geometry courses, I am uniquely positioned to conduct this study. This allowed me to pose questions, build rapport with teacher participants, and approach data analysis with an “on the ground” teacher perspective. It is important that I recognize that teachers have a variety of ever-changing perspectives on issues such as economic inequality, what it means to do mathematics, and what it means to prepare young people as civic agents, and that I came into the study with my own evolving conceptualizations about these ideas. Because I was a mathematics teacher I feel that I have a sense of just some of the possibilities for the

investigation of economic inequality in mathematics, but I also know that teaching is highly contextualized and that context is shaped by many factors.

I recognize that my particular context presented clear affordances and, to an extent, encouragement for teaching about inequality. I taught in a public, pilot high school. The pilot school model of experimentation with pedagogies that tend to challenge the norm of mainstream education made for a comfortable environment for me to experiment. I did not have to administer district assessments every three weeks, like other teachers at non-pilot schools in the district, so I had more freedom to implement project-based lessons, many of which were about social issues. I do not feel that the administrator overseeing me shared my perspectives on the purpose of mathematics education but my first year of teaching was the first year the school opened and everyone was so busy building the school I was only observed a few times. I think this was both a challenge because I did not have outside perspectives to enhance my pedagogy, but at the same time I did not feel pressure to stick to a timeline or to use our traditional, procedural textbooks I had advocated against purchasing.

My undergraduate training in Sociology also provided me with what I felt was a meaningful, but certainly not complete, foundation for thinking about designing a mathematics class in which I would strive to engage students in challenging structural inequalities. Exposure to Youth Participatory Action Research projects across the San Francisco Bay Area and in Los Angeles, while they were outside of mathematics learning contexts, also helped me to think about what action-research on inequalities could potentially look like in mathematics class, and particularly what working with young people to develop their civic power can look like.

Just some challenges I experienced to teaching about social, racial, and economic inequality were: a lack of curricular examples and time to develop them and network with others

as I was trying to stay afloat as a pilot school teacher with additional commitments to my union contact; thinking about how to “unteach” ideas about what it means to do mathematics because my students were fourteen years-old when I taught them and already had a lot of ideas about mathematics being about memorizing impersonal formulas and getting correct answers; and making sense of my identity as a white heterosexual female benefiting from intersectional privilege in many ways teaching about inequality to students who had many assets I did not and experienced oppressions I did not. As a teacher of Latina/o students, most from economically marginalized backgrounds, I mostly thought about the teaching of societal inequality in relation to my students and what it may mean to empower them as mathematicians and change agents.

Like other scholars who write about TMSJ, I view teaching as a lifelong process of learning and growing (Bartell, 2011; Gutstein, 2006). I recognize that each teacher participant of this study has their own story and ever-changing worldviews, including their ideologies about inequality, mathematics, and social change that have been shaped by their identities and array of life experiences from before they entered the classroom to their experiences as teachers.

Teaching is complex and highly contextualized, especially teaching in an interdisciplinary way, combining fields that are often not brought together in secondary teaching. Having only taught secondary mathematics in a Los Angeles public school and only having networked with just some communities of teachers from other locations makes me very interested in how teachers from around the county make sense of learning about economic inequality in the mathematics classroom.

## Study Design

For this dissertation research, I conducted a secondary analysis of data from Rogers and Westheimer's (2013) comparative education research study entitled *Learning About Inequality*, which investigates what young people are taught about economic inequality in United States and Canadian schools. I have served as a graduate student researcher on the *Learning About Inequality* project and contributed to each of its phases. The first phase of this study involved document analysis of social studies curricular frameworks from all states and provinces/territories in the United States and Canada, respectively, to understand the ways in which aspects of economic inequality are included—or not included—in standards documents. The second phase involved designing and conducting a survey of approximately 3300 secondary social studies, English, and mathematics teachers. I contributed to the design of survey questions, particularly questions that would invite mathematics teachers to share the ways they engage their students mathematically with issues of economic inequality and what may have shaped their understandings of economic inequality. The third phase of the project involved conducting two rounds of interviews with a subset of teachers of all subjects who reported on the survey that they teach about economic inequality. I contributed to the design of the interview protocols and conducted the majority of mathematics teacher interviews in the first round of interviews and all of the mathematics teacher interviews in the second round follow-up interviews.

I examined a subset of the *Learning About Inequality* project data. In my study of teaching about economic inequality in U.S. mathematics education, my primary unit of analysis is individual secondary mathematics teachers. I utilized a mixed methods approach to draw on the large-scale data set of survey responses from a cross section of secondary mathematics teachers across the United States, as well as follow-up interviews with a subset of mathematics



teachers who reported on the survey that they teach about economic inequality. Given the limited scope of research investigating how the mathematics teaching profession thinks about inequality, mathematics, and civic action, mixed methods allowed for breadth and depth exploring these concepts of interest (Creswell et. al, 2003). This study draws on the strengths of quantitative research, capturing the responses of a large number of people and providing numerical data to test hypotheses, as well as on the strengths of qualitative research, allowing participants to make meaning of and interpret complex phenomena (Johnson & Onwuegbuzie, 2004). The survey data captures hundreds of teachers' responses, and the interviews offer an in-depth examination of teachers' perspectives on and rationales for teaching about economic inequality.

## **Survey**

For the *Learning About Inequality* survey, schools were selected randomly using the National Center for Education Statistics and the Private School Universe Survey databases. Three to five social studies, three English, and three mathematics teachers were invited to participate from all selected schools in the United States and Canada. The teachers are nested within schools that are representative of public schools by free or reduced lunch, school size, and region. To partially address my first and second sets of research questions about if, why, and how teachers strive to teach about economic inequality and what aspects of it and of mathematics they teach about, I analyzed survey data from the 422 United States public secondary mathematics teacher participants. I chose to focus only on public school teachers because I would be able to make claims from this representative sample, whereas the private school data is not a representative sample.

**Survey participants.** 422 public school secondary mathematics teachers participated in the survey, a representative sample of public school secondary mathematics teachers in the

United States. The vast majority of teachers are White, with 82.5% of participants being White, mirroring the population of secondary mathematics teachers in the United States, 5.2% were African American, 3.6% Hispanic, 3.6% Asian, 1.9% Other, and 0.2% Pacific Islander. This closely reflects racial representation in the mathematics teaching profession; in 2011-2012 in U.S. public schools, 81.5% of mathematics teachers were White, 6.4% Black, 6.2% Hispanic, and 4.1% Asian (NCES, 2013). 60% of the respondents were female, 38.6% male, and 1.4% other or preferred not to answer. 14.9% of teachers reported growing up upper or upper-middle class, 56.6% as middle class, and 27% as lower or lower-middle class. 65.4% were mathematics majors in college and 31.3% were education majors. Teachers reported a range of political self-identifications, with 34.1% reporting they are somewhat or very liberal, 35.8% moderate, and 30.1% somewhat or very conservative. They also reported a range of classroom experience, with 11.8% having taught 1-3 years, 15.4% 4-6 years, 17.8% 7-10 years, 30.1% 11-20 years, and 23.7% more than 20 years. More than half of the sample consists of teachers with more than 11 years of experience. NCES data was used to construct the sample of schools, which includes information on student demographics (such as free or reduced lunch status and race), school size, and region. For the mathematics teachers, 34.1% of the teachers' school of work had a low percent of students on free or reduced lunch (<30% of the student population at the school), 37.7% had a middle-range of students on free or reduced lunch (between 30 and 70%), and 28.2% had a high range (>70%).

**Survey questions.** The survey captured the following self-reported information: what mathematics courses they teach; if they teach about economic inequality and, if so, how often; why they do or do not teach about economic inequality; what aspects of economic inequality they address; strategies they draw on to teach about economic inequality (e.g. analyzing data

about economic inequality); what resources they draw on to create their curriculum; characteristics of teachers and their backgrounds, such as teacher political ideology and civic participation; their stances on economic inequality (e.g. if they think it is a problem); the type of school they teach at (public vs. independent); and the socio-economic status of the school community (See Appendix A for the survey instrument). Prior to the distribution of the survey, content validity and face validity were addressed by sharing the survey questions with various experts who study civic education.

**Survey administration.** The survey was administered online using Qualtrics. While conducting the survey online may have limited participants to people who feel comfortable with using a computer to complete the survey, this should not be much of concern for teachers, who are likely called upon to use a computer and access the internet in their line of work. Conducting it online allowed for teachers from across the country to easily access study participation.

## **Interviews**

To address all three sets of research questions, I utilized a critical, qualitative approach (Steinberg & Cannella, 2012; Kincheloe & McLaren, 2002) to analyze in-depth, phenomenological interviews with a subset of mathematics teachers survey participants. The interviews seek to make meaning of these particular teachers' experiences and conceptualizations of mathematics and teaching about inequality.

**Interview participants.** The interview participants are a sub-sample from the survey sample. All teachers surveyed (422 teachers) were asked if they would be interested in participating in an interview, and 120 teachers (28.8%) said yes. Of those teachers who agreed, those who reported on the survey that they teach about economic inequality in their mathematics classroom (those who did not say never), 76 teachers, were invited to participate in an interview.

12 ultimately agreed to participate. There were not any other characteristics of teachers that filtered them out or were areas of focused recruitment (e.g. there was not an attempt to have a diverse sample along race, sex, class, college major, political self-identification, years teaching, or the percentage of students at their school on Free or Reduced Lunch). However, in addition to the public school teacher participants who agreed to be interviewed, four teachers in this interview sample are independent school mathematics teachers at elite private schools; they are included to expand understanding of how mathematics teachers address economic inequality, especially from the perspective of working without national or state standards and with students from affluent backgrounds. The interview participants are organized in Table 4, arranged according to school type and free-reduced lunch percentage.

**Table 4: Mathematics Teachers' Backgrounds and School Information**

Name*	Race	Sex	Social Class	College Major	Political Self-Identify	Years Teaching	School Type	% FRL**
Adesh	Other - Indian	Male	Lower middle	Math	Liberal	4-6	Public	High
Brian	White	Male	Lower middle	Math	Conservative	4-6	Public	High
Denise	African American	Female	Middle	Education, Math	Liberal	> 20	Public	High
Roslyn	African American	Female	Middle	Education, Math	Conservative	1-3	Public	High
Daniel	White	Male	Upper middle	Education, Math	Liberal	7-10	Public	Middle
Lisa	White	Female	Middle	Education, Math	Moderate	11-20	Public	Middle
Edward	White	Male	Middle	Psychology, Math	Liberal	11-20	Public	Low
Kevin	African American	Male	Lower middle	Engineering	Moderate	11-20	Public	Low
Mark	White	Male	Upper middle	Math	Moderate	> 20	Private	N/A
Adam	White	Male	Middle	Economics	Liberal	7-10	Private	N/A
Carl	White	Male	Upper middle	Math	Conservative	> 20	Private	N/A
Scott	White	Male	Middle	Classical Studies, Math	Moderate	4-6	Private	N/A

\*All names are pseudonyms.

\*\*Percent of students at school qualifying for free or reduced lunch. High is >70%, Middle is between 30 and 70%, and Low is <30% of the student population at the school.

A third of the teachers interviewed were People of Color (all of whom teach in public schools), whereas the survey sample consisted of only 14.4% teachers of Color. Whereas a majority of the teachers surveyed were female, only three interview participants were female, two of those people being African American Women. Three of the four teachers of Color taught at public schools with a high percentage of students on Free or Reduced Lunch. Like the survey sample, interview participants reported growing up in a range of social classes, with all of them placing themselves falling somewhere in the middle class range. Mostly all teachers majored in Mathematics or Mathematics and Education, with one teacher double majoring in Psychology and another in Classical Studies. Two teachers did not major in either Mathematics or Education; Edward studied Engineering and Adam studied economics.

Like the survey sample, the interview participants have a range of political self-identifications. Three teachers reported they have conservative leanings, two of those teachers being at public schools with a high percentage of students on Free or Reduced Lunch and one being at an elite private school; four self-identified as moderate; and five teachers self-identified as liberal. Only one teacher, Adam, chose “Very Liberal” on the survey, as opposed to “Somewhat Liberal.” It is notable that of the twelve interview participants who teach about economic inequality, only one chose *very liberal* on the survey (and identifies as a “bleeding heart liberal,” in his words). As described previously in the literature review, this sample differs from teachers who have been studied as they strive to teach mathematics for social justice and those who explicitly teach to reveal and challenge economic injustice.

Eight of the twelve teachers have been teaching more than six years, with three of them teaching for longer than 20 years. Only one teacher was within her first three years. This is not a

sample of novice teachers exploring the topic of economic inequality but a sample of teachers with a range of years of experience.

A few teachers in each Free or Reduced Lunch range were represented in the sample, in addition to the four elite private school teachers. This also differs from samples of teachers often under study in teaching mathematics for social justice scholarship, which tends to examine teachers and their students at high poverty schools, with the exception of Esmonde's (2014) examination of teaching about social issues in mathematics at an economically privileged school in Canada.

**Interview design.** The twelve teachers participated in a first round interview in the Summer of 2015 and a second round interview in the Summer of 2016. Seidman's (2013) three-part approach to interviewing informed the first round interview protocol design: focused life history, details of experience with the phenomenon under study, and reflection on the meaning of those experiences. All three parts were conducted within one sitting, and the focused life history portion of the interview was the final question and was brief, asking teachers to make connections between how they think about teaching about economic inequality and their lives growing up or experiences since then. Teachers chose what about themselves to speak to. Prior to the first round interview, participating teachers were asked to share a lesson plan or description of one that attends to issues of economic inequality. Not all mathematics teachers provided this artifact prior to the interview; some stated they did not have a formal lesson plan to share. In those cases, they were asked to provide a written description of the lesson over email ahead of time. This lesson or its description served as a "critical incident" the teachers focused in on during the first portion of the interview. I sought to uncover their specific motivations for teaching it and what they hoped their students would get out of the lesson in relation to learning

about inequality. The protocol then moved to broader questions about teachers’ beliefs and concludes with a brief focused life history segment (See Table 5 for sample questions; See Appendix B for the full interview protocol).

**Table 5: Sample Interview Questions from First Round Interview**

<b>Interview Segment</b>	<b>Sample Question</b>
Details of experience	I would like to ask you to describe what you did during the lesson itself. Can you walk me through the lesson in as much detail as possible?
Reflections on meaning	Why do you think it is important to engage young people in lessons about economic inequality? In what ways might <i>your</i> students use that knowledge and information?
Focused life history	What are some experiences you have had that shape your ideas regarding teaching about economic inequality?

The second round follow-up interviews, which took place one year later, included additional questions to more deeply understand how the teachers define economic inequality, how they have come to develop their ideas about it, and how they have addressed economic inequality in the past year, a particularly relevant area of exploration because of the attention to economic inequality in the presidential election and with current issues in the news, such as lead poisoning in the water in Flint, Michigan. Especially important for my third research question, this second round follow-up interview also sought to uncover how mathematics teachers: 1) think about developing students’ civic action - the ways they hope their students will improve society with mathematics, and 2) think about what it means to do mathematics or think mathematically (See Appendix C for the full interview protocol). Data from the second interview allowed me to better understand how Westheimer and Kahne’s (2004) framework on democratic citizenship may be nuanced to center mathematics and how Ernest’s (2009) framework may be utilized to explain how teachers think about what it means to do mathematics in lessons about economic inequality.

**Conducting interviews.** The interviews were semi-structured, so that the questions were followed rather closely, but sometimes deviating in sequence and sometimes asking additional

follow-up questions. Due to do the national scope of the study, interviews were conducted using a videoconference platform. Each interview was audio-recorded, with first round interviews lasting between twenty-six and forty-four minutes and second round interviews lasting between thirty-two and fifty-eight minutes. To enhance the validity of the study, following the interviews, participants were provided an opportunity to engage in member checking to review and modify their interview transcripts (Lincoln & Guba, 1985).

### **Data Analysis**

As the quantitative survey data and qualitative interview data inform each other, I used an iterative process of data analysis, alternating between the data sources (Onwuegbuzie & Teddlie, 2003). Discovering trends in the survey data led me to look for how teachers discuss those areas in depth in the interviews. As I analyzed how teachers discussed their curricula and conceptualizations of economic inequality, mathematics, and civic action, new questions arose for me leading to new statistical tests to run from the survey data.

To make sense of how teachers' responses differ across teacher, course, school, and community characteristics, I drew on both survey and interview data. Several items from the survey allowed me to understand what about the teachers, the courses they teach, the schools they teach at, and where they teach predict their responses to the questions in Column A in Table 5. I performed a multinomial logistic regression to explore predictors of teaching about economic inequality and report the findings of it. For the purpose of analysis, I collapsed the responses "monthly," "weekly," "a few times a week," and "daily" into one category I name *often*, taking the stance that if mathematics teachers integrate economic inequality in their course monthly or at a greater frequency this is an occurrence that happens often. Integrating economic inequality monthly would mean making approximately ten connections in the mathematics class per school



year. I considered ten times or more per school year to be often. I named once or twice a semester as *occasionally*. In addition to findings from the multinomial logistic regression, I report descriptive statistics. Additionally, the interviews invited teachers make sense themselves of how they feel their conceptualizations of teaching about economic inequality came to be.

I focused on interview participants’ responses to particular interview questions for analysis pertaining to each of the three research questions (see Tables 6 and 7).

**Table 6: Survey and Interview Questions for Analysis, Research Questions 1 and 2**

	<b>Column A: Key Survey Questions for Analysis</b>	<b>Column B: Key Interview Questions for Analysis</b>
<b>Research Question 1:</b> To what extent do secondary mathematics teachers in the United States report teaching about economic inequality in their classrooms? What rationales do they articulate for why they do or not teach about economic inequality? Across teacher, school, and community characteristics, what factors are related to whether and how frequently teachers teach about economic inequality?	<ul style="list-style-type: none"> <li>- During this class, how often have you addressed issues related to economic inequality (for example, the distribution or disparities of income and wealth)?</li> <li>- When you have talked about economic inequality with this class, why did this topic arise? (reasons provided, such as it is an issue affecting the community in which I teach)</li> <li>- Why do you think that you have never talked with this class about economic inequality? (reasons provided, such as the topic does not relate to the standards of the class)</li> </ul>	<ul style="list-style-type: none"> <li>- Can you tell me about a particular time that the lesson seemed to achieve one of the goals related to economic inequality (if it did achieve at least one of your goals)? What happened?</li> <li>- Why do you think it’s important to engage young people in lessons about economic inequality?</li> </ul>
<b>Research Question 2:</b> In lessons about economic inequality: what mathematics content do they address, what aspects of economic inequality do they address, and how does mathematics and economic inequality content relate? How do they strive to teach about economic inequality in the mathematics classroom?	<ul style="list-style-type: none"> <li>- When you have talked about economic inequality with this class, which of the following topics have you addressed? (topics listed, i.e. unemployment, or what can be done to address economic inequality)</li> <li>- When you have talked about economic inequality with this class, in which context did you discuss this topic? (historically/present day, in the nation/globally)</li> <li>- When you have talked about economic inequality with this class, which of the following strategies have you used? (strategies provided, such as analyzed or collected data about economic inequality using mathematical tools)</li> <li>- When have you talked about economic inequality with this class? (e.g. during the warm up, or within the core lesson)?</li> <li>- When you have talked about economic inequality, how often have these lessons fulfilled a state content standard? (options provided)</li> </ul>	<ul style="list-style-type: none"> <li>- Can you please walk me through the lesson in as much detail as possible?</li> <li>- When you think about teaching about inequality, were you happy with how the lesson went? Why? If you taught it again, would you do it more or less the same or would you teach it differently?</li> <li>- For this lesson, what specifically did you want students to know or understand about economic inequality?</li> <li>- Have you experienced any obstacles in your efforts to teach about economic inequality?</li> </ul>

**Table 7: Interview Questions for Analysis, Research Question 3**

<b>Key Interview Questions for Analysis</b>	
<p><b>Research Question 3:</b> How do mathematics teachers think about the role of mathematics education in preparing students to engage civically in issues of inequality?</p>	<p>-Some people would say because it's math you don't need to bring in the personal or human dimension and others would say that math actually does have an important personal or human dimension. How do you think about this?</p> <p>-What knowledge or understandings or skills do you think are important for students to have in relation to economic inequality? What mathematics understandings or skills are important?</p> <p>-In lessons about economic inequality, are there particular things you hope students gain awareness of? How do you view mathematics as playing a role in that awareness?</p> <p>-Why do you think it's important for your students to become more aware?</p> <p>-What are you hoping students will do (if anything) about economic inequality after this class is over? Are there ways you hope mathematics is part of or informs what they do?</p> <p>-This may be a question not often asked of math teachers: Are there ways you hope your students will, now or in the future, engage civically in powerful ways?</p> <p>-Some people would say mathematics is a creative and flexible process of inquiry, while others would say mathematics is more rational and follows procedures to find a right answer. How do you think about what it means to do mathematics?</p> <p>-Some people argue (and others disagree) that mathematics brings objectivity or neutrality to studying economic inequality. What do you think?</p>

The data analysis process involved a constant comparative method (Bogdan & Biklen, 1982) of looking for patterns throughout the data collection process and sharpening and building on themes, looking for confirming and disconfirming evidence (Erickson, 1986). As I conducted interviews, I audio recorded them and took notes. Following the interviews, I drafted analytic memos with vignettes that embody salient points the participants spoke to; and I took note of what may develop as emerging themes. Following the completion of the interviews, I developed a coding scheme, utilizing descriptive, In Vivo, and values coding (Saldaña, 2013), so that I could build ideas and facilitate posing questions from the data (Bazeley, 2013). Overarching codes and sub-codes included: “why math” (mathematics teacher rationale for why they teach or do not teach about economic inequality, in the mathematics classroom), “what math” (what mathematics content they teach), “what economic inequality” (what economic inequality content they teach), “how” (pedagogic strategy), “nature of mathematics” (how they think about mathematics as: difficult/approachable; impersonal/human; pure/application-oriented; fixed/flexible; answers/process; experts/everyone), “awareness,” and “action.” I constructed a

codebook and organized the data into meta-codes and ultimately various themes. To preserve the voices of teachers, my analytic process often used their verbatim language. I drew findings from looking across the quantitative and qualitative data.

The “What Kind of Citizen” and (what I am referring to as) the “What Kind of Mathematician” frameworks that inform my conceptual argument provided a lens for how I conducted data analysis, particularly in relation to addressing my third research question.

### **Summary**

As I discovered predictors of teaching about economic inequality from the survey data, I returned to the interview data to further explore how those areas came up for teachers (e.g. I found that political engagement predicted teaching about economic inequality, so I reviewed the interview data to see how teachers brought up the ways in which they follow the news, talk about politics with others, and are active in their community in relation to what they do in the classroom). Also, discovering themes that came about from the interview data encouraged me to pose more questions from the survey data (e.g. in the interviews teachers discussed integrating economic inequality as a core part of their lesson or not, connecting economic inequality exploration to mathematical exploration or not, and addressing economic disparity or not, and variations in between; so I returned to the survey data to look at what percentage of teachers reported teaching about the distribution of wealth or income, in mathematical ways, in the core of their lesson). As I looked across results from descriptive statistics and the multinomial logistic regression as well as emergent themes from the interviews, I sought to make sense of and present these findings by first describing the larger sample of survey participants and then diving into the qualitative interview data to tell teachers’ stories that more deeply explored or offered explanations to or nuanced the survey findings, sometimes complicating survey findings.

## **CHAPTER FOUR: THE WHO AND WHY OF TEACHING ECONOMIC INEQUALITY IN THE MATHEMATICS CLASSROOM**

This first findings chapter explores the extent to which secondary mathematics teachers in the United States report teaching about economic inequality in their classrooms and the rationales they articulate for why they do or not teach about economic inequality. In other words, this chapter seeks to describe the *who* and *why* behind teaching about economic inequality in mathematics. This chapter reports on survey participants, a representative sample of public school secondary mathematics teachers in the United States, and interview participants, a subsample from the survey sample with an additional four independent school mathematics teachers at elite private schools - who are included to expand understanding of how mathematics teachers address economic inequality, especially from the perspective of working without national or state standards and with students from affluent backgrounds.

### **Mathematics Teachers Who Teach about Economic Inequality**

On the survey, teachers were first asked if they teach Algebra 1. If they responded yes, they were asked to answer a range of questions keeping in mind their Algebra 1 class, specifically the earliest period they teach in the day if they teach multiple periods of it. If they responded no, they were then asked if they teach Statistics (if yes, they answered subsequent questions about that class), followed by Calculus (if yes, they answered subsequent questions about that class). If they reported not teaching any of those three courses, they were asked to share the name of the course they teach most often and respond to subsequent questions regarding that course. What resulted was 35.1% of teachers reporting about Algebra 1, 15.9% about Statistics, 15.6% about Calculus, 10.7% about Geometry, 9.5% about Algebra 2, 4.2%

about Pre-Calculus, and 9.0% of teachers about another course such as an integrated math course or a non-traditionally named course, such as “Bridge Math.”

Of all public school secondary mathematics teachers surveyed, 70.3% reported facilitating discussions about social and political issues with their students. They could have interpreted this question to mean doing so within or outside of a mathematics lesson. Another question more specifically zoomed in to address issues of economic inequality: “During this class, how often have you addressed issues related to economic inequality (for example, the distribution or disparities of income and wealth)?” To this, 60.4% of teachers said that they have addressed economic inequality in their math class, meaning they did not respond *never* to this item. A majority of United States secondary public mathematics teachers surveyed report addressing economic inequality with their mathematics students. Likely of interest for teacher educators and others interested in encouraging mathematics teachers to bring in real-world social and political issues as discussed in the literature review, especially including the mathematics behind and within understanding and taking action on societal inequality, it is not the case that teachers mostly report not touching the topic; a majority of teachers report they do bring it up. 39.6% of teachers reported *never*, 32.5% were labeled *occasionally*, and 28.0% were labeled *often* (See Table 8).

**Table 8: Teaching about Economic Inequality in Mathematics Class**

Response	Percent	
Never	39.6	<i>Never</i>
Once or twice a semester	32.5	<i>Occasionally</i>
Monthly	19.9	<i>Often</i>
Weekly	5.2	
A few times a week	1.9	
Daily	0.9	

## Predictors of Teaching About Economic Inequality

To explore how teacher, school, and community characteristics relate to teachers reporting they teach about economic inequality, I conducted a regression analysis and report descriptive statistics. A multinomial logistic regression model with dependent variable *Teaching about economic inequality* (placing teachers in one of three categories: never, occasionally, often) was conducted with 23 independent variables (see Table 9).

**Table 9: Independent Variables in Multinomial Logistic Regression**

<b><i>Demographics</i></b>
-Social class growing up
-Race
-Gender
<b><i>Other teacher information</i></b>
-Years teaching
-Took courses in undergraduate or graduate that addressed economic inequality
<b><i>Teacher politics</i></b>
-Political self-identification
-Engage*
-Gap between the rich and everyone else in the U.S. has increased in last 20 years
-Gap between rich and poor is a problem
-People can get ahead if willing to work hard
-Hard work no guarantee for success
-Economic system unfairly favors the wealthy
-Reduce poverty by raise taxes on wealthy and expand programs for poor
<b><i>Course information</i></b>
-Course
-Class designation (e.g. honors, regular) of the class they reported on
-How much control they have over course textbooks
-How much control they have over course content
-How much control they have over course curricular pace
<b><i>School experiences</i></b>
Extent to which school administrators supportive
Extent to which colleagues share beliefs
<b><i>School characteristic</i></b>
-Percentage of students on free or reduced lunch at school
<b><i>Community characteristics</i></b>
-How characterize political learning of community where teach
-Percentage of people who voted for Obama in school's region

There were 361 cases with complete data considering these variables.

The variable named *engage* was formulated by Rogers and Westheimer (2016) to capture the extent to which teachers are politically engaged, which combines how often teachers reported being involved in an organization to make a difference in their community or society (double

weight), how often they reported following the news, and how often they reported discussing economic inequality with their family and friends.

The multinomial logistic regression is significant (Chi square = 158.57,  $p < 0.05$ , 80df). The model correctly predicts teaching about economic inequality in 59.0% of the cases and explains 35.5% of the variability in the data (according to Cox and Snell pseudo R-square). Analysis revealed six significant variables in the model that predict teaching about economic inequality: Control over selecting content, skills, and topics to be taught; course; the combined variable *engage* as described above; if their undergraduate or graduate coursework ever addressed the topic of economic inequality; gender; and political self-identification (see Appendix D).

**Control over content.** A majority of teachers reported having no or minor control over their course content (63.5% of mathematics teachers surveyed, compared to 36.5% of teachers who reported having moderate or great control). Teachers who reported greater control over the content, skills, and topics to be taught were more likely to report that they teach about economic inequality. Specifically, when comparing teaching about economic inequality occasionally to never, teachers who reported having moderate or great control over the content they teach are 3.80 times more likely to teach about it than those with minor or no control ( $p < 0.05$ ). Comparing teaching about economic inequality often to never, teachers who reported having moderate or great control over the content they teach are 3.97 times more likely to teach about it than those with minor or no control ( $p < 0.05$ ). See Appendix D.

**Course.** Teachers who reported on a statistics course were much more likely - 5.41 times - to teach about economic inequality than teachers of other subjects, when comparing those teaching about economic inequality often versus never ( $p < 0.05$ ). See Appendix D. To explain

this effect, it could be the case that the content of statistics courses lends itself to teaching about economic inequality in such a way that teachers feel they can make direct connections (through significance testing, distributions, and so on) and/or teachers who choose to be statistics teachers could be people more interested in social topics like economic inequality, or more broadly in real-world quantitative associations and the complexity of statistics to explain them.

**Political engagement.** Teachers who reported more frequent political engagement, as conceptualized by the *engage* variable, were more likely to report that they teach about economic inequality. Those with high level engagement were 3.37 times more likely to teach about economic inequality than those with low level engagement ( $p < 0.05$ ), when comparing teachers who reported teaching about economic inequality often as opposed to those who reported never. See Appendix D. This suggests that mathematics teachers who are more “in the mix” of politics, reading or watching the news, talking about politics with friends and family, and politically engaged in the community tend to also bring in political connections to their mathematics classrooms. Teachers’ political involvement in relation to teaching about economic inequality is explored more deeply in subsequent discussions of findings from teacher interviews.

**Taking courses on economic inequality.** Looking to teachers’ higher education experiences revealed another predictor of teaching about economic inequality: if teachers reported taking courses during their undergraduate or graduate studies in which the topic of economic inequality was addressed they are more likely to teach about the topic themselves. Teachers who took courses that examined economic inequality are 2.83 times more likely to sometimes teach about economic inequality, when comparing teachers who teach about the topic occasionally as opposed to never ( $p < 0.05$ ). Teachers who took courses that examined economic inequality are 3.81 times more likely to teach about economic inequality, when comparing



teachers who teach about the topic often as opposed to never ( $p < 0.05$ ). See Appendix D. It is important to note that this finding could be attributed to different explanations: such courses shaping their understandings, those who are more interested in issues of inequality self-selected into those courses in the past, or that teachers who presently teach about economic inequality may better recall that they took courses on it. It is possible that most mathematics teachers, if they did not take coursework that addressed economic inequality in their undergraduate or graduate years, never explored this topic in an educational setting. This is profound considering the extent to which schools reproduce economic inequality. If they did not learn about economic inequality within educational settings it may not be surprising that they are less inclined to bring it up with their own students.

Regarding college major, it is of note that the five teachers who were political science majors and the two teachers who were sociology majors all said that they teach about economic inequality. It may be the case, though these data cannot make the argument because so few teachers in this sample studied such areas, that teachers who studied a social science or science field which require interdisciplinary applications of mathematics are more likely to become mathematics teachers who mathematics with interdisciplinary connections.

**Political self-identification.** Analysis revealed that liberal teachers are 3.56 times more likely than conservative teachers to teach about economic inequality often, compared to never teaching about it ( $p < 0.05$ ). See Appendix D. Arguing that the economic system unfairly favors the wealthy, that poverty should be reduced by raising taxes on the wealthy, or that the economic inequality gap is a problem were not statistically significant as predictors of teaching about economic inequality. While liberal teachers are more likely to take up economic inequality often,

it does not appear to be the case that teachers with political stances specific to economic inequality take it up more.

**Gender.** Analysis revealed that male teachers are 2.24 times more likely than female teachers to report teaching about economic inequality often, compared to never teaching about it ( $p < 0.05$ ). See Appendix D. While race and social class growing up were not significant, gender was. There could be different explanations for this relationship including male teachers also feeling a greater sense of control over content or female teachers feeling more of a need to adhere to traditional mathematics teaching to prove their mathematical mastery as an under-represented population of mathematicians. Regarding race, with few teachers falling into each category of People of Color, race as related to teaching about economic inequality is difficult to make substantive conclusions from using quantitative analysis from this survey. Seventeen teachers of Color reported never teaching about economic inequality, twenty teaching it occasionally, and sixteen teaching it often. Given that the topic under examination in this study is economic inequality, it is interesting to note that teachers' reported social class growing up did not predict taking up economic inequality.

### **Mathematics Teachers' Rationales for Teaching about Economic Inequality**

The teachers who reported teaching about economic inequality at any frequency on the survey were asked what prompted them to address the topic (see Table 10).

**Table 10: Why Teach about Economic Inequality in Mathematics Class (out of 255 teachers)**

<b>Response</b>	<b>Percent</b>
It is related to a current event in the news.	43.5%
My students prompt me to address the issue because the topic concerns them.	43.1%
It is an issue affecting the community in which I teach.	34.1%
It is a concern of mine.	29.0%
None of the above	16.1%
It is an important theme within the curriculum I am already teaching.	14.1%

Percentages add to >100% because teachers could respond yes to more than one rationale.

It is notable that the least common response was that economic inequality is an important theme within the curriculum they are teaching. Of the 36 teachers who reported it is an important curricular theme, 14 of them were reporting about Algebra 1, 12 about Statistics, 3 about Calculus, and 7 about other courses; so there was not one course that stood out as teachers arguing the curriculum includes economic inequality as a theme. Across many variables - including how engaged teachers in their community and with the news and teacher political ideology - no variables stood out as distinguishing the 36 teachers from the rest of the sample who said they teach about economic inequality for other reasons.

The most common two reasons teachers reported for what encourages them to teach about economic inequality are students prompting them to address the topic because it is a concern of the students (43.5%), and current events (43.1%). This finding reflects that many teachers report a level of responsiveness to make space for such an area that matters to their students or the general public. The two next most common reasons teachers chose for what prompts them to teach about economic inequality - for each reason about a third of the teachers - are economic inequality affecting the community in which they teach, which could be interpreted as affecting a community's economic privilege, diversity, or marginalization (34.1%), and economic inequality being a concern of their own (29.0%).

### **Exploring What Prompts Mathematics Teachers to Teach about Economic Inequality**

The interviews with a subset of the survey sample allowed for and revealed greater depth and understanding into teachers' reasons for teaching about economic inequality. Referring back to Table 4, interview participants were diverse among a number of areas including political self-identification, years teaching, and percentage of students on free or reduced lunch. The interview sample consisted of majority White teachers, with 4/12 being People of Color, and mostly male

teachers, with 3/12 being female. All teachers reported growing up somewhere in the middle class range and almost all that they majored in mathematics in college. The ways in which teachers think about their backgrounds and characteristics of their schools and students come up in relation to why they teach about economic inequality is explored in this section.

To tell the story of why mathematics teachers teach about economic inequality, I explore 1) how teacher interview participants discussed what prompts them to teach about it, matching onto and deepening understandings of what teachers reported on the survey as discussed above, and 2) how the teacher interview participants articulated their learning goals for students or what it is they strive to promote in their classrooms by teaching about economic inequality.

The twelve teachers who participated in interviews discussed four primary areas of influence as prompting them to teach about economic inequality, corresponding with common survey responses as discussed above: their own backgrounds and experiences, their students' backgrounds and interests, current events, and the perspective that mathematics is interdisciplinary and therefore calls for relevant integration of social and political topics.

Near the conclusion of the first round of interviews, teachers were asked if they have had any experiences that have shaped their ideas regarding teaching about economic inequality (e.g. experiences growing up, experiences as an undergraduate or graduate student; experiences in professional organizations; experiences in community organizations, unions, or religious organizations). This open-ended question offered space for the teacher participants to choose the direction of their response, whether to take up discussion of one or a combination of the listed areas.

**Teachers' backgrounds, experiences, and political engagement.** Five teachers pointed to their own class background growing up as shaping why they address economic inequality

issues with students. Adesh, an Indian American teacher at a high poverty school, said that growing up he had working class, immigrant parents and explained:

Once I recognized those situations as something I was personally growing up in, it was just natural for me to understand my students in that way. It allows me to connect with some of my students who may not necessarily understand that there are people who can have that particular type of lifestyle or growing up environment and still make a change.

Here, Adesh shared that his own upward economic mobility and the individual navigation required to improve his standing is what prompts him to address economic inequality - because his students, like he did, have possibility for upward economic mobility. Similarly, Lisa, who designed a school-wide mathematics course on financial literacy, explained that it was watching her parents undergo bankruptcy and her mother now being a financial advisor that influenced her to design the course mostly focused on individual navigation but that includes mathematical examination of economic inequality within it. Adam, Denise, and Scott all stressed that they grew up middle class (not with little means, not with a “silver spoon”). Adam shared he was somewhat embarrassed to say that it was coming to realize that he looked down on those with less economic means when he was young as now prompting him to teach about economic inequality. Denise shared that her parents gave provided her with financial literacy knowledge that she wanted to pass to students and Scott that his parents always stressed service to alleviate economic hardship for others, especially considering that his mother grew up in poverty.

Three teachers pointed to other past experiences witnessing or studying inequality that expanded their social and political consciousness. Roslyn discussed how taking a Sociology course during her graduate coursework exposed her to nuanced understandings and arguments about racial and economic inequality in the United States. For Daniel, it was becoming involved in a program for teachers across subjects that is centered on global awareness and includes

visiting schools abroad with high proportions of youth living in poverty. They both discussed how having these life-defining experiences that encouraged them to challenge their worldviews shaped their desire to bring the topic to students in their classrooms. Carl, now a teacher at an elite private school, attributed his wanting to teach students about economic inequality to his prior experiences teaching at an economically marginalized public school where he witnessed “very, very smart” students struggle and coming to feel that no one should “turn a blind eye” to economic inequality, including himself and his current students who are mostly affluent.

Teachers also chose to discuss activity they are presently involved in as driving what prompts them to teach about economic inequality, and only one teacher brought up the news as prompting him to teach about it. To give a general sense of how engaged teachers reporting being, Table 11 below displays how the interview participants responded on survey items about being politically aware and involved.

**Table 11: Mathematics Teachers and Politics**

<b>Name</b>	<b>Follow News</b>	<b>Talk Politics with Friends/Family</b>	<b>Participate in Org. to Make Dif. in Community/Society</b>
Mark	Few times a week	Weekly	Daily
Denise	Daily	Daily	Weekly
Roslyn	Daily	Daily	Weekly
Carl	Daily	Few times a week	Weekly
Daniel	Few times a week	Few times a week	Weekly
Kevin	Few times a week	Few times a week	Weekly
Brian	Never	Few times a week	Weekly
Edward	Daily	Few times a week	Monthly
Scott	Daily	Never	Monthly
Adam	Daily	Few times a week	Never
Adesh	Daily	Few times a week	Never
Lisa	Weekly	Weekly	Never

While on the survey Adesh reported never being involved with an organization to make a difference in the community or society, he discussed in the interview how a very recent act of violence toward a female student on campus led him to get involved in school and community activism centered on challenging racial, gender, and economic inequality. While he explained he

did not often make connections to issues of economic inequality in his instruction of mathematics (e.g. his primary example was discussing economic inequality in AP Statistics after the AP exam when students viewed the documentary *Freakonomics*), he joined a committee at the school to design an advisory program that addresses these issues with students. Several teachers discussed the role of going to church and community service work connected to their religious experiences as influencing them to want to support students to think about those who are less fortunate, the most common type of participation in an organization to make a difference. Mark was the only teacher to explicitly bring up following the news; he discussed regularly following NPR - but not any of the major news stations - as well as attending social science talks as prompting him to bring in relevant examples to the mathematics class where he sees clear connections to that material. He provided a multitude of examples of news stories and talks as influencing mathematical conversations and curriculum, as he explained, “I try to model that notion of we're always learning and we should be reading the news.” Consistent with survey results on the most engaged teachers reporting they teach about economic inequality most often, Mark discussed being highly engaged and integrated economics inequality in a multitude of ways.

**Students’ socioeconomic backgrounds.** A majority of teachers interviewed pointed strongly to their students’ socioeconomic backgrounds as driving them to bring up economic inequality in the classroom. For these teachers, it was either the case that they taught students who were economically privileged and felt a duty to expose them to the reality that economic inequality exists and—for those who took it one step further—that the playing field is not equal in society; or that they taught students who were mostly economically marginalized and felt it relevant for students to know that they can improve their financial circumstance through

education and financial literacy, that the system is highly inequitable, or a combination of both. Mark, a private school teacher, discussed seeing a student carry several thousand dollar bills in his pocket on a field trip illuminating how privileged his students are; and Edward, a public school teacher serving students from affluent backgrounds, explained that knowing his students' parents design technology and make very large salaries from their work and that his students tend to hold views that economic success is all about hard work is what pushes him to teach about it, to challenge for students that it is not the case the hard work equals success. Holding a similar view but teaching an economically marginalized group of students, Roslyn described: "The American Dream ... You know, if you work hard, you can succeed. There's some merit to it, but in a large way there's a greater system playing against the population I teach that doesn't really make that completely true. I think that it's a topic that directly affects them, some of them being Black or them being from a low socioeconomic status, a lot of them having these aspirations and not understanding why so many of them get funneled basically to the same pathways." She wanted her students to know both that the system tends to be stacked against people like them but that it is not deterministic, that they have agency.

**Current events.** For many teachers, current events prompted them to address economic inequality. Teachers emphasized feeling as though they should not avoid current events but rather embrace discussion and exploration of them. Some argued it is the role of the teacher, whether mathematics or not, to bring current events into class so that students know that they have a space to discuss important topics. Within the group of teachers who argued it was current events that prompt them to discuss economic inequality, teachers fell into three categories: those that connect current events to mathematics learning regularly, those who never connect discussion of current events to mathematics, and those who mostly do not make mathematical



connections but find rare opportunities to (e.g. one or two times in the school year they feel that the news can connect to the content they are teaching). Those who did not connect current events to mathematics regularly often had side conversations with students or whole class conversations about current events that students were already discussing amongst themselves or a topic that the teacher identified as one they felt students should have space to discuss. For example, Scott, a private school teacher, pointed to just one lesson on exponential growth and loans that addressed economic inequality and when I asked if there were other instances he could think of where they make connections to economic inequality, he said, “Unofficially, it does come in the classroom, especially whenever something has happened news wise.” Similarly, Adam, also a private school teacher, explained that sometimes “current events just take over,” that his students are “looking for an outlet to discuss” current events and he likes “to provide that safe environment, because they don’t see eye to eye.” For example, during the first round interviews, which asked teachers to reflect back on the 2014-2015 school year, several teachers brought up making space for discussion about Black Lives Matter protests. During the second round interviews, which asked teachers to reflect back on the 2015-2016 school year, almost all teachers shared that students were very interested in discussing the presidential primaries. A few teachers mentioned that economic inequality came up in conversation, prompted by Senator Bernie Sanders’ focus on the issue in his bid for the democratic presidential nominee. In contrast, Lisa explained that she does not have time to address current events and believes students get access to current events discussion in the economics class they take.

**Curriculum calls for it.** Finally, and far less often than the other driving factors discussed above, a few teachers shared that it is their perspective that economic inequality and other “real-world” topics are part of their curriculum that prompted them to address it in their

mathematics classrooms. These teachers argued that mathematics is interdisciplinary and cannot be separated from social, cultural, and political phenomena. Thus, they view economic inequality as a curricularly relevant area in their classrooms, which corresponds with the survey response “It’s an important theme in the curriculum I am already teaching,” which only 14% of teachers selected. Sometimes textbook problems about economic inequality, most notably in statistics courses, which are often accepted as application-oriented, prompted teachers to address economic inequality. For example, Carl taught about pay discrimination as he supported students to solve a statistics problem relating to Simpson’s Paradox. Unlike other teachers in the sample, Edward, teacher of Statistics and Research Methods at a low percentage free and reduced public school, and Mark, private school pre-Calculus teacher, discussed bringing in lessons they designed themselves because they worked to make interdisciplinary connections throughout the school year outside of what is offered in their textbooks. Edward forged integrations mainly through exploring peer-reviewed quantitative social psychology research studies and Mark mainly through current local and national events and related data.

### **Exploring Mathematics Teachers’ Learning Goals for Teaching Economic Inequality**

Also crucial to understanding why mathematics teachers teach about economic inequality is how they articulate their learning goals or outcomes for doing so. Embedded in teachers’ rationales for teaching about economic inequality are arguments about the kind of awareness and action they hope to promote for students.

**Mathematical learning goals driving teaching about economic inequality.** First, teachers argued that their desire for teaching about economic inequality is driven by a desire to expand students’ learning of mathematics. There were two argument streams within the larger argument about mathematical learning goals. First, some argued it is not primarily that

awareness or action around issues of economic inequality propel them to incorporate learning about economic inequality in the mathematics classroom, but rather that examples about the topic can be in service of learning mathematics more deeply - which is their job: to teach mathematics. Examples about economic inequality allow students to engaged in more sophisticated ways with mathematical tools and concepts. Edward was adamant about this being his learning goal for students as he shared, "I'm not teaching about economic injustice. I'm not teaching about social issues. I'm using those as examples to show how the statistics works and how research methods can be done and show what issues come up with research methods and so forth." Edward, who emphasized mathematical goals for teaching about economic inequality, positioned mathematics as a more separate, objective entity from the social sciences that can be more deeply understood from problem application.

Second, some teachers argued that they included explorations of economic inequality because this supported students to be more excited and engaged in mathematics class, an often "dry" school subject for students. Adam asserted, "They could be bored as hell in math class but when we get on a topic like this they really engage and they're just hungry to know and to learn these life topics." He went on to explain, "it's of utmost importance to put that human side to it, the social side and practical side. Physics examples are only so interesting to kids. But they're very interested in social issues. Trigonometry identities put kids to sleep." As Mark discussed his international students arguing against high tax rates in the United States in the context of a mathematics project, he admitted, "Though it saddens me at time, the whole world just doesn't naturally love [mathematics] and so when you can bring in these contemporary issues you can hook some students that aren't necessary as mathy." Daniel, who had participated in a global studies program for teachers, explained that in project on third world country population change

and poverty his students had never been more engaged in anything else he facilitated the entire school year, stating, “once they start to see any sort of injustice, they're ready to pounce and investigate and really get involved”; thus, doing this project became a motivating factor for him to want to do more explorations like it so that students would find mathematics more engaging.

**The goal of awareness, but awareness for what purpose?** A common theme across teachers interviewed was that they teach about economic inequality because they hope to expand students’ awareness. Of the teachers who mentioned mathematical learning goals in the section described above, almost all of them also articulated goals of awareness. The ways they talked about students becoming more aware were linked to different purposes: general awareness (without implied action) and awareness for taking action related to being more empathetic, for informing individual navigation including financial literacy, and for collective change.

When posing the question to teachers of what their goals are in addressing issues of economic inequality with their students, the most frequent response can be captured in Mark’s argument: “I just think the awareness is huge.” For many, this means making space for students to understand that economic inequality even exists. For example, Daniel articulated, “ultimately it’s just a general awareness, an understanding this problem exists and it’s not as far away as a third world African country; the biggest problem with economic inequality is that a lot of people don’t recognize it as such.”

Beyond knowing it exists, teachers also argued mathematics can help students to be “aware of the scope of the issue,” as Scott named it, describing how mathematics can reveal the magnitude of inequality. Edward was passionate about students understanding that it is not just hard work that determines economic status, that there are “advantages you can get if you come from a more economically stable family”; when I followed up to ask what he hopes students may

do with that awareness, he responded, “I don't have any specific hopes or goals in that sense, but I would like to think that they'll go on to college and provide somewhat a voice of reason.”

Another way in which teachers discussed wanting students to be aware was specific to being aware of how statistics can be misleading, merging a mathematical goal with their goal of general awareness (e.g. to be a critical consumer of a news story citing quantitative data on the income gap). Denise argued that statistics can help people see economic inequality but that “if you're not wanting to admit that there is economic inequality, then you can fudge the numbers too.” Adam also stated that “somebody can come out and say whatever they want” but that “mathematical rigor forces you to wrestle with true underlying realities,” to “distinguish good facts from bad facts.”

A few teachers discussed awareness as a first step to making change but did not go on to say what kind of change or action they envision students engaging in. In this sense, there was a vagueness to how they conceptualized the purpose of being aware. This may also reflect that mathematics teachers have not been supported to think about this, or do not have the language off the top of their heads to discuss this area. As Scott said, “That's the only way they can make change. If they don't realize there's a problem there, then they can't be working on how to fix the problem.” Similarly, Daniel discussed wanting students to become “socially responsible young adults” but was not specific with a description of how he conceptualizes this.

Brian, a self-identified conservative teacher, was an anomaly; he was the only teacher to assert he hopes students are more aware but explicitly stated that he does not hope for action: “Probably my personal belief with economic inequality is that it's always going to be there to some extent. I don't have a thought or a hope that some student that I've taught at some point in time is going to find the cure for economic inequality in our society. I think it will always exist.”

As touched on above in describing teachers who were prompted to teach about inequality because they are teachers of economically privileged students, three private school teachers discussed awareness for building empathy. Scott argued, “My biggest hope is that they'll be able to approach issues of economic inequality with a sense of empathy, that they won't just write it off: ‘Oh, those poor people aren't working hard enough’ or, ‘Oh, those poor people are idiots,’ or, ‘Oh, they're just welfare queens,’ that they actually understand that's not the case at all and to be able to empathize.” In the same light, Carl shared he wants his students to not see and treat people of little economic means as less capable. Adam said that he hoped his students would put themselves in others’ shoes and not “take advantage” of people less well off.

One of the ways in which teachers expressed a clear conception of why they want students to be more aware was for students’ individual navigation, including financial literacy. Kevin spoke generally of his students needing skills to compete to navigate college, not expanding further on why they need to understand economic inequality to do this. While Adesh argued that if students know about inequality they will be more equipped to “climb out of their income brackets,” Roslyn also wanted students to “fight” individually, but from the perspective of critiquing systemic inequality, that “things are unfairly set up against them.” Several teachers spoke to hoping students would become more financially literate. As the strongest financial literacy advocate, Lisa called the kinds of investigations she facilitates for students in the Personal Finance class “citizen math.” When I asked her what she hoped students would do with their knowledge, she said, “not live off of welfare and food stamps, take care of yourself, handle it yourself, make yourself better for your family. Know how to make budget, invest wisely, know exponential functions for depreciating car worth and monthly payments for loans, and how to do taxes and why they’re paying taxes and why it’s so much.” Brian shared the perspective that it is

because students' parents have not been successful that they do not educate their children to be financially successful. Like Lisa, he argued that because of this, "to have a stronger citizenry," all students should take a finance course. Different from Lisa and Brian's stances, Scott and Denise spoke to understanding "how people get screwed over" (Scott) and how "the bank is robbing you blind (Denise). This was just part of Denise's narrative; she said she hopes students can do everything from challenge how they and others get taken advantage of financially to know how to use a credit card and budget to know how to tip a waiter at a restaurant. Scott emphasized more strongly speaking to how poor people are target for things such as "predatory credit cards" and "payday loans" and gave an example of supporting students to develop financial media literacy by examining an advertisement "for getting \$1000 in your bank account over night."

Few teachers pointed to awareness for inspiring students to engage in charitable work. None of these teachers linked charity work to the kind of knowledge or understanding mathematics can offer but talked about this action as separate from mathematics. Adesh gave the example of students volunteering at the a retirement home or cleaning up the neighborhood; Scott the Children's Miracle Network, Habitat for Humanity, and the Special Olympics; and Carl the Boys and Girls Club.

Finally, teachers held various conceptions of awareness for civic action. Roslyn, Denise, and Adam brought up that they hope their students will vote. Denise said she urges her students to vote—when they are old enough—in presidential races but also state and local elections. She referred to this as being "productive citizens wherever they go." In addition to voting, Adam said students could get involved in local leadership, whereas Roslyn a great deal of skepticism in the government, stating, "I do not have high hopes for our civic system." She said that her approach

to change is more at the “micro level,” first arguing people should create community change, then regional change, and so on. Then, she admitted, “But I haven’t thought about it enough.” She mentioned students going to town hall meetings and Adesh mentioned students going to school board meetings. While Lisa’s financial literacy narrative (discussed above) prevailed for her as the action she hopes students take, she spoke of one student of hers she believed “could make the right bill or law” because she views him as a future politician. Scott also spoke of a select few students making change, but in a different way; he said, “very few of them are going on to be researchers,” referring to a select few amount of students being involved in change by doing quantitative social science research. Finally, Mark discussed “math as a tool for democracy” and “math for the greater good” but did not offer specific definitions other than to follow up with, “I have nothing against investment banking, but I want them to do a profession where they’re happy and can make a difference for people” and gave an example, like Scott, of doing research-action.

### **Obstacles to and Rationales Against Teaching about Economic Inequality in Mathematics**

Both the survey and interview data shed light on why teachers do not teach about economic inequality in their math classes. Even though the interviews were conducted with teachers who reported teaching about economic inequality on the survey, all teachers spoke to reasons why teaching about economic inequality in math was challenging, why they do it infrequently, or why they do not do it at all in some of the math subjects they teach.

Teachers who chose *never* to the question of if they address economic inequality, which was 167 teachers, were asked why they do not address economic inequality in their class (see Table 12).



**Table 12: Why Not Teach about Economic Inequality in Mathematics Class (out of 167 teachers)**

<b>Response</b>	<b>Percent</b>
This topic does not relate to the standards for this class.	84.4%
I don't feel prepared to facilitate discussions on this topic.	28.1%
I don't have the curriculum or materials that I need to address this topic.	26.3%
I am concerned about how parents or community members might react to lessons on this topic.	12.6%
I am concerned about how my students might react to lessons on this topic.	12.0%
I am concerned about how administrators might react to lessons on this topic.	11.4%
None of the above	4.2%

Percentages add to >100% because teachers could respond yes to more than one rationale.

The vast majority of teachers who reported not teaching about economic inequality reported that they do not because the topic does not relate to the standards for the class (84.4%). These teachers may view such a topic to be an issue more applicable to the social studies. This response reflects a particular view of mathematics and what it means to relate to the standards of mathematics. Over a quarter of teachers reported that they do not feel prepared to teach about economic inequality, which was also true for not having the curriculum or materials they need to address the topic. If they were prepared or if they had materials, there is a chance this significant amount of teachers would engage in teaching about economic inequality. Less common of a reported deterrent was being concerned about how others would react, including parents / the community, students, and administrators.

Similar to providing greater insight into why math teachers do teach about economic inequality, the interviews provided a deeper understanding of why math teachers do not teach about economic inequality, do not teach about it often, do not teach about it in some math classes but do in others, or what obstacles are for them when they do.

### **Exploring Obstacles to and Rationales Against Teaching about Economic Inequality in Mathematics**

As Roslyn explained, “I would like to adopt a social justice math approach, but with all the testing that we have to succumb to, our kids wouldn't be prepared for it if I took that

approach ... The pacing, we were so behind.” The predominant reason teachers provided in the interviews as an obstacle to teaching about economic inequality was not having enough time due to a mathematically content-packed and rushed pacing guide, often connected to the timing and frequency of standardized tests. The four private school teachers interviewed did not discuss this as an obstacle, whereas the public school teachers did, particularly those at high and middle free or reduced lunch range schools. Denise explained that she feels pressure because topics like economic inequality is not what is “in the pacing guide.” Daniel’s comments exemplify the stance of most teachers interviewed: “In high school courses there's just this huge, huge list of stuff that you need to cover. It seems so broad, and it's difficult to connect one topic to the other, so you're constantly jumping around. You try to keep some consistency and if you dwell too long on any given thing, you're going to be regretting it by the end of the year.” It is the long list Daniel spoke of that made him feel he needs to “reign it in” with topics such as economic inequality.

Another common area of discussion that the mathematics teachers brought up was not feeling prepared to dive deeply into social and political issues, economic inequality included. While teachers expressed confidence in doing the “mathematics side” of economic inequality-related lessons, it was often the case that they expressed not feeling prepared to get into debate or even conversation about the causes or consequences of economic inequality, consistent with Bartell’s finding of teachers in a mathematics for social justice professional development as discussed in the literature review. Daniel explained, “I don't feel like I have a lot to contribute in terms of addressing the problem or why something is. I can present how things look and the way that it is. I wouldn't want to focus on social issues too much more mostly because I don't feel I have the expertise too much.” Teachers were split between taking the stance that social studies

and English should be the ones to take such areas up and wanting to know about more curricular examples and pedagogical strategies so they could take on more themselves within the mathematics classroom. Kevin, Adesh, and Carl expressed that subject areas like social studies and English are spaces in which students will wrestle more deeply with issues of inequality. Carl said that he wants students to be aware of inequality but that will take place “within the bounds of teaching the course.” Roslyn, while expressing she studied systemic inequality in her graduate coursework and thinks about root causes of it, said that it is not designing explorations that she does not feel unprepared for but supporting students to leave those explorations “becoming progressive instead of just becoming angry.” She credited this to students not having earlier foundations in their education that pushed them to think about prejudice and privilege in history and how people need to claim their prejudice and privilege. She was the only teacher interviewed who problematized dominant paradigms for teaching social science, although a few other teachers stated more generally that it is a problem that young people have a “bootstraps mentality” or believe solely in meritocracy.

Finally, teachers discussed not doing more to incorporate economic inequality and topics like it because they do not see it as very connectable to their content. Edward argued that while statistics is ripe for content connections, pre-calculus is “more dry.” On the other hand, Mark argued that pre-calculus is an excellent course to make connections in because students are so mathematically advanced by the time they reach that level that they have many tools at their disposal to draw on. Adam explained in his statistics course that social issue topics come up throughout the year but that in Algebra 2 and pre-calculus there are not many areas of content he could connect economic inequality to, other than regression models. A telling indication of teachers expressing skepticism and curiosity about mathematics course content as inviting

learning about economic inequality is at the conclusion of a few interviews teachers asked me what I was hearing from other mathematics teachers I interviewed because they wanted to know if there were other ways the content they teach could even be connected to economic inequality. Edward told me that he would imagine mathematics teachers who teach subjects other than statistics probably had much less to share with me than teachers of statistics.

Similar to the survey finding where only 11.4% of teachers said they did not teach about inequality out of concern about their administrators' reactions, in the interviews, teachers did not bring up fear of administrative backlash as an obstacle. One possibility for why this is the case—considering that in teaching for social justice scholarship navigating the challenge administration is well documented—is that none of the teachers interviewed discussed major, time-consuming units that address economic inequality, so perhaps the lessons and individual problems they chose to facilitate did not even come under the radar of school administration at all. The details of teachers' lessons are discussed in the following chapter.

The interview responses that informed the above results on obstacles to teaching about economic inequality were from the first round interviews that took place in Summer 2015. There was one difference of note regarding obstacles when the second round interviews were conducted the following summer as Donald Trump and Hillary Clinton were concluding their presidential campaigns: several teachers expressed not addressing social and political issues as much because they felt “politically exhausted.” Scott shared that because an overwhelming majority of young men at the all-boys private school where he teaches support Donald Trump, attributing this to what he called “teenage misogyny” against Hillary Clinton, he feared bringing up controversial political topics such as economic inequality.

## Summary

A majority of United States mathematics teachers report addressing economic inequality in their classrooms. Mathematics teachers who report teaching about economic inequality are from a variety of backgrounds and teach in various school contexts. That said, being more politically engaged, having an undergraduate or graduate background learning about economic inequality, teaching statistics, having control over content taught, being male, and self-identifying as liberal predict teaching about economic inequality. Teachers' rationales for teaching about economic inequality are nuanced and often relate to holding mathematical learning goals and/or goals for students to become more aware and, in some cases, take action on economic inequality. Most teachers interviewed argued that mathematics is central to students' awareness of inequality. Obstacles to teaching about economic inequality include packed mathematics pacing plans, teachers not having enough of a background in social and political issues, and teachers not feeling like their content can be connected to issues of inequality. However, many teachers report being interested in doing more than what they do. To understand what it is they presently do, the subsequent results chapter explores the kinds of lessons and opportunities teachers discuss presenting to their students to engage in economic inequality.

## **CHAPTER FIVE: THE WHAT AND HOW OF TEACHING ECONOMIC INEQUALITY IN THE MATHEMATICS CLASSROOM**

This results chapter explores what mathematics teachers address in lessons about economic inequality and how they discuss addressing it. In other words, this chapter addresses the *what* and *how* of teaching about economic inequality in the mathematics classroom. Specifically, findings reveal the aspects of economic inequality teachers address, the mathematics content they address, and how they relate the mathematics and economic inequality content. Finally, I address how they strive to take up the kinds of problems, lessons, and activities they engage in with their students. Like the previous chapter, this chapter reports on survey participants, a representative sample of public school secondary mathematics teachers in the United States, and interview participants, a sub-sample from the survey sample with an additional four independent school mathematics teachers at elite private schools.

### **Economic Inequality Content and Mathematics Classroom Activities**

First, I explore the economic inequality content and mathematics classroom activities teachers surveyed reported engaging students in.

#### **Economic Inequality Content Covered**

The survey provided opportunities for teachers to specify the topics and aspects of economic inequality they address and if they bring up economic inequality as an intersection with other forms of inequality. While not an expansive list, teachers selected from a list of possible topics (see Table 13).

**Table 13: Economic Inequality Topics Covered (out of 255 teachers)**

<b>Topic</b>	<b>Percent of Teachers who Report Teaching Economic Inequality</b>
Unemployment	63.1
Distribution of wealth and income	56.9
Hunger/homelessness	38.4
Social welfare policies	35.7
Tax policies	33.7
Predatory loans	32.2
Charity	21.2
Unions	13.7
Other topics	5.5
Trade policies	3.1
The Occupy Movement	1.0

Percentages add to >100% because teachers could respond yes to more than one topic.

There are a multitude of ways in which teachers could have approached these topics. For example, the most often selected topic, unemployment, could be addressed by analyzing employment discrimination or interpreted to mean teaching financial literacy skills to support students to gain employment themselves. Regardless of how all teachers surveyed interpreted addressing each of these topics, it is of note that a majority of mathematics teachers who reported teaching about economic inequality are reporting they address unemployment and the distribution of wealth and income.

It is also of note that the least addressed topic was the Occupy Movement, which is the only topic on this list that inherently problematizes systemic economic inequality. The survey asked teachers to reflect on the 2014-2015 school year; with the Occupy Movement's predominant activity taking place in 2011 and 2012, it is possible that teachers addressed it in prior years. It is also possible that teachers could have found it challenging to integrate the topic or that they viewed it as too political or polarizing.

**Aspects of economic inequality.** Teachers were also asked if the causes and consequences as well as more philosophical aspects of economic inequality came up as they addressed it, areas that could be interpreted by mathematics teachers as outside of the realm of

what can or should be addressed in the mathematics classroom (i.e. beyond quantitative conversation). Still, a majority (55.3%) of mathematics teachers who reported addressing economic inequality reported that the causes of economic inequality comes up and 38% reported what can be done to address economic inequality comes up. 20.4% of teachers reported addressing the meaning of a just or fair society and 16.1% the meaning of a just or fair economy. These responses reflect that there are many mathematics teachers reporting they attend to non-quantitative aspects of economic inequality, with about one-fifth of mathematics teachers who report addressing economic inequality reporting they take up justice or fairness.

**When and where.** In terms of the time period and location teachers addressed when topics of economic inequality came up, mathematics teachers more often reported teaching about economic inequality in the present day than historically (72.9% vs. 17.6%) and more often reported teaching about economic inequality in the United States than in other countries (65.1% vs. 27.8%). This suggests that when topics of economic inequality came up in class they tended to come up in ways that were “closer” to students, both in terms of time and place.

**Economic inequality and other areas of intersection.** 53.7% of teachers reported that they discuss economic inequality and financial literacy together, 62.0% economic inequality and educational inequality together, 42.4% economic inequality and gender inequality together, and 39.2% economic inequality and racial inequality together. These findings raise more questions than they answer, including the extent to which financial literacy and educational inequality came up with respect to students’ individual navigation, and the extent to which teachers present genderblind or colorblind explorations of class when economic inequality is addressed.



## Mathematics Activities

Mathematics teachers also had an opportunity to share on the survey the kinds of activities they engaged students in related to economic inequality (see Table 12). Looking at data (tables, graphs, and statistics) was the most often selected activity by mathematics teachers. Over two-thirds of mathematics teachers who reported teaching about economic inequality reported looking at data with their students, implying some type of quantitative exploration.

**Table 14: Economic Inequality Activities (out of 255 teachers)**

Activity	Percent of Teachers who Report Teaching Economic Inequality
Looked at data (tables, graphs, statistics)	67.5
Discussed a current event in society related to economic inequality	49.8
Discussed economic inequality in relation to students' personal experiences	39.2
Analyzed or collected data using mathematical tools	34.9
Conducted simulations or created mathematical models of economic inequality	18.0

Percentages add to >100% because teachers could respond yes to more than one activity.

Three of these options imply some kind of direct quantitative exploration (looking at data, analyzing/collecting data, and conducting simulations or creating mathematical models). However, it is possible that in discussing the other two areas (current events and students' personal experiences) teachers did or did not have these conversations in concert with mathematical dialogue or curricula.

**Connecting to standards.** Teachers reported on how often their attempts to address economic inequality fulfill teaching mathematics content standards (see Table 15). A majority of teachers reported never or rarely fulfilling standards when economic inequality comes up. This could be because the dialogue or exploration does not connect to mathematics at all (e.g. the

students and teacher discuss a current event related to economic inequality in the first few minutes of class), or it could be because the mathematics that is connected to the economic inequality exploration is not in the standards for the course it is being explored in (e.g. a lesson on wealth distribution in a Geometry class that does not integrate any concepts from Geometry standards). Over a quarter of teachers report often or always fulfilling standards in their explorations, however, highlighting that some mathematics teachers feel issues such as economic inequality are feasible to connect to their course standards.

**Table 15: Economic Inequality Lessons Fulfilling Standards (out of 255 teachers)**

Frequency	Percent of Teachers who Report Teaching Economic Inequality
Never	23.5
Rarely	32.2
Often	18.4
Always	7.5
I don't know	18.4

**When during math class.** A potential indicator of teachers taking up economic inequality in a way that was integrated with their mathematics teaching is when during class time they reported doing such activities (see Table 16).

**Table 16: When During Class Address Economic Inequality (out of 255)**

When	Percent of Teachers who Report Teaching Economic Inequality
Within the core lesson of the day	52.5
As an enrichment after the lesson is completed	41.2
During the warm-up activity	25.5
None of the above	12.5
After standardized testing is over for the year	7.1

Percentages add to >100% because teachers could respond yes to more than one class time.

A majority of teachers who reported teaching about economic inequality reported doing so within the core of their lesson. The second most often time was outside of a lesson as enrichment, which could have been related to mathematics or could not have. Approximately one-quarter of

students reported addressing economic inequality during a warm-up, which also could have or could not have been related to mathematics.

Of those 134 teachers who reported teaching economic inequality in the core of their lesson, 64.2% of them reported addressing the distribution of wealth or income (whereas 56.9% who reported addressing economic inequality in any part of class time said the distribution of wealth or income came up). Furthermore, of those who reported teaching economic inequality in the core of their lesson, 83.6% reported looking at data (in contrast with 67.5% who report teaching about economic inequality any time), 44.8% analyzing or collecting data (in contrast with 34.9% who report teaching about economic inequality any time), and 21.6% engaging students in simulations or mathematical models (in contrast with 18.0% who report teaching about economic inequality any time). These findings reveal that mathematics teachers who report teaching about economic inequality as a core part of their lesson more often report taking up the distribution of wealth and connecting economic inequality exploration with mathematical exploration.

#### **Teaching the distribution of wealth or income in the core of mathematics lessons.**

Because it is challenging with the survey instrument to measure the extent to which teachers are integrating economic inequality into their mathematics lessons, to zoom in on mathematics teachers' responses who potentially take it up in ways that more deeply integrated, I examined data from those mathematics teachers who responded that they address economic inequality in the core of their lessons (I interpreted this as they more likely see what they are doing as part of the mathematics curriculum) *and* that they look at data, analyze/collect data, and/or conduct simulations or mathematical models (I interpreted this as they are more likely bringing quantitative exploration to what they do) *and* that they selected addressing the distribution of

wealth or income (I interpreted this as they are more likely getting at economic inequality). In scholarship on *teaching mathematics for social justice*, as discussed in the literature review, teachers are often described as doing each of those. There were 78 teachers (18.5% of all teachers) who responded positively to these three areas. These teachers may certainly not claim to have or center social justice orientations to their teaching, but it is interesting to note that almost one-fifth of all teachers reported doing all of these. Also of note are differences in teachers who fulfill these three categories specifically in comparison with teachers who report addressing economic inequality but not attending to all these areas (see Table 17).

**Table 17: Addressing Economic Inequality in More Deeply Integrated Ways**

Survey Response	Those Who Report Addressing Economic Inequality	Those Who Report Addressing Economic Inequality -- More Deeply Integrated Ways
Reported on statistics class	15.9	43.6
Moderately or highly engaged politically	52.4	67.9
Took undergraduate coursework exploring economic inequality	66.4	80.8
Has control over content they teach	36.5	55.1

### **Mathematics and Economic Inequality Content Covered in Interview Focus Lessons**

Prior to the first round of interviews in Summer 2015, participating teachers were asked to share a lesson plan or description of one that attends to issues of economic inequality. The first portion of the first round interview prompt posed questions about this focus lesson, allowing space for teachers to speak specifically to a concrete example of a time when economic inequality came up for them. Table 18 displays a summary of the focus lessons teachers discussed. In some cases, interesting examples teachers provided from second round interviews the following summer are added into the chart as well (e.g. Carl’s focus lesson was on gender pay differences and then the following year he discussed teaching about the presence of lead in

Flint, Michigan’s water). In the cases of Brian and Kevin, they did not have examples of focus lessons to discuss, which was related to their interpretation of teaching about economic inequality to mean teaching with student poverty in mind or teaching with economic inequality among their students in mind. In the case of Denise, she spoke to many instances during which financial literacy topics arose but did not pinpoint a particular lesson in which they came up. The table below is organized by subject, with teachers who spoke about their Statistics classes on top as Statistics was the most discussed course, followed by Pre-Calculus, Integrated Math III, Honors Math II, and Personal Finance. While some of the interview sample teachers also taught Algebra, Geometry, and Calculus and those subjects came up during the interviews as well, no teachers chose those subjects for their focus lessons.

**Table 18: Focus Lessons on Economic Inequality**

<b>Name</b>	<b>Control Over Content</b>	<b>Course Discussed in Interview</b>	<b>Focus Lesson(s) - Mathematics Area Addressed</b>	<b>Focus Lesson(s) - Economic Inequality Issue Addressed</b>	<b>Lesson Description</b>
Carl	Moderate	AP Statistics	Simpson’s Paradox / Statistical significance	Gender pay differences / Lead in Flint, Michigan water	Integrated problem on the topic as example / Testing to see if difference in Flint’s lead levels statistically significant
Adam	Great	AP Statistics	Trends	Geography as predictor of wealth	Integrated problem on the topic as example
Edward	Great	Statistics and Research Methods*	Trends	SES as predictor of educational outcomes	Students examine statistical relationships by drawing on peer-reviewed studies, such as on stereotype threat
Adesh	No	Statistics	Statistical significance testing	Hiring discrimination based on race	Following AP exam, watched Freakonomics and exploration generated after watching film
Denise	Moderate	Statistics	None specified	401(k) Plans, Credit cards	Financial literacy topics come up throughout course
Mark	Great	Pre-Calculus	Piece-wise functions / Exponential functions / Logistic functions	Tax rates / College tuition increase / Zika Virus	Integrated each of these topics and more as examples or, in the case of the Zika lesson, as a simulation
Scott	Moderate	Pre-Calculus	Exponential functions / Scales of	Loans / Lead in Flint, Michigan water	Students did various problems to compare how much owed with different interest rates,

			measurement		time, etc. / Investigated magnitude of difference in Flint's lead levels
Roslyn	No	Integrated Math III	Interpreting graphs (e.g. trends), Constructing representations (e.g. distributions)	Several societal inequalities including distribution of wealth	Students created representation of how they think wealth is distributed across five groups and compared with real data; then examined graphs of various inequalities
Daniel	Minor	Honors Math II	Exponential functions	Population growth in most populated countries	Examining mathematical and social implications of population growth
Lisa	Minor	Personal Finance*	"Pay check math" and basic math for taxes	Minimum wage	Students researched the minimum wage debate and took stance
Brian	Great	Across courses	None described	None described	Discussed economic inequality among students, focused on calculator access
Kevin	Minor	Across courses	None described	None described	Discussed economic inequality among students, focusing on poverty; Ruby Payne influenced his ideas

\*Offered in math department; counts as math class.

Teachers fell into one of the following four categories: discussing a focus lesson *and* numerous other examples of connecting mathematics and economic inequality as well as other social issues (Edward, Mark, Lisa), discussing the focus lesson as one of a few instances of addressing economic inequality during the school year (Carl, Adam, Scott, Roslyn), unintentionally addressing economic inequality in their focus lesson and not having other examples of integration (Adesh, Daniel), or not having any focus lessons (Denise, Brian, Kevin). Each group of teachers is explored further in the sections below.

### **Numerous Connections**

Edward, Mark, and Lisa discussed making connections between mathematics and economic inequality as well as other social issue topics throughout the school year. Edward and Lisa, both public school teachers - at low and middle free or reduced-lunch schools, respectively - spoke to teaching somewhat nontraditional mathematics courses - Edward teaches a class

entitled Statistics and Research Methods (which counts as Statistics and is offered within the mathematics department) and Lisa a Personal Finance course she designed (which in the second round interview she shared is now taught school-wide and is also offered within the mathematics department).

Edward explained that he brings peer-reviewed social science quantitative research studies to his students or that they inform problems he designs for them to engage in, strongly emphasizing that such studies bring objectivity to understanding economic inequality. He cited teaching the statistics behind understanding socio-economic status as a predictor of educational outcomes and concepts such as stereotype threat. As discussed in the previous chapter, he insisted that he is not teaching about economic justice issues but rather teaching statistics and using these examples to illuminate statistical concepts.

Lisa shared a lesson on minimum wage as her focus lesson. Unlike Edward, she discussed supporting students to dive into arguments in support of or against raising the minimum wage. She first began the lesson asking students to share their initial perspectives on raising minimum wage and then put students into groups of four, asking each to play a role—a state representative, a federal representative, a consumer, or a business owner—as they came up with researched arguments about raising minimum wage. The mathematics she encouraged students to draw on was what she referred to as “paycheck math” to understand workers’ paychecks and the taxes they will pay and benefits they will receive, stating her students need to understand this mathematics and political arguments about minimum wage because “they are the ones who work at McDonald’s.” She describe attending to mathematics as “easy as the math for making a budget” and that they “go up to exponential functions for depreciating cars and their own monthly payments for loans.”

Unlike Edward and Lisa, Mark is a private school teacher. He described a focus lesson on step functions as a way of looking at tax rates. He was driven to devise this lesson because he noticed that the international students at the private school where he teaches were astonished at how low tax rates are in the United States, comparatively. Mark said he strived to have a “socratic attitude” as students explored tax rates. He then asked students to take a stance on whether or not to raise tax rates. What stood out from both of Mark’s interviews was that he listed off numerous examples in addition to this focus lesson, including lessons on: how gas prices are increasing and college tuition is increasing in relation to minimum wage, the average salaries of different professions including those who make salaries that place them in the top one percent, opiate use in the state where he teaches and how there are not higher rates of it but that more people tend to report it because they get support as opposed to incarcerated like in other states, and the spread of Zika. Mark explained:

I spend an awful lot of energy trying to figure out how can I deliver content that's rich and meaningful that's engaging to these students that's going to give them the math that they need to know. I like to think of myself as sufficiently aware and interested in learning and staying up-to-date on the news and such that I'm aware of stuff that I can share with them and relate to the kids and find a hook that's going to work.

While Mark shared that he also teaches Algebra 1, he shared that he most often makes these types of connections in Pre-Calculus, a “fantastic clearinghouse for really interesting stuff” because he argued that students have a range of mathematics content mastered and the Pre-Calculus content is advanced enough that he can bring in the rich mathematics he feels like connects well.

### **The Focus Lesson as the Primary Instance of Teaching about Economic Inequality**

Carl, Adam, Scott, and Roslyn each discussed a focus lesson as one of a few instances of addressing economic inequality during the school year. Carl described that when teaching the



statistical concept of Simpson's Paradox he began with an example on baseball and then gave students a problem in which they are asked to determine if gender pay discrimination is taking place by considering or not considering the fields that women are over and under-represented in or looking at overall trends. He then explained coming back to this topic when students learned about significance testing, testing to see if there are statistically significant gender differences in pay. A teacher at a prestigious all-boys private boarding school, Carl said he feels a responsibility to expose the affluent young men he teaches to conversations such as these. In the second round interview the following year, Carl described addressing the Flint, Michigan water crisis as he taught about statistical significance testing, calling on students to compare lead levels there with what should be expected, although he said, "it really didn't come up as an economic issue, but as a health or safety issue." Since he had mentioned that the students and he explored news reports about the lead levels, I asked, wondering if race and class came up at all, "In those news articles, in discussion amongst students, did it come up who the people are who are affected by the higher presence of lead?" and he responded that he did not recall that specifically coming up.

Similarly, Scott described one focus lesson in the first round interview and also discussed bringing up Flint, Michigan's water in the second round interview. His focus lesson was on compound interest; he said he began by writing the compound growth equation on the board, defining each component of it, and leading students through a few example problems. He had researched college student loan agency rates to inform the remainder of the lesson, as he then presented students with several problems to solve on saving and borrowing for college. For homework, he assigns a problem on calculating mortgage. He said the most memorable comment a student made in class following the lesson was, "Wow, I now see why people say that the

banking sector screws them over.”” While Carl brought up the lead levels in Flint in his Statistics class to explore significance testing, Scott brought it up in Pre-Calculus as the class was exploring scales of measurement. He explained:

Most of them were just shocked at exactly what the number suggested. With a lot of them, they heard the news, they saw on the report, and they just had no real concept of what any of that means. They knew it was bad and they knew that there was an issue, but they couldn't put it in context of anything. Being able to discuss the numbers and explain exactly what was going on, that fully helped them to realize, indeed, the scope of the issue.

Scott argued that mathematics offered a way for students to have a grasp of the magnitude of difference. When I asked Scott if the race and class of people affected came up, he said, “It did, but more through just natural conversation, not as part of any lesson or anything.” He went on to explain, however, that the class did discuss and problematize specifics behind the government response to the crisis. How both Carl and Scott taught about Flint, Michigan reveals that mathematics teachers may be more comfortable or more inclined to focus on the mathematics component of a social or political inequality issue and not frame this exploration to students as an exploration about inequality.

In Roslyn’s focus lesson, unlike Carl and Scott, she called on students to explicitly examine and name the intersections of racial, gender, and class inequality. Roslyn, a teacher at a high free and reduced price lunch school teaching majority Black and Latino students, introduced an integrated mathematics unit on inequalities by offering students opportunities to explore societal inequalities. On the first day of the lesson she asked students to compare their guesses at how wealth is distributed among quintiles of people in the United States with the reality, and then they watched a film about economic inequality. On the second day, when students came into the classroom she had graphs displayed around the room representing various inequalities

such as gender pay gaps, education level pay differences, and incarceration rates by race. She asked them what stood out to them and what surprised them. The dialogue then transitioned into the definitions of societal inequality and mathematical inequality. Following that, Roslyn explained, “then we proceeded on to do some of the math stuff,” distinguishing the prior activities as not mathematically explicit activity despite students exploring distribution and graphical representations.

Adam, like Carl a private school teacher at an all-boys school seeking to support his students to be engaged in Statistics, shared that it was challenging to recall particular examples but shared one problem he presented to students on correlations, looking at what variables are correlated with wealth. He also shared that in Statistics when he teaches the difference between mean and median, a basic statistical concept, he asks students to think about if or how Bill Gates being added to a sample would affect the mean and median wealth of a group of people, stating that he hoped students would see how each are valid measures of central tendency but that report different information. He emphasized that conversations related to economic inequality come up at various instances in Statistics but that the other courses he teaches “deal with topics that don't lend itself to this discussion at all.”

Unlike the first group of teachers, Carl, Adam, Scott, and Roslyn did not discuss making multiple natural interdisciplinary connections between mathematics and economic inequality; however, they each could point to at least a couple instances of integration.

### **Unintentionally Addressing Economic Inequality**

Two mathematics teachers, Adesh and Daniel, discussed how they unintentionally brought in conversation around economic inequality into the mathematics learning in their classrooms. Adesh showed the film *Freakonomics* to his AP Statistics class following the AP

exam at the end of the school year, with the plan to show it because there would be statistics involved, but not anticipating that it would lead to mathematical conversation on economic inequality. Daniel, a public school teacher who participated in a global teachers program abroad, taught a unit in an integrated honors level II mathematics class with the intention of wanting students to learn the mathematics behind global issues such as population growth. Daniel explained that his intended focus was mathematical modeling—that it is central to the Common Core—and that real-world situations are interesting to explore because they do not fit models perfectly. He asked each student to select a country, one of the world’s one hundred most populous countries. They then had to answer various questions about the country and draw on their knowledge of exponential functions to model population growth. Daniel noted that many students took up further investigating poverty and inequality in their focus countries and that it was class conversation on those issues that was the “richest” dialogue in class all year. Both Adesh and Daniel welcomed such dialogue and reflection that resulted from explorations not intended to be about economic inequality and were also both explicit in sharing that they want to do more purposeful integration in the future because of how engaged students were *and* that the topic of exploration is important for students to understand as citizens.

### **No Focus Lessons on Economic Inequality**

Three teachers did not have focus lessons on economic inequality to share because they did not teach any particular lessons about it. Given the nature of this study, this could be interpreted as an instrument design or recruitment limitation, reflecting the challenge of studying teaching *about* economic inequality as connected to mathematics learning. Still, revealing findings about teaching about economic inequality came out of interviews with these three teachers. Denise discussed having numerous conversations with students throughout the school

year on financial literacy topics including budgeting, using a credit card, saving for retirement, and buying a car. She also discussed it being important that students know about predatory lending practices and how their participation in politics matters but did not share examples of how that came up in her classroom. Denise sent a lesson plan prior to the interview, but it did not include an economic inequality topic connections.

Both Brian and Kevin, public school teachers at a high free and reduced lunch percentage school and low free and reduced lunch percentage school, respectively, did not discuss bringing up topics related to economic inequality with their students at all. Brian, a politically conservative teacher, focused what he shared in the interviews on his observation of students not having equal access to calculators because of their financial circumstances. Kevin, who was an engineering major in college, discussed encouraging students to individually navigate through college and that they need mathematics to ultimately be financially secure because it opens doors for future education for them. When I asked him if various economic inequality topics have ever come up in his classes, he responded, “I think those probably will come up in social studies class or something, but not in a math class because I do algebra and geometry,” reflecting a perspective about what it means to do mathematics.

### **Addressing Economic Inequality Outside of Mathematics Learning**

As discussed above, Denise’s inclusion of economic inequality topics into her classroom were limited to non-mathematics learning. While most teachers discussed particular lessons in which mathematics integration did occur, almost all of them discussed welcoming conversation about economic inequality and other relevant social issues outside of mathematics time because of how they think about their role as teachers. As discussed in the previous chapter, several teachers spoke to seeing themselves as mentors in students’ lives, regardless of the subject they

teach. Several teachers expressed wanting students to know their classroom is a space where current events are open for discussion. Acknowledging that, Adam explained, “Current events would take over. The boys are looking for an outlet to discuss them. And I try to provide a safe environment because they don't see eye to eye.” Similarly, Scott shared, “Unofficially, economic inequality does come up in the classroom, especially whenever something has happened news-wise. 95% of time issues come up it's not connected to a math lesson.” Both Adam and Scott discussed that it is important to them for students to see them as politically aware and open for discussion *because* they are math teachers, because they want students to know that regardless of what they do in life they can be aware and have their own views and perspectives. In this way, they're challenging for students the role of the mathematics teacher but not via teaching about economic inequality. Roslyn felt similarly but highlighted that it is within informal conversations one-on-one or in small groups with students that race and class inequality come up most often, that when she hears students comment on these issues, she engages them. Adesh stood out in that he discussed engaging students in discussion about inequality and other topics such as sexual harassment in a non-mathematics advisement course he and a committee of other teachers on his school campuses started.

In the second round interview in Summer 2016 as the presidential election approached, several teachers brought up that students discussed the election in class, including how economic inequality was (or was not) a focus. Denise was one of the teachers who wanted to make space for students to have this conversation, and she discussed encouraging them to not only be invested in the presidential race but in state and local elections. She explained, “it was one of those teachable moments, where you just don't want to say, "Okay, let's get back to the lesson at hand," because I feel that we teach, we need to teach the whole child. That is part of what we do

in current events and getting them to understand what's going on and what could their future hold.” As she does not integrate discussion of economic inequality with mathematics learning, it is not surprising she sees political discussion as getting away from the lesson. Even Brian who focused his interview conversation on his students needing access to calculators noted that when student conversations about the election came up they tended to be divided along race and class in terms of who was more conservative or more liberal-leaning. Carl also discussed the election with students saying he wants the class to be driven by what they are interested in, so that when he hears about what they are energized about, such as economic policy of Trump, Clinton, and Sanders he tries to “strike while the iron is hot.” Similarly, Lisa said of the election and economic inequality, “it was more brought up spontaneously than actual lessons.” Mark noted that when the Flint water crisis was making national news he was discussing lead poisoning with his students because there was also high lead levels in that area, but that those conversations were more about “checking in with students and having side conversations.”

This finding reveals that regardless of how teachers develop and integrate interdisciplinary curriculum with mathematics and social and political issues, they are frequently making space for discussion on topic like economic inequality with their students.

### **Mathematics Teachers Taking a Stance**

During mathematics lessons about economic inequality as well as during the informal dialogue mathematics teachers made space for on the issue, teachers shared a range of views about sharing their own perspectives on economic inequality with students, with some being very against making their perspectives known for reasons such as fear of coming off as having an agenda or fear of students not thinking for themselves, while others sought to make their perspectives known.

## **Staying Away from Indoctrinating**

Some teachers framed sharing their own perspectives as interfering with students coming to their own conclusions. For example, Scott said, “I always try to as best as I can maintain neutrality in the classroom. I want to educate them on an issue but not steer them one way or another. I want them to make up their opinion.” Similarly, Denise shared, “When it comes to the issues of inequality, I leave them to talk. I give them a question or I’ll give them a scenario or something and I’ll let them, because they’re older. I try not to impose my views on the kids. I try to let them look at the scenarios and look at the whatever is out there.” Roslyn shared that in discussing lead poisoning in Flint, Michigan, she would only share her perspectives and highlight that she feels this happened because the people there are economically and racially marginalized if the students asked her. When I asked why she has that approach, she said, “I don’t want to sway their thinking process. I think they’re getting near to adulthood, they should be able to think for themselves, rationally, and try to hear other people’s arguments, and see if it sticks or if it holds. I think they’re set up to think teachers have some higher power of knowing everything. I already know I’m going to have more sway than their peer group.” While a few teachers felt this way, it was not common for teachers to say they strive to maintain complete neutrality.

## **A Balance of Perspectives**

A few teachers argued that their role as a teacher is to keep a balanced classroom in terms of the ideas that are shared. Adesh’s approach is to not share his perspectives but to try to “be a moderator” and “share both sides.” Similar to Adesh, Carl shared, “I very much try not to interject my own opinions and beliefs into it because I want them to have their own and I don’t want what I feel to color what they may feel, especially when you may have teenage boys that



are impressionable. They may say something they think is just because you want to hear them say that. I try very much to leave my own thoughts out of it and just mediate.” Daniel hesitated to share his beliefs in fear of pushing students away,” so instead said, “I often find myself, regardless of my personal beliefs, sort of playing devil's advocate. The role of a teacher I feel is to expose the students to as many different opinions and perspectives as possible.” He admitted, however, that participating in the global classroom program gave him stronger opinions about global inequality that were challenging for him to suppress when the topic came up in class because he is now so passionate about global poverty and inequality. Brian also highlighted how he will question or bring forth different sides to an argument: “I start off and would try to go through a lot of the conversation and go back and forth with a lot of the facts as I ask questions and I attack both sides. If one side is getting more leverage over the other, then I ask questions that keep them both going. I argue as, I don't know, as a moderator, as one that wants to get the facts and information out there.” His desire to “get the facts and information out there” leads to the next way in which teachers discussed sharing their perspectives.

### **Mathematics is Objective, Neutral**

Sometimes mathematics teachers' arguments for why they chose to share or not share their perspectives were explicitly tied to how they see themselves as teachers of mathematics. For example, a few teachers argued that they would only share objective, numerical facts whether or not they shared their own views. Edward, Scott, and Mark emphasized turning to “published evidence” or “indisputable things,” the role of the mathematics teacher being a facilitator who could bring in such indisputable, quantitative evidence. Edward, who stated he teaches in a liberal area and wants to avoid conservative students feeling like they need to silence themselves, explained, “It's not that I'm not sharing my beliefs. It's just I'm only going to

do so in the context of factual, already-published evidence, so it's possible there's a bias in what I select and I don't realize it, but I try not to present opinions as fact. There's all sorts of studies that show this or that, and I have no problem discussing the findings of studies and explain possibilities within those as long as I'm not showing a bias outside of the research that was already presented. That kind of objectivity, I think, opens their eyes to a lot of things without feeling pressured to join the liberals or anything like that.” Edward further argued that focusing on the facts makes a political issue a nonpolitical one.

Similarly, Scott argued, “I'm usually very open with them. I definitely preface, whenever things like this come up, that they are just, indeed, my opinion on the matter. I try also doing it in a way where I'm not being judgmental one way or another. It's just sort of like: This is my opinion. This is what the evidence suggests. This is what research has done and has concluded. I try to keep it open-ended, so that way it's not ... I'm trying not to get up there and preach on a soapbox.”

Mark used the same language of wanting to avoid preaching by turning to objective numerical data: “I try to be very objective and help students to, in all contexts, to try to avoid being accusational or really trying to strongly sway and more just talk about: These are indisputable things. Then, this is how I feel about some things. I try to not make it preaching or sermon like. I try to ... I do a lot of data work with the school and really just try to be as objective as possible.”

Adam was the fourth teacher to emphasize objectivity and indisputable facts as he discussed bringing up income disparity with with his economically privileged students: “As far as the income inequality thing, I think there's enough sort of factual information out there that I don't make any secret of the fact that I'm kind of a bleeding heart liberal kind of thing and I side

with the proletariat, so to speak. I think just leaning on the facts, I'd say, 'Hey, whether you agree with this or not, this is just the way it is that there's this percentage of the population that this is what they actually make,' and that kind of stuff.”

### **Sharing Stance**

Finally, Lisa shared in the interview that her parents and brother have small businesses and that raising the minimum wage “would just destroy them” because they can barely afford to pay wages and benefits for their employees at the current minimum wage. Her view on minimum wage in general is that it should not be raised. She said was not shy to share this with students and was the only teacher interviewed, aside from Adam who said he shared he is a “bleeding heart liberal,” who shared strong stances in a very upfront way with students. Interestingly, when describing the lesson she did with students on minimum wage, she said that she would need to find articles for students to read about the issue because they did not have the skill set to find sound articles themselves and also shared that most ended up also concluding it should not be raised; this could bring into question how much room the students felt they had to have a different stance than she. However, Lisa also made the point that since she is open with her beliefs she feels it encourages students to be open with whatever theirs happen to be.

### **Summary**

From an exploration of what kinds of economic inequality content and mathematics content teachers take up, as well as how they discuss taking up what they do, findings reveal that teachers have a range of ways they strive to teach about economic inequality in the mathematics classroom. None of the teachers interviewed taught multiple lessons throughout the year with an intended social justice focus, as teaching for social justice scholarship conceptualizes. Yet, each of these teachers are open to thinking about mathematics and economic inequality. Teachers see

economic inequality fitting into different mathematics courses, sometimes throughout the school year but more commonly during particular curricular moments. The extent to which they tie mathematics standards for the course they are teaching to the economic inequality issues varies. For most teachers, they strive to bring up economic inequality and other relevant social and political issues with students whether or not this exploration is tied to mathematics. While teaching mathematics for social justice scholarship argues that all teaching is political, mathematics teachers have complex views about this area, often asserting that mathematics should stay away from being political or that it is inherently an apolitical field.

## **CHAPTER SIX: MATHEMATICS, AWARENESS, AND ACTION**

This chapter explores how mathematics teachers think about the role of mathematics education in preparing students to engage in issues of inequality. To do this, I draw on interview data, first exploring how the mathematics teachers think about what it means to do mathematics in the context of learning about inequality; teachers bring complex perspectives of understanding mathematics as a particular kind of tool. Then, I explore how mathematics teachers think about what it means for students to be aware of and take action on economic inequality; they have a range of ideas on what they hope students will become aware of and what they hope students will do with this awareness.

### **What Kind of Mathematician?**

Mathematics teachers' reflections on addressing economic inequality offer insight into how they think about what it means to do mathematics, in the context of learning about inequality. Paul Ernest's (2009) framework provides a lens through which to analyze different dimensions of how teachers think about the nature of mathematics. He defines an image of mathematics as "a view, perception, or informal account of mathematics as a discipline and area of enquiry [...] partly made up of tacit inferences, assumptions, and beliefs about the nature of mathematics (p. 46). This analysis draws on Ernest's framework to identify three "kinds of mathematicians" that wrestle with issues of inequality: the interdisciplinary mathematician, the objective mathematician, and the critical mathematician. The teachers interviewed raise interesting perspectives and difficult questions about each of the three ways of conceiving mathematics. I conceptualize each not as mutually exclusive nor do I argue teachers fall into having one view of the ideal mathematics student who wrestles with issues of inequality;

teachers focused, in different ways and to different extents, on how mathematics as a tool can bring an interdisciplinary lens, objectiveness, and a critical eye to understanding inequality. Analysis revealed a few teachers emphasized aspects of all three kinds of mathematicians described below. Within each way of viewing the mathematician, I provide examples to show that how teachers think about mathematics as connected to the kinds of opportunities they offer students to explore issues of inequality.

### **The Interdisciplinary Mathematician**

Ernest (2009) argues that when it comes to thinking about how different knowledge areas are related, it is possible to think about mathematics as isolated and discrete or as “joined up with and inseparable from other forms of knowledge.” Traditional philosophies view mathematics as in search of truth that is asocial, acultural, and apolitical and isolated from other knowledge areas, whereas new philosophies view mathematics as socially and culturally constructed and politically situated and not separate from other knowledge areas (Ernest, 2009). This investigation revealed that teachers think about mathematics as interdisciplinary to different extents.

Whereas most teachers discussed mathematics as a class in which the subject can and should be merged with social science to some extent in relation to teaching about economic inequality, this was not the case for all teachers. Kevin discussed talking about politics periodically with students in conversations completely separate from mathematics learning. He explained, “Social issues come up in a social studies class, not in a math class. I do algebra and geometry.” In his case, related to his interpretation of mathematics as a separate area of study, he did not offer any opportunities for students to merge mathematics learning with learning about economic inequality. Similarly, Adesh argued that almost all social and political issues cannot be

connected to mathematics and that mathematical rigor means “sticking to the heavy curriculum” devoid of social and political issues. He admitted that mathematics can have applications but the application component does not need to be integrated when mathematical procedures are taking place. The only instance of economic inequality coming up that he referred to was after the AP Statistics exam when students were watching a film, so it was not a structured lesson and the discussion came up unintentionally. Finally, Brian shared the perspective that it is only AP students who will go into mathematics-related fields and need to be able to think about mathematics in more in-depth ways but did not define interdisciplinary mathematics learning as in-depth learning; he did not express the view that mathematics is an interdisciplinary area that everyone needs to wrestle with and therefore he also did not integrate issues of economic inequality in his classroom.

Ernest (2009) asserts that viewing mathematics as inseparable from other forms of knowledge means having the perspective that mathematical concepts and methods have been created to solve real and pressing problems. Roslyn exemplified this perspective when she shared, “doing math means asking questions to interrogate graphs and research about inequality and how change happens and measuring the change.” Mark discussed a mutuality of learning about mathematics and learning about economic inequality: “Real life situations can allow you to understand math differently, or math can allow you to understand real life situation differently.” He cited numerous examples of opportunities he strived to offer to students to do just that, including on topics such as taxation rates around the world and what is fair. Daniel also emphasized a strong interdisciplinary stance as he argued that mathematics and social issues like economic inequality should not be brought together in the context of a periodic problem but that “to teach a social concept in the math classroom well, it needs to be something that is sort of an

overarching theme of the year.” He did not see himself as doing this yet, as he discussed just discovering how powerful learning can be when his students learned about global population growth and poverty in a project.

Most teachers fell somewhere in the middle of conceptualizing the interdisciplinary mathematician. Carl stated he wants students to learn about economic inequality in the mathematics classroom “within the bounds of teaching the course,” interpreting mathematics as a discipline that can sometimes be integrated with learning about economic inequality but that mathematics is a subject area defined by the mathematics that needs to be covered. This perspective was reflected in how he addressed a lesson on the lead levels in Flint, Michigan. Students investigated if there were statistically significant levels of lead but did not take time “within the bounds” of the class to take up this issue explicitly as an issue about economic inequality; they explored mathematics behind the issue but not mathematics and the issue in concert.

Another way teachers fell in the middle was to express that there are limits to where interdisciplinary mathematics learning happens. Of his Statistics and Research methods class, Edward said, “they’re finally in a math class where they can tackle real-world problems and deal with social issues [...] I would imagine most of the math teachers you talked to who don’t teach statistics have rather different responses.” Edward distinguished statistics as opposed to other mathematics department classes as a site of interdisciplinary mathematics learning, explaining his decision to offer opportunities to explore economic inequality as related to that interpretation of mathematics. Adam also said, in discussing how he teaches about trends related to socioeconomic status, “Statistics is what matters. You open the newspaper, it’s everywhere. This is the age of big data.” While Adam expressed feeling similarly to Edward about statistics, he



argued that it would be “utopian” if he “could somehow teach” by “maybe flipping [mathematics] on its head and like, ‘Hey, let’s just meander through interesting topics and then along the way, we’ll stumble into lots of interesting math and then in context you see how valuable and useful math is and that sort of sparks your interest.’”

Teachers’ notion of what it means to be an interdisciplinary mathematician is related to how they think about teaching economic inequality. When they make such interdisciplinary connections they can approach mathematics’ role in different ways, which leads to the next kind of mathematician.

### **The Objective Mathematician**

Ernest (2009) argues that philosophies of mathematics and the public’s image of mathematics are guided by thinking about the “values position” that mathematics takes. He asserts that traditional philosophies of mathematics view mathematics as value-free, focusing on right answers and objective facts. If someone holds a traditional image of mathematics, they believe that mathematics is a challenging, impersonal, abstract field that follows fixed rules to reveal a single solution, an objective fact. On the other hand, he argues that new philosophies and public images of mathematics think about mathematics as “value-laden but in objectivized form.” Most mathematics teachers in this study emphasized mathematics as lending an objective lens, in one way or another, to understanding issues of economic inequality.

Mark stated outright that he strives to be “as objective as possible” and to keep any mathematical discussion of issues of inequality from “being personal.” He shared that he thinks about quantitative awareness as developing a “factual, database mindset.” This stance is driven by his frustration that, speaking generally of the media, politicians, and citizens, “people make emphatic, sweeping statements without quantifying,” but that learning mathematics can assist

students to have “more objective and precise language,” thus allowing them to “argue intelligently with mathematics.” He links objectiveness to intelligence. For Mark, his ideas about the objectivity of mathematics translate into how he frames lessons about inequality to students. He described how, in explorations of economic inequality, he tells students that, regardless of how he or students “feel about some things” (e.g. political opinions on economic inequality), “[mathematical statements or findings about inequality] are *indisputable things*” (emphasis added). Similarly, because of Edward’s perspective that peer-reviewed quantitative studies are scientifically objective in nature, that they “present a position without feeling like you’re trying to be convinced or it’s a matter of opinion,” he said that the ways students look at inequality in his classroom is “less of a philosophical debate.” He gave the example of examining the data behind stereotype threat research, arguing that findings from the data “has nothing with trying to be fair or social justice or anything” and actually makes the issue of affirmative action “not a political issue.” Edward discussed how the examination of quantitative studies and the non-biased proof they offer guides the entire course he teaches, stating, “That kind of objectivity opens their eyes to a lot of things.”

Daniel, Scott, Carl, and Adam each used similar language to describe their understanding of the objective nature of mathematics: “It really makes things real” (Daniel); “Numbers don’t lie. The numbers are the numbers, they are what they are. That’s purely objective” (Scott); “A real concrete way to measure actual, real benchmarks” (Carl); “Whether you agree with this or not, this is the way it is” (Adam). In this way, they describe the objective mathematician as bringing proof to claims about inequality in ways that proof would not otherwise be present without mathematics. While the interdisciplinary mathematician views mathematics as complementary to other ways of knowing, the objective mathematician emphasizes mathematics

as superior to other ways of knowing. Scott explained, as he was referring to exploring the lead levels in the water in Flint, Michigan, “When they see the numbers behind it, they can finally understand that that’s a problem.”

However, each of them offered a different type of caveat to objectivity, complicating the notion of the objective mathematician. Daniel explained that “you don’t need math to understand economic inequality but [...] when you start to analyze the extent or the consequences, that’s where math can lend itself nicely.” Similarly, Adam argued, “There’s a lot of politics which isn’t about numbers, but math is critical in establishing facts [...] going to the numbers, those are oftentimes the facts.” Unlike Edward, they emphasized that it is possible to have understandings of economic inequality that are meaningful without turning to the numbers. Adam chose to say that numbers are *oftentimes* the facts, an interesting word choice to reveal that facts can come from non-quantitative places too. While Scott emphasized “purely objective” numbers that “don’t lie,” he followed that up with, “That’s not necessarily neutral or neutrality because you can then take those objective numbers and spin them however way you want to. With that, an element of the subjective comes in, at that point.” In this way, he is arguing that mathematics offers objectivity but that, in Ernest’s (2009) words, the process of doing mathematics is also “value-laden.” Carl also explained that there is “room for argument in certain circumstances” and said he gave the example to students of how the courts have to choose a p-level to use for discrimination cases.

Scott, Carl, and Adam also made the argument that the objective nature of mathematics allows for a particular benefit when wrestling with issues of economic inequality: that it can reveal the scope or magnitude of it in a way that is undeniable. Carl said, “You can actually give a number to how unfair something is.” When discussing wealth distribution with students, Adam

said he is “comfortable going there” because when they look at data the students can say “there is this percentage of the population that makes this much.” When discussing the federal budget and assistance programs, Scott said calling on students to reflect on magnitude using mathematics matters, explaining “It’s not even 1/10 of 1/10 of 1/10 of 1% of that trillion dollar budget we’re talking about here.”

Roslyn critiqued the idea that mathematics is value-free most directly, taking the strongest stance that mathematical explorations of economic inequality are “not cleaner by any means,” that political and moral arguments are woven into the mathematics and statistics of economic inequality. She critiqued strict objective, impersonal interpretations of mathematics as she shared, “Sometimes you are stripped of the humanity and you're just looking at these hardcore numbers,” and then added, “I don't think that [mathematics is] neutral.” Roslyn discussed the process of doing mathematics, in the context of an integrated mathematics class unit on various societal inequalities, as wrestling with where graphical representations on inequalities come from, who conducts the studies, and different conclusions that can be drawn from them. Unlike Mark and Edward, Roslyn discussed mathematics itself as value-laden and fluid, not something that is objective and fixed which people can then, after doing the mathematics, form opinions from. Yet she still discussed how mathematics “makes issues concrete, memorable, gives a picture,” and as she related to showing graphs of societal inequalities to her students, she argued, “There is power in visual representations to see and understand change.” I characterize her perspective of the objective mathematician to include viewing mathematics as “value-laden but in objectivized form,” as Ernest (2009) names it.

## **The Critical Mathematician**

Another way in which teachers discussed the kind of mathematician who wrestles with economic inequality is the “critical mathematician.” Ernest (2009) explains that mathematics can be thought of as developing “critical, independent, and yes - even democratic - ways of thinking and being.” People can hold different ideas about the relationship between mathematics and reality; from a traditional perspective, mathematics is “unreasonably (miraculously) effective in applications to empirical reality,” or as “constructed systems and models inspired by and abstracted from human practices and problem situations,” therefore always open to and calling for critique. Several teachers emphasized how they view mathematics as a critical tool that students can use to assess the legitimacy of claims about inequality.

Some teachers who emphasized mathematics as an objective endeavor also expressed that mathematics can be used as a tool to critique. For example, Adam discussed offering opportunities for students to critique claims as legitimate. He defined his role as a mathematics teacher around his commitment to develop critical mathematicians:

You teach kids to tell the difference between good facts and bad facts, to be critical in their consumption of any sort of input that they get. You don't just take it at surface value. For them to do that, they need a lot of tools and that's obviously the role of the teacher. I'm definitely of the opinion, 100 percent I believe, I'm in the camp that the facts and the data are there to help us, but there are a lot of potential pitfalls and that's what a lot of people need help understanding better. That's the role of the teacher, to help them sort that out.

Adam argued that mathematical rigor can help students to wrestle with underlying realities, to ask critical questions such as, “Can they really do that without raising taxes?” which can help students to understand the world around them and “distinguish good from bad facts.”

Scott and Mark gave examples of the “potential pitfalls” of representations of mathematics that Adam spoke of. Mark discussed opiate use in different states with his statistics

class, calling on them to understand that only looking at rates of use cannot offer conclusive information about how often they are used, pointing them to one state “where pregnant women imprisoned for reporting it” and another where they are “instead get guided to healthcare, counseling, rehab,” highlighting that rates seem higher in the latter state because women feel more comfortable reporting their usage. Mark asserted that everyone should “have a fundamental understanding of statistics” and “be a more discerning consumer of information” because “statistics manipulates.” Scott also discussed hoping students would develop crucial media literacy with mathematics, particularly in relation to the media. He gave the example of a popular talk show host in a commercial trying to convince people they could get \$1000 in their bank accounts over night, saying that he points out to students “if you read the fine print on that commercial, it is horrible. It is like the worst thing you could do. If you don't pay that money back almost immediately, it's basically going to bankrupt you. It's almost designed to make sure you're going to... They're going to take all your money, you're going to just be left with nothing.” He gave other examples such as “predatory credit cards” and payday loans as being manipulative, and therefore offering opportunities to students when they study exponential growth to challenge “how that can really screw over somebody.”

As Roslyn described, the critical mathematician asks “probing questions” and “understands how you understand.”

### **What Kind of Awareness? What Kind of Actor?**

Teachers share complex ideas about the kind of mathematician they hope students will become, in the context of learning about economic inequality; similarly, they have a range of perspectives about the kind of informed individual or civic actor they hope students will become. While the previous section focused specifically on mathematics, the present section focuses on

awareness and action. Mathematics teachers' reflections on addressing economic inequality offer insight into how they think about preparing young people to engage with issues of inequality. Some teachers offered ideas about mathematics and civic preparation, while others did not emphasize developing students as citizens. When asking them about economic inequality, teachers argued that students should become more quantitatively aware. Some teachers emphasized awareness of financial literacy skills—with possible actions as a result of that learning to be to pull themselves up financially and/or teach others financial skills. Most teachers argued students should develop sociopolitical awareness of economic inequality—with possible actions as a result of that awareness being to be more inspired to individually navigate finances and their higher education, to participate in charity or community service, to be more empathetic, to run for office, to conduct quantitative research on inequality, to be an activist for justice, or, simply, to be more aware for the sake of being more aware. Each of these goals for quantitative awareness and the nuances of possible actions, including civic action, resulting from awareness are explored in this section.

### **Financial Literacy**

While I posed questions to teachers about economic inequality—why they wanted their students to be aware of it and what they hoped their students would do about it—a few of them focused their responses exclusively on financial literacy, on how students can be better informed to support their own economic advancement, and some teachers who talked about sociopolitical awareness brought up financial literacy as well. Given that several teachers framed financial literacy as part of teaching about economic inequality (or, in some cases, what teaching about economic inequality is all about) is a notable finding.

The course that Lisa designed, Personal Finance, almost entirely focused on financial literacy, with the exception of the lesson on minimum wage but even within that lesson the mathematics she guided students through was what she referred to as “paycheck math.” Lisa, a public school teacher at a middle-range free or reduced price lunch percentage school, focused on themes such as budgets, loans, and credit cards. When asked about her hopes for students to address economic inequality she said, “Math helps develop yourself, to grow your money and wealth management.” She defined “citizen math” as “to not live off of welfare and food stamps, take care of yourself, handle it yourself. Charity starts at home. Make yourself better, just for your family.” An economic situation she framed as an economic injustice that she wanted students to be aware of was small businesses being required to pay their workers more, as her family members were small business owners. Lisa did not bring up that she hoped students would have an awareness of economic inequality in society but brought up that she has in mind “one energetic student who could make the right bill or law.”

While Brian, a public school teacher at a school with a high percentage of students on free or reduced lunch, did not talk directly about teaching lessons on financial literacy, he was adamant about the need for financial literacy in schools in response to what skills he hope students would have related to understanding economic inequality:

[Students] don't understand how bad paying interest is on different things and how beneficial saving is, and how beneficial saving is early on. How to budget. There's just not courses out there where we're educating them for that. We hurt our whole population because of that, because we end up with more people on welfare. We further increase that economic gap because we're not educating. I mean, people are learning that from their parents or they're not. If they're on the lower end of it all, they're not learning. Their parents have not been successful in that arena. If their parents are not successful in that arena, and we're not training them any differently then they're going to learn their parents' habits, and that's going to perpetuate the cycle to probably even a greater extent.



His response reveals that his answer to addressing economic gaps is for people to become more financially literate but he also stated that he believes that since there will always be economic inequality he does not have particular hopes that students will do something about it.

Denise and Scott both discussed hoping students would build a sociopolitical awareness of economic inequality, which will be addressed below, but emphasized financial literacy strongly throughout their interviews as well. Denise described she hopes students will budget their money well, understand credit cards, plan for a 401K, and know how to tip a waiter. She discussed addressing these topics as covering economic inequality and as civic preparation:

I think economic inequality is something that, of course, as kids, they don't really understand fully, but once they can grasp, "Okay, well, I can do this so that I don't need this high interest credit card, and I'm looking at the interest rates, and the AP, and all of that ..." They can come away from my class knowing... I believe that they can come away from my class being a better citizen.

While Denise teaches at a public school with many students on free or reduced lunch, Scott is a private school teacher and emphasized he hoped his students would be financially literate to understand affording college and, especially for his middle class students, know about taking out loans to afford college. The majority of the mathematics content he discussed teaching in the interviews was around exponential growth, related to a unit on college loans.

All of these teachers argued that students, armed with financial literacy knowledge, could take action by making choices that would improve their personal financial wellbeing.

### **Sociopolitical Awareness of Economic Inequality**

The majority of teachers, to different extents and for different reasons, discussed hoping their students would be aware of economic inequality in society. Unlike those concerned primarily with financial literacy, they shared about wanting students to be aware of economic inequality as a problem of public concern. Teachers discussed a range of possible actions they

hoped students might take as a result of that awareness: to be more inspired to individually navigate finances and their higher education, to participate in charity or community service, to be more empathetic, to run for office, to conduct quantitative research on inequality, to be an activist for justice, or, simply, to be more aware for the sake of being more aware.

**Individual navigation.** Kevin did not teach about economic inequality and Adesh discussed bringing it up unintentionally after watching a film. However, they both mentioned they want students to be aware of discrimination, including class discrimination. Adesh said he hopes students will “enact change by climbing out of their income brackets” and Kevin that “students should know what they’re doing” referring to getting skills they need to navigate college. Kevin cited seeing Ruby Payne speak as informing his thoughts about poverty and how poor people should come out of it. The rest of the teachers taught about economic inequality and linked their hope for students building sociopolitical awareness to particular lessons they incorporated.

**“Realizing there’s a problem there.”** The four private school teachers and one public school teacher at a low free and reduced lunch percentage school discussed awareness of economic inequality from a similar perspective: they want their students to know that economic inequality exists, to be aware of how they are economically privileged, and to consider the lived experiences of others who are less well off than they are as they go about their lives. Adam explained, “They just simply don’t know, it’s not part of their world experience.” He described how his students are unaware that they are in “the top ten percent of society as far as income is concerned because everyone around them seems so much richer.” Scott strongly emphasized that awareness is a pre-condition for taking some kind of action and that he sees his role to be to “get these kids prepared to enter the world and make a difference within it.” He explained, “If they

don't realize there's a problem there, then they can't be working on how to fix the problem.” He wants students to know that people do not start at a level playing field and that “there are really people suffering” so they will be motivated to then think about what they may do to help. Scott was very specific in wanting to challenge his students holding perceptions such as “poor people are idiots” and “they’re just welfare queens” and instead support them to be empathetic. He sought to do this through exploring topics such as predatory loans. Edward named this is students “realizing their privilege and how it’s not just about hard work.” He explained that the reason he explores with students through quantitative data that people have advantages when they come from a more economically stable family is driven by his desire to support them to challenge their privilege.

Daniel, a public school teacher at a middle-range free or reduced price lunch school, as well as Roslyn and Denise, public school teachers at a high percentage free or reduced price lunch school, also emphasized awareness. When followed up with a question on action, Daniel responded, “Ultimately it’s just a general awareness, an understanding this problem exists and it’s not as far away as a third world African country; the biggest problem with economic inequality is that a lot of people don’t recognize it as such.” Roslyn specified that she hopes students’ awareness includes understanding how social and economic conditions change over time and being aware of how research on inequality can be interrogated. While Denise focused most dialogue with students on financial literacy as discussed above, she also brought up how she wants students to be aware of economic power and discrimination in society: “Math is helpful because it shows them how one can be taken advantage of or how one group of people cannot prosper because of some type of bias or prejudice, and they need to be aware.”

**A vague sense of potential action.** In terms of how they hope students may take action

on economic inequality, Edward said, “I don’t have any specific hopes or goals in that sense, but I would like to think that they’ll go on to college and provide somewhat a voice of reason.” He also mentioned wanting students to “get beyond political sound bites and specious arguments.” Carl vaguely stated he hopes his students “would find ways within their communities to help do away with some of those inequalities” to “help children with lesser means.” He did not provide examples of his students using their awareness to challenge inequality. Several teachers shared ideas about the kinds of ways they hoped their students would take action, especially when prompted with civic questions, but often did not have very concrete ideas about action, or many specific examples of it. Teachers discussed empathy and consuming information (critically or not) as actions. Teachers rarely discussed participatory action beyond some saying they hope some students run for council. Some teachers who discussed teaching for awareness of systemic inequality then discussed more individual forms of action. It was rare they linked something they were doing in their class to something that would prepare students to engage in action, so when they shared action it was more of a hope. Still, it is important to explore the range of ideas teachers brought up.

**A range of potential actions.** Adam listed a range of actions including “first and foremost, they’re not being the people who take advantage of other people,” “to just have a little perspective,” “to not be caught up in materialism,” “voting, involvement in local leadership, be up to speed on issues,” and for “those who are inclined, pursuing things and social sciences and policy and that kind of stuff.” He did not elaborate more on not taking advantage of others (he was the only teacher to bring this up), involvement in local leadership, or pursuing social sciences and policy. He concluded by stating, “it’s not like they have to do something huge.”

Scott gave the examples of students getting involved in the Children’s Miracle Network, Habitat for Humanity, and the Special Olympics. He added, “And not just charity work but non-profits” but noted that he hopes students get civic skills from their other classes.

Mark shared he hopes his students will be empathetic and nonjudgmental and “have a notion of social responsibility.” When following up to ask what he meant by this, he used the phrases “math as tool for democracy,” “math for the greater good,” and wanting students to have a “global perspective,” but did not define these ideas. He discussed professions students may take up when he mentioned some students may go into quantitative research about inequality and said, “I have nothing against investment banking, but I want them to do a profession where they’re happy and can make a difference for people.” He seemed to be searching for words as he concluded with, “I just have a hard time conceptualizing a specific strategy where math would be able to address economic inequality other than the understanding.”

Daniel strongly asserted that he believes it is the “responsibility of a math teacher to foster a socially responsible young adult” and said he would be “proud if they became an activist and fighter for justice and human rights, and proud if they were nailing down a job when they were never given a chance.” He was the only teacher to directly mention activism but did not follow up with examples of it or discuss bringing up activism in his classroom.

Roslyn was the only teacher to critique that status quo of “the civic system.” She explained that she does not have a lot of hope that, through it, marginalization of People of Color and low-socioeconomic status people will improve. While saying she felt like she had not thought about it enough, she said that she hopes the younger generation will “create community change, then regional change.” She said that local bridges are more effective than policy. While sharing she does not have “high hope for the government,” she said she would still like to see

students vote and participate in town halls. In her lesson about various forms of inequality, she explained that she hoped students would see how “things are set up against them” (e.g. that women would more deeply understand the gender wage gap, that her Black students would understand the school-to-prison pipeline). Overall, she concluded that she wants students to “fight harder, and also get a little grit.”

Across the teachers, they focused on hoping students would be aware of economic inequality, touching on a range of ideas of what students might do about it such as being more empathetic to those with lesser means, participating in charity or community service, voting, getting involved in local leadership, or pursuing the social sciences (e.g. conducting quantitative research on inequality). Often times, they generally shared hopes that their students would “make a difference for people” or “help do away with some of those inequalities.”

## **CHAPTER 7: CONCLUSION**

### **Overview of Study Findings**

This mixed methods research gives a picture of the secondary mathematics teachers in the United States who take up the topic of economic inequality, the ways in which they strive to do so, and how their ideas about mathematics and preparing students to be more aware and take action are linked to their teaching about economic inequality.

### **Teaching Secondary Mathematics Students about Economic Inequality**

This examination discovered how common it is for public school secondary mathematics teachers in the United States to address economic inequality in their classrooms, what predicts them doing so, and why they do or do not take up such a topic. Drawing on survey data (n = 422) from a representative sample of public school secondary mathematics teachers in the United States, 70.3% reported facilitating discussions about social and political issues with their students and 60.4% of teachers said that they have addressed economic inequality in their mathematics classroom. Exploring how teacher, school, and community characteristics relate to teachers reporting they teach about economic inequality regression analysis revealed six predictors: gender, political self-identification, level of political engagement, if teachers took higher education coursework about economic inequality, teachers' control of course content, and course. School factors such as the percentage of students receiving free or reduced price lunch did not predict teaching about economic inequality.

A range of areas prompt teachers to teach about economic inequality, with most teachers reporting current events or their students prompt them to address the topic. While 60.4% of teachers reported addressing economic inequality, 39.6% reported never addressing it. Exploring

why they do not revealed that the vast majority (84.4%) of teachers feel the topic does not relate to the standards for their mathematics class.

From interviews with a sub-sample of eight public school mathematics teachers from the survey, and with four additional elite private school teachers, all of whom reported teaching about economic inequality on the survey, this study revealed that teachers take up economic inequality with their students because they want their students to be more engaged in mathematics class and/or because they hope they will be more aware of inequality in society.

However, they also discussed obstacles to teaching about economic inequality as having too much mathematics content to cover in the school year to take time for such exploration, not feeling prepared enough to engage students in the topic, and being unsure of how a lot of the mathematics they teach could forge valuable connections to the topic.

### **Economic Inequality Content and Mathematics Content Addressed**

Exploring the kinds of lessons mathematics teachers take up revealed that teachers strive to make connections in various mathematics courses. Addressing unemployment and the distribution of income or wealth were the two most common economic inequality topics mathematics teachers reported addressing, according to survey data. In terms of where and when their lessons referred to, teachers reported mostly addressing present-day economic inequality within the United States. Over two-thirds of mathematics teachers who said they address economic inequality said they have looked at data, such as tables, graphs, or statistics, with their students. About a third of the teachers reported analyzing or collecting data using mathematical tools. Approximately 18% of all teachers surveyed reported teaching economic inequality 1) in the core of their lesson, *and* 2) by doing at least one of the following: looking at data,



analyzing/collecting data, conducting simulations or mathematical models, *and* 3) by addressing the distribution of wealth or income.

From teachers' descriptions of specific lessons in interviews, they tended to discuss making connections to economic inequality either in statistics lessons on significance testing or identifying trends or lessons on exponential growth. While teachers discussed a range of economic inequality topics such as gender pay discrimination, socioeconomic status as a predictor of educational outcomes, tax rates, minimum wage, and financial literacy topics, few teachers discussed offering students multiple opportunities in the school year to wrestle with issues of economic inequality. Two teachers discussed weaving in topics from the news and quantitative studies regularly. Some teachers unintentionally brought up economic inequality but still found it fruitful to discuss and others did not discuss any specific lessons in which economic inequality came up. Most teachers explained that, outside of mathematics lessons, they strive to provide space in their classrooms for students to dialogue about current issues but also mostly shared that they stay away from sharing their opinions about economic inequality or only strive to share them within "objective" dialogue because they do not want to indoctrinate students and want to ensure a balance of perspectives.

### **The Role of Mathematics in Engaging with Issues of Economic Inequality**

How mathematics teachers think about their teaching of economic inequality is related to their conceptions of what it means to do mathematics and their ideas about the ways in which students may become more aware of and take action on economic inequality. Interviews with teachers revealed that how teachers think about mathematics as an interdisciplinary field, an objective discipline, and a critical tool relates to the kinds of opportunities they offer to students to explore economic inequality. An interdisciplinary view of mathematics was connected to

teachers looking for opportunities to weave in economic inequality. Teachers who think about mathematics as objective emphasize the superiority of numbers, graphs, and statistics to provide proof that economic inequality exists or that it is the magnitude it is. Teachers who emphasized that mathematics can critically challenge claims about inequality also discussed offering opportunities for students to do this within their classes. Similarly, the different ways in which teachers think about how learning about economic inequality builds students' awareness and prepares them to take action relates to the opportunities they offer students. When asked about economic inequality, some teachers turned the conversation to financial literacy and explained how they want students to be able to individually navigate their finances and higher education opportunities so that they can be more economically prosperous as individuals. Most teachers interviewed discussed hoping to build students' sociopolitical awareness of economic inequality, preparing students to participate in charity or community service, be more empathetic, run for office, conduct quantitative research-action on inequality, be an activist for justice, or, simply, be more aware for the sake of being more aware. In many cases, teachers' vague responses or partial ideas about action reflect that teachers have not had many opportunities to think about or articulate their mathematics teaching connected to the kinds of action they hope students take, with some teachers stating outright they have not thought about it much.

### **Building a Conceptual Framework of Mathematics Teachers' Conceptions of Quantitative Civic Literacy**

How mathematics teachers think about *quantitative civic literacy* is not in particular fixed categories but is complex and in most cases teachers do not indicate having had opportunities to think through what it means to them and how they strive to support students to build it, especially because their goals for action are sometimes not related to the state or social order, or

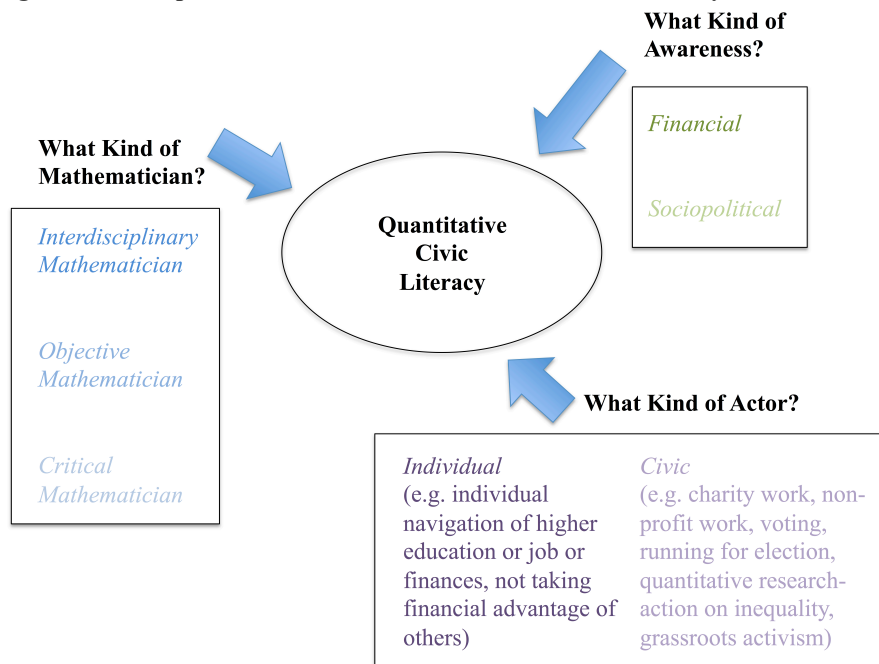
they are partially formed civic goals. While I hypothesized that the What Kind of Citizen (Westheimer & Kahne, 2004) framework would offer a lens through which to understand how teachers think about preparing mathematics students as citizens, in the context of lessons about economic inequality, this examination revealed that mathematics teachers do not fit nicely into being guided by the vision of one of the three categories of citizens- *personally responsible*, *participatory*, or *social justice-oriented*. Oftentimes, teachers have partially formed ideas about how their students may become citizens, they mention civic action of several different kinds as well as or sometimes only as action that is not civic in nature, and they sometimes do not link what they do in the classroom to their ideas about students becoming citizens but rather speak generally about how they hope students may take civic action in the future.

Still, the What Kind of Citizen framework, combined with arguments about the nature of mathematics, is an important guide in forming a conceptual framework to map mathematics teachers' conceptions of quantitative civic literacy. While the What Kind of Citizen framework centers on action and the overarching vision of civics-centered programs, and while mathematics teachers have emerging ideas about action that I argue can and should be more nuanced and do point toward the kinds of citizen Westheimer and Kahne (2004) conceptualize, it is clear that mathematics teachers emphasize mathematics' power in building awareness – and that there is not just one way it can do so. Gutstein (2006) discusses that mathematics lessons can foster in students a *sense of social agency*. He points out that mathematics can build a sense of agency and offer ideas about potential actions but action itself or even explicit reference to it does not have to take place within the lesson or project to be meaningful for students, which was reflected in this interview data through how teachers discussed their hopes for students developing awareness and taking action. I extend Gutstein's argument to specify that teachers do not need to discuss

civic action directly or engage students in it within the context of the mathematics classroom to be preparing students in particular ways as actors. For example, if students are supported as “critical mathematicians” who critically consume graphical representations of economic inequality and teachers focus on expanding students’ sociopolitical awareness of inequality, students are in more of a position to understand and act on root causes of inequality, as the “social justice-oriented citizen” does.

I argue that how teachers build *quantitative civic literacy* is shaped by how they conceive of mathematics, how they seek to develop awareness, and how they hope their students may take action (see Figure 1).

**Figure 1: Conceptual Framework of Quantitative Civic Literacy**



In mapping a framework for quantitative civic literacy, I extend the What Kind of Citizen framework to include not just potential civic actions teachers have in mind when teaching students about economic inequality but also individual actions as well as awareness that can

guide, influence, or inform civic action. Additionally, Ernest's (2009) images of mathematics provide insight into how teachers conceive of different kinds of mathematicians who use mathematics as a tool to become more aware of (and possibly take action on) inequality. These "kinds of mathematicians," therefore, also shape this conceptual framework for quantitative civic literacy. Each of these orientations toward mathematics can make mathematics accessible, relatable, and useful as a tool for students' awareness and potential action.

Overall, teachers who emphasized mathematics as an interdisciplinary endeavor, a "value-laden discipline in objectivized form," and a learning process that involves bringing a critical lens to economic inequality issues *and* who emphasized striving to build students' sociopolitical awareness for civic action tended to discuss offering more nuanced opportunities for their students to wrestle with economic inequality in their mathematics classrooms.

Quantitative literacy scholarship, in particular *Mathematics and democracy: The case for quantitative literacy* (NCED, 2001), argues that it is a crisis that people do not have the quantitative literacy to participate as a citizen of a democracy; however, that people are not learning about inequality as part of quantitative civic literacy is not framed as a crisis. This framework adds to quantitative literacy scholarship by centering awareness of inequality as a key component of quantitative literacy. Teaching mathematics for social justice scholarship, which does emphasize teaching about inequality, can explore more deeply a range of perspectives from mathematics teachers about why inequality should be taught about in mathematics, their views of the nature of mathematics, and how they think about (or do not think about, or think about in complicated ways) preparing students as citizens. This quantitative civic literacy framework can be useful to teacher educators and scholars striving to support mathematics teachers to teach more about the sociopolitical world because it can support them to better understand how

mathematics teachers think about what can come out of doing such work with students, not just those with an explicit social justice focus but teachers coming into the profession with a range of views.

Finally, this conceptual framework of quantitative civic literacy can support teachers in developing or further nuancing their theories of change about inequality in society, something that mathematics teachers did not express feeling like they had a strong conception of or had been given opportunities to think about. To strengthen teachers' conceptions of quantitative civic literacy, they should be presented with more opportunities to think through the nature of mathematics, building awareness, and preparing students for action, which I attend to in the subsequent section on how teachers can be supported to be further engaged in the work of teaching about inequality.

### **Implications for Teacher Education and Interdisciplinary Collaboration of Mathematics and Social Science Teachers**

Implications for this study could be drawn for schools, districts, and education reformers; the implications here zoom in on teacher education, focusing on takeaways from the study that suggest ways in which secondary mathematics teachers could be prepared to teach about inequality, and then on potential for interdisciplinary collaboration between mathematics and social science teachers.

### **Broadening the Engagement of Mathematics Teachers in Teaching About Economic Inequality**

**Supporting the many mathematics teachers who report taking up economic inequality.** Considering that approximately 60% of public school secondary mathematics teachers surveyed reported that they have addressed economic inequality in their mathematics

classroom at least once or twice a semester, it is a topic a majority of teachers address. The survey sample in this study is not a pre-selected group of teachers interested in the topic or teachers who have had support or training in the area but representative of the population of public school mathematics teachers in the United States. Since so many teachers report taking up economic inequality in some capacity, it is imperative that teacher education programs prepare teachers to engage students around this topic.

This study reveals that it is not just teachers of economically marginalized Students of Color who think about integrating topics like economic inequality in mathematics. From the survey, I found that the proportion of students on free or reduced price lunch at the teacher's school did not predict reporting teaching about economic inequality. From the interviews, I found that teachers who discussed teaching more economically and racially privileged students or more diverse groups of students discussed the importance of exposing their students to an awareness of economic inequality, to understanding that it indeed exists and that its magnitude is profound. Teacher education can be a space where future teachers (of students from various backgrounds) have the opportunity to explore how and why they can address economic inequality.

While self-identified liberal teachers were more likely than conservative teachers to report teaching about inequality according to the survey, other variables specific to teachers' stances on economic inequality (e.g. if the wealthy should be taxed more, if hard work leads to success) did not predict teaching about economic inequality. Of those interviewed, one teacher identified as a "bleeding heart liberal" and one brought up the notion of teaching social justice. Since it is not the case that only particularly progressive or social justice-motivated mathematics teachers strive to take up inequality, this implies teacher educators can think about ways to

engage a broad set of teacher candidates in thinking about teaching about inequality. How can teachers with various political perspectives be called on and supported to address inequality with their students?

**Inviting mathematics teachers who report not teaching about economic inequality to the table.** This also means approximately 40% of teachers surveyed reported *never* teaching about economic inequality. This is not a majority but still a significant amount of teachers so an important question to pose from this study is: How can teachers who have never attempted to teach about economic inequality—an area of social concern that relies on mathematical understandings—be introduced in teacher education to rationales for why they might do so and what tends to be challenging for those who do, how they might get started, and how what they might do is connected to perspectives on mathematics, awareness, and action? This study suggests that taking up conversations about the nature of mathematics with teachers is important because many teachers do not currently express an understanding of the ways that issues of economic inequality might be related to their mathematics curriculum. A vast majority of teachers in the survey who reported not teaching about economic inequality also stated that they do not do so because the topic is not related to their course content. Many of these teachers can be encouraged to examine their ideas about what counts as doing mathematics. This study also suggests that there are other windows of opportunity with many teachers who say they do not teach about economic inequality at all. Survey data revealed the 28.1% of teachers who reported not teaching about economic inequality stated they do not feel prepared to facilitate discussions on the topic, and 26.3% of them stated they do not have curriculum or materials they need to address it; this is a substantial amount of teachers who may be quite open to integrating economic inequality in their mathematics classroom, if they had the support both pedagogically



and content-wise to think about how they would do it. Teachers who participated in interviews—even though almost all discussed teaching about economic inequality—often brought up that they would like support to be able to imagine doing more than they do. Teacher education is a space where teachers can learn about and reflect on cycles of praxis, including on teaching about inequality in mathematics.

**Mathematics teachers learning about economic inequality.** While there are many possible ways to interpret the survey finding that those who took undergraduate or graduate courses are more likely to teach about economic inequality, it is worth exploring supporting teachers early on to learn about systemic inequality and theories of change in society, understanding this background not as a supplemental to mathematics teaching but as an integral part of it. Teachers cannot teach about economic inequality in society if they themselves have not been pushed to think about how it is defined, the causes and consequences of it, and the mathematics within it. Furthermore, just learning more about economic inequality and how connections can be made often is not enough, as once teachers get in the classroom they feel they have little agency. Supporting teachers to establish concrete strategies for building curricular agency and ways to develop a sense of agency in the present educational climate may support teachers to further integrate economic inequality.

**Fostering mathematics teachers' sociopolitical awareness and engagement.** The political awareness, engagement, and activity of teachers is not often discussed or fostered within teacher education programs and within schools, especially in mathematics education, which is often perceived as an apolitical school subject (Gutiérrez, 2010). Survey participants who reported greater political engagement tended to teach about economic inequality more often, and interview participants who brought in current events and quantitative studies the most also made

more interdisciplinary connections to economic inequality throughout their courses. Mathematics teacher education can foster teachers' engagement with the news and community organizations as central to the teaching of mathematics. Secondary methods courses and other spaces in teacher education can address how teachers may engage with the news and community work with a mathematical eye and then bridge that political engagement to classroom dialogue and lessons. As some teachers discussed, it is after years of experience that they feel comfortable forging connections from real-world events to mathematics; however, teacher education can teach how to look for and strive to make connections between social and political issues and mathematics.

**Envisioning where and when in mathematics courses students can take up issues of economic inequality.** Surveyed teachers who reported on Statistics courses were much more likely to report teaching about economic inequality often, and interviewed teachers tended to discuss statistics as being a course with natural connections to inequality considering all kinds of problems related to looking for trends, testing statistical significance, and representing distributions. Teacher education can do more to prepare teachers of statistics to facilitate teaching problems and projects on topics like economic inequality. That said, because other subjects did not have as many examples, aside from mostly financial literacy-related examples in the mathematics of exponential growth (loans, car payments, and so on), teacher educators can think more about how teachers of all secondary mathematics subjects can be supported to see examples of and look on their own for connections. In teacher education, teacher candidates can be supported to envision what an interdisciplinary mathematics classroom may look like.

**Bringing frameworks on the nature of mathematics and civic preparation to mathematics teacher education.** From conducting interviews in this study, I discovered that most mathematics teachers think of themselves as having a role that extends beyond the teaching

of mathematics, that they see themselves as mentors in front of young people and it matters to them that students know they can talk about areas like current events, going beyond mathematics content. I also discovered that most teachers are passionate about students being more aware of inequality. However, most teachers did not share fully formed ideas about the connection between the nature of mathematics, preparing students to be civic actors, and teaching about inequality.

Teacher education is a space where teachers can question the nature of mathematics and what it means to prepare young people as civic actors in the mathematics classroom. In teacher education courses, they can begin to develop clarity around these areas and think about how their ideas about them relate to opportunities they offer to students. One way in which they could do this is to wrestle directly with frameworks such as those of Ernest (2009) and Westheimer and Kahne (2004), identifying how teachers can enter the classroom with varying ideas about mathematics and civic preparation. How can teacher education students learn about new philosophies in the field of mathematics that, according to Ernest, emphasize the humanistic nature of mathematics and how it is connected to the social and political? How can they learn about and dialogue about participatory and social justice-oriented ways of preparing citizens (in mathematics)? For example, teachers who believe strongly that teaching about economic inequality is important because it can advance students' mathematical understandings can be pushed to think about different ways doing so could also expand students' awareness and potential for action and why that matters. As another example, for other teachers who do emphasize that awareness is important because it is the first step to making change without specifying what kind of change, wrestling with frameworks about action can be useful as tools

for teachers to develop clarity around the kinds of actions they could prepare students for in their classrooms.

To support mathematics teachers to teach about economic inequality, while textbook and other curricular problem contexts or standards need to shift to include the topic so that teachers feel supported to integrated it in their classrooms, it is not enough; teachers need to be supported to deeply think through how integrating such a topic is connected to complex, underlying understandings of what it means to do mathematics and what it means to prepare students to be socially and politically aware actors. If teachers are given opportunities to wrestle with these understandings, they will also ultimately be more prepared to call on students to do so as well, which is important because students develop their own understandings about what mathematics means and how they can make change.

### **Calling for Collaboration Between Mathematics and Social Studies Teachers**

Findings about mathematics teachers imply great potential in expanding teaching about economic inequality if mathematics and social studies teachers are supported to work in interdisciplinary capacities in the secondary setting. While social studies teachers may tend to come into their work with more coursework and training on the teaching of social issues, mathematics teachers have essential expertise on quantitative understandings of data about the world. Both mathematics and social science teachers need one another to imagine the kinds of opportunities they can present to students to learn about inequality. One long-time mathematics teachers in this study discussed how attending quantitative social science talks allowed him to always read the news with a mathematical eye and make regular connections in his classroom. Teachers from the social sciences and mathematics should be positioned as experts within schools and professional development spaces who are needed to develop nuanced, rigorous

lessons for students, regardless of whether the lessons are ultimately taught in the social science classroom, mathematics classroom, or in both simultaneously. Mathematics teachers need social science knowledge and background, and social science teachers need mathematical understandings to address areas such as trends and distribution needed to teach inequality.

### **Study Limitations and Future Research**

This research strives to tell at least part of the story of mathematics teachers taking up economic inequality. While a mixed methods research approach to investigating mathematics teachers' integration of teaching a critical sociopolitical issue as connected to their ideas about mathematics and about citizenship contributes to scholarship on how mathematics teachers do this work, there are limitations of this study important to highlight considering potential future research directions.

### **Posing Questions about Teaching Economic Inequality**

While collecting and analyzing both survey and interview data, it became apparent that it is challenging to ask teachers questions about teaching about inequality. Mathematics teachers interpret addressing economic inequality in a wide range of ways such as addressing economic gaps (or poverty) within the student body at their school or students in their classes (not in relation to the teaching of mathematics), as indicated by interviews with Kevin and Brian, as teaching quantitative financial literacy skills, or as teaching mathematics lessons about economic inequality in society. While the survey gave the example of teaching about the income or wealth distribution when asking if teachers address economic inequality and questions gave teachers the opportunity to specify if they address the topic in the core of their lesson, it is possible teachers surveyed interpreted this question similarly to how Kevin and Brian did in the interviews. It is also challenging to get a sense from the survey data how often teachers reported integrating

economic inequality into a mathematics curricular opportunity for students and how often it comes up non-related to course content. With few teachers sending a lesson plan or description prior to interviews as requested, it is possible teachers over-reported, on the survey and during the interviews, how often they address economic inequality. In interviews, teachers seemed to move back and forth between discussing problems, activities, and conversations they actually had with students and their ideas about what integrations they believe would be nice to have more of. While challenging to pose questions clearly and interpret teachers' interpretations, including when it came to asking about civic development support because of teachers not seeming to have had opportunities to articulate their ideas about this in other spaces, this became an interesting and telling finding of the study in and of itself.

### **An Intersectional Lens**

This study did not directly investigate the extent to which teachers teach about inequality through an intersectional lens (i.e. how race, class, gender, and other forms of inequality are bound together and shape people's experiences). A survey question asked if racial inequality and gender inequality came up when teachers addressed economic inequality (less than half reported positively for each; it would be interesting to know why it is not more common given the deep historical and present-day connections among race, gender, and class oppression). Interviews focused on economic inequality as well, largely in part because quantitative connections to the topic are so clear; to teach *distribution* of wealth, the mathematics concept of *distribution* must be involved in some way. It was interesting to note the ways in which some teachers interviewed still brought up race and gender inequality as well. Carl taught about gender pay discrimination; Roslyn looked with students at graphs of a number of inequalities by race, class and gender; and Carl and Scott taught about lead levels in the water in Flint, Michigan yet neither explicitly

addressed race *nor* class inequality when teaching about it. Future research can explore mathematics teachers' conception of inequality as an intersectional phenomena and how they take up or may take up intersectional lessons with students.

### **Teachers of Color, Women, and Women of Color**

While the survey participants closely mirrored the racial and gender representation of mathematics teachers in the United States, this meant that few teachers of Color participated in the survey, not enough teachers to test for statistical significance of teaching about economic inequality by racial groups. Future work should focus more on teachers of Color and how they take up issues of inequality. The interview sample consisted of three women, two of whom were teachers of Color, despite 60% of survey participants being women. The relationship between gender and teaching about inequality discovered in this study (that men are more likely than women to report teaching about it) should be further explored to explain what accounts for this difference (e.g. if it is related to men also feeling like they have more control over content, or if it is related to women teachers striving to prove their mathematical expertise in a field in which they are under-represented and therefore not straying from more traditional ways of engaging students in mathematics). More women and women of Color specifically in future conversations and classroom observations could add to understanding who, how, and why mathematics teachers teach about economic inequality.

### **Teaching Economic Inequality in Action**

While mixed methods of survey and interview data provided insights into the issue neither method alone could address on its own, this investigation did not include classroom observations. In this study, I found that 18% of all teachers surveyed reported teaching economic inequality 1) in the core of their lesson, *and* 2) by doing at least one of the following: looking at

data, analyzing/collecting data, conducting simulations or mathematical models, *and* 3) by addressing the distribution of wealth or income. Investigating their classrooms (and further investigating their backgrounds and political orientations and engagement) would provide more nuanced understandings of what teachers take up and the ways in which these teachers are similar to or differ from teachers with stated social justice goals. Future research will benefit from observations of the mathematics classroom when the topic of economic inequality arises; classroom observations would further enhance understandings of the ways in which teachers facilitate lessons about inequality, focusing in on their pedagogies and the kinds of learning students engage in.



## APPENDIX A

### *Learning About Inequality Survey Instrument (Rogers & Westheimer)*

Q1.1 Thank you for taking this survey about how high school teachers across the United States and Canada introduce topics of social and political concern in their classrooms. Survey responses are completely confidential. We will not report information about any individual teacher or any individual school. The survey takes about 15 minutes to complete. You can begin the survey at any convenient time. If you want, you can pause and return to it later. Your responses will be automatically saved for when you return. The survey must be submitted within one week. When you complete the survey, you will receive a \$10 Amazon gift card. You also will be entered in a lottery for one of three \$250 Amazon cards that you can use to support your work as a teacher. You must finish and submit your survey to receive your gift card and be entered in the lottery. If you would like further details about the study, please click on the “Learning about Social and Political Life” Information Sheet below. If you have any questions about the survey, please contact UCLA Professor John Rogers (jrogers@gseis.ucla.edu). Information Sheet - Learning about Social and Political Life Study If you agree to take the survey, please choose 'I agree to take the survey.' If you are not interested in taking the survey, please choose 'No, thanks.'

- I agree to take the survey (1)
- No, thanks (2)

If No, thanks Is Selected, Then Skip To End of Survey

Q1.2 Thank you for agreeing to take this survey. If you want to go back to previous questions during the survey, please use the 'Previous' button provided in the survey. Do not use the 'back' arrow on your browser or your responses may be invalidated. We will now begin the survey.

Q2.1 Before we begin, we need to ask you some preliminary questions to determine your eligibility to participate in this survey.

Q2.2 Do you still work at  $\{e://Field/School\}$ ?

- Yes (1)
- No (2)

Q5.1 Now we are going to ask you about the particular courses that you currently teach.

Q5.2 Do you currently teach Algebra 1?

- Yes (1)
- No (2)

If Yes Is Selected, Then Skip To Please answer the following questions...

Q5.3 Do you currently teach Statistics?

- Yes (1)
- No (2)

If Yes Is Selected, Then Skip To Please answer the following questions...

Q5.4 Do you currently teach Calculus?

- Yes (1)
- No (2)

If Yes Is Selected, Then Skip To Please answer the following questions...Answer If &nbsp;Do you currently teach Algebra 1? No Is Selected And No Is Selected And Do you currently teach Calculus? No Is Selected

Q5.5 What is the name of the math class you teach most often?

Answer If &nbsp;Do you currently teach Algebra 1? Yes Is Selected

Q5.6 Please answer the following questions for one section or period of your Algebra 1 class. (If you teach more than one section or period of Algebra 1, relate your answers to the section or period you teach earliest in the school day.)

Answer If Yes Is Selected

Q5.7 Please answer the following questions for one section or period of your Statistics class. (If you teach more than one section or period of Statistics, relate your answers to the section or period you teach earliest in the school day.)

Answer If Do you currently teach Calculus? Yes Is Selected

Q5.8 Please answer the following questions for one section or period of your Calculus class. (If you teach more than one section or period of Calculus, relate your answers to the section or period you teach earliest in the school day.)

Answer If What is the name of the social studies class you teach most often? Text Response Is Not Empty

Q5.9 Please answer the following questions for one section or period of your  $\{q://QID264/ChoiceTextEntryValue\}$  class. (If you teach more than one section or period of  $\{q://QID264/ChoiceTextEntryValue\}$ , relate your answers to the section or period you teach earliest in the school day.)

Q5.10 Most students in this class are in what grade in school?

- 9th (1)
- 10th (2)
- 11th (3)
- 12th (4)
- This class enrolls students across many different grades. (5)

Q5.11 Does this class have any of the following designations? (Please click on all items that apply.)

- Regular (This is sometimes called “Regular/College-Prep”) (5)
- Honors or Advanced Placement (1)
- Special Education (2)
- Remedial/Intervention (3)
- Other special designation (please specify) (4) \_\_\_\_\_

Q5.12 Which of the following best describes the academic achievement of the students in this class relative to other students in the school?

- Low (1)
- Average or mixed achievement (2)
- High (3)

Q5.13 During this class, how often have you done the following:

	Never (1)	Once or twice a semester (2)	Monthly (6)	Weekly (3)	A few times a week (4)	Daily (5)
Facilitated discussions about social or political issues (1)	•	•	•	•	•	•
Discussed the importance of supporting opinions with evidence (2)	•	•	•	•	•	•
Examined multiple sources or perspectives and discussed trustworthiness of the information (3)	•	•	•	•	•	•
Addressed issues related to gender inequality (4)	•	•	•	•	•	•
Addressed issues related to racial	•	•	•	•	•	•

inequality (5) Addressed issues related to economic inequality (for example, the distribution or disparities of income and wealth) (6)	•	•	•	•	•	•
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Answer If Thinking about this class, how often have you done the following: Addressed issues related to economic inequality (for example, the distribution or disparities of income and wealth) - Never Is Selected

Q5.14 Why do you think that you have never talked with this class about economic inequality? (Please click on all items that apply.)

- This topic does not relate to the standards for this class. (1)
- I don't have the curriculum or materials that I need to address this topic. (2)
- I don't feel prepared to facilitate discussions on this topic. (3)
- I am concerned about how my students might react to lessons on this topic. (4)
- I am concerned about how administrators might react to lessons on this topic. (5)
- I am concerned about how parents or community members might react to lessons on this topic. (6)
- None of the above (7)

If This topic does not relate ... Is Selected, Then Skip To End of Block  
 If I don't have the curriculum... Is Selected, Then Skip To End of Block  
 If I don't feel prepared to fa... Is Selected, Then Skip To End of Block  
 If I am concerned about how my... Is Selected, Then Skip To End of Block  
 If I am concerned about how ad... Is Selected, Then Skip To End of Block  
 If I am concerned about how pa... Is Selected, Then Skip To End of Block  
 If None of the above Is Selected, Then Skip To End of Block

Q5.15 When you have talked about economic inequality with this class, which of the following topics have you addressed? (Please click on all items that apply.)

- Hunger and homelessness (1)
- Unemployment (2)
- Tax policies (3)
- Trade policies (4)
- Social welfare policies (5)
- Charity (6)
- Unions and labor (7)
- The Occupy Movement (8)
- Distribution of income or wealth (10)
- Predatory loans and access to credit (11)
- Other (please specify) (9) \_\_\_\_\_

Q5.16 When you have talked about economic inequality with this class, have you discussed any of these topics as well?(Please click on all items that apply.)

- Financial literacy (1)
- Educational inequality (2)
- Gender inequality (3)
- Racial inequality (4)
- None of the above (5)

Q5.17 When you have talked about economic inequality with this class, which of the following areas have you addressed? (Please click on all items that apply.)

- Causes of economic inequality (1)
- What can be done to address economic inequality (2)
- The meaning of a just or fair society (3)
- The meaning of a just or fair economy (4)
- None of the above (5)

Q5.18 When you have talked about economic inequality with this class, in which context did you discuss this topic? (Please click on all items that apply.)

- As it exists today (2)
- In the context of a particular historical period (1)
- Within the United States (4)
- In other countries (3)
- None of the above (6)

Q5.19 When you have talked about economic inequality with this class, which of the following strategies have you used? (Please click on all items that apply.)

- Read fiction or nonfiction in which economic inequality is a theme (1)
- Examined popular representations in which economic inequality is a theme (e.g., music, comics, TV shows, photography, political cartoons, etc.) (13)
- Watched a documentary about economic inequality (2)
- Looked at data (graphs, tables, statistics) about economic inequality (3)
- Required students to differentiate facts from opinion in a text about economic inequality (4)
- Had students compare and contrast two or more viewpoints about economic inequality (5)
- Discussed a current event in society related to economic inequality (6)
- Discussed economic inequality in relation to students' personal experiences (7)
- Analyzed or collected data about economic inequality using mathematical tools (8)
- Conducted simulations or created mathematical models of economic inequality (21)
- None of the above (22)

Answer If When you have talked about economic inequality with your students, what strategies have you used?... Read fiction or nonfiction in which economic inequality is a theme Is Selected

Q5.20 You mentioned that you read fiction or nonfiction in which economic inequality is a theme. Can you give an example of a book, essay, or other piece of literature that you used in class that addresses economic inequality? (Leave blank if you can't think of an example.)

Q5.21 When have you talked about economic inequality with this class? (Please click on all items that apply.)

- During the warm-up activity (1)
- Within the core lesson of the day (2)
- As an enrichment after the lesson is completed (3)
- After standardized testing is over for the year (5)
- None of the above (4)

Q5.22 When you have talked about economic inequality with this class, why did this topic arise? (Please click on all items that apply.)

- It is an important theme within the curriculum I am already teaching. (1)
- It is related to a current event in the news. (2)
- My students prompt me to address the issue because the topic concerns them. (3)
- It is an issue affecting the community in which I teach. (4)
- It is a concern of mine. (6)
- None of the above (5)

Q5.23 When you have talked about economic inequality with this class, how often have these lessons fulfilled a state content standard? (Please click ONLY ONE item.)

- Never (1)
- Rarely (2)
- Often (3)
- Always (4)
- I don't know (5)

Q6.1 Now we would like to ask you about a different course you are teaching.

Q6.2 Aside from the course we just discussed, is there a different math course you teach?

- Yes (1)
- No (2)

If No Is Selected, Then Skip To End of Block

\*Repeat questions for second math course.

Q11.1 Now we have a few questions about how your teaching is shaped by the environment in your school and community.

Q11.2 How much control do you personally have in your classroom at your school over the following areas of your planning and teaching?

	No control (1)	Minor control (2)	Moderate control (3)	Great deal of control (4)
Selecting textbooks and other instructional materials (1)	•	•	•	•
Selecting content, topics, and skills to be taught (2)	•	•	•	•
The pace of instruction (3)	•	•	•	•

Q11.3 Please choose the answer that best reflects your feelings for each of the following statements.

	Strongly disagree (1)	Disagree (2)	Agree (3)	Strongly agree (4)
The school administration supports my beliefs and values about what students should learn. (1)	•	•	•	•
Most of my colleagues share my beliefs and values about what students should learn. (2)	•	•	•	•



Q11.4 How would you generally characterize the school community in which you teach?

- Very liberal (1)
- Somewhat liberal (2)
- Moderate (3)
- Somewhat conservative (4)
- Very conservative (5)
- Prefer not to answer (6)

Q12.1 Now we would like to ask you a few questions about your own civic practices, understandings, and beliefs.

Q12.2 In the last month, how often have you done the following?

	Never (1)	Once or twice (2)	Monthly (6)	Weekly (3)	A few times a week (4)	Daily (5)
Followed news by reading a newspaper or news magazine, watching national news on TV, listening to news on the radio, or reading news online (1)	•	•	•	•	•	•
Talked about politics or government with your family and friends (2)	•	•	•	•	•	•
Talked about politics or government with colleagues	•	•	•	•	•	•

at school (3)						
Participated in an organization that tries to make a difference in your community or broader society (4)	•	•	•	•	•	•

Q12.3 Please choose the answer that best reflects your feelings for each of the following statements:

	Strongly disagree (1)	Disagree (2)	Agree (3)	Strongly agree (4)
In the last twenty years, the gap between the rich and everyone else in the U.S. has increased. (1)	•	•	•	•
Most people who want to get ahead can make it if they're willing to work hard. (2)	•	•	•	•
Hard work and determination are no guarantee for success for most people. (3)	•	•	•	•
The economic system in this country unfairly favors the wealthy. (4)	•	•	•	•
A good way to reduce poverty is to raise taxes on wealthy people and corporations	•	•	•	•

in order to expand programs for the poor. (6)				
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Q12.4 Do you think the gap between the rich and the poor is a very big problem, a moderately big problem, a small problem, or not a problem at all in our country?

- Very big problem (1)
- Moderately big problem (2)
- Small problem (3)
- Not a problem at all (4)

Q13.1 Finally, we would like to collect some demographic information. As we noted above, all of your answers on the survey are confidential.

Q13.2 What was your undergraduate major? (Please click on all items that apply.)

- Economics (1)
- Education (2)
- History (3)
- English (13)
- Philosophy (4)
- Political Science (5)
- Pre-Law (6)
- Psychology (7)
- Sociology (8)
- Mathematics (10)
- Statistics (11)
- Other (please specify) (9) \_\_\_\_\_

Q13.3 Please estimate the total number of quarter and semester courses you have taken at the undergraduate or graduate level in each of the following areas:

	Total courses (1)
Economics (1)	
Sociology (2)	

Q13.4 Did any of your undergraduate or graduate coursework ever address the topic of gender inequality?

- Yes (1)
- No (2)

Q13.5 Did any of your undergraduate or graduate coursework ever address the topic of racial inequality?

- Yes (1)
- No (2)

Q13.6 Did any of your undergraduate or graduate coursework ever address the topic of economic inequality?

- Yes (1)
- No (2)

Q13.7 For how many years have you been teaching?

- 1–3 years (1)
- 4–6 years (2)
- 7–10 years (3)
- 11–20 years (4)
- More than 20 years (5)
- Prefer not to answer (6)

Q13.8 What is your gender?

- Male (1)
- Female (2)
- Other (3)
- Prefer not to answer (4)

Q13.9 If you were asked to use one of these commonly used names for the social class you belonged to when you were growing up, which would it be?

- Upper class (1)
- Upper-middle class (2)
- Middle class (3)
- Lower-middle class (4)
- Lower class (5)
- Prefer not to answer (6)

Q13.10 What is your race?

- White/Caucasian (1)
- African American (2)
- Hispanic (3)
- Asian (4)
- Native American (5)
- Pacific Islander (6)
- Other (7)
- Prefer not to answer (8)

Q13.11 How would you characterize yourself?

- Very liberal (1)
- Somewhat liberal (2)
- Moderate (3)
- Somewhat conservative (4)
- Very conservative (5)
- Prefer not to answer (6)

Q14.1 We are planning to conduct follow-up phone interviews with some teachers who fill out this survey. During these interviews we will discuss a particular lesson plan, provided by the teacher, that touches on social and political issues. Teachers who participate in the follow-up phone interview will receive a \$25 Amazon Gift Card and be entered an additional time in the lottery for the \$250 Amazon Gift Card to support classroom teaching. Would you be willing to participate in such a follow-up phone interview? Completing this survey does not in any way obligate you to participate in the interview.

- Yes, you can contact me for a follow-up phone interview. (1)
- No, please do not contact me. (2)

If No, please do not contact me. If Selected, Then Skip To You have now completed the survey. Th...

Q14.2 Thanks for your willingness to participate in a follow-up phone interview. We will be deciding which teachers to interview over the next few weeks and will be contacting teachers in June, July, and August. If you are selected for a follow-up phone interview, what is the best email address for us to contact you in June, July, or August?

Email address (1)

Q14.3 You have now completed the survey. Thank you very much for your time and your responses. After you click the "NEXT" below, you will receive an email within one week containing a code that you can redeem for \$10 of Amazon credit. If you do not receive an email within one week, please check your spam folder to make sure that the message was not placed there in error by your service provider or email software. If you still have not received the email, please contact UCLA Professor John Rogers ([jrogers@gseis.ucla.edu](mailto:jrogers@gseis.ucla.edu)).

## **APPENDIX B: *Learning About Inequality* First Round Interview Protocol (Rogers & Westheimer)**

Hello. My name is \_\_\_\_\_. I am part of the research team working with UCLA Professor John Rogers and University of Ottawa Professor Joel Westheimer on a study of what students learn about contemporary social and political issues, such as economic inequality, in their high school classrooms. Does this time still work for you for a 30-40 minute interview? (If yes, proceed. If no, ask for an alternative time to call back.)

I am going to ask you a few questions. Your answers will be confidential—we will not report your name or the name of your school or school district. If you do not want to answer any of the questions, just let me know and we will skip the question. I am planning to audio-record the interview. If you like, we would be happy to provide you with a transcription of the interview so you can check it for accuracy. Can we proceed with the audio-recording? [If teacher declines, our interviewer will type responses as the interview proceeds.]

[During this introduction, you should be sure to: a) Briefly introduce yourself; b) Note for recording, the name of the teacher you are speaking with and the date of the interview. Also let the teacher know that you will be asking about 12 questions over the next 30-40 minutes and so you might move things along at times to be sure that you make it through all the questions. You can also let the teacher know the different “sections” of the interview—a few short answer questions to start, an opportunity to talk about a particular lesson, and then some general questions at the end.]

Are you ready to begin the interview?

Great. We are going to start with the lesson plan you sent us.

1) Was this a lesson you found somewhere or that you developed yourself?

1a) [If found lesson] Where did you find this lesson? Do you often draw lessons from this source? Why do you look to this source?

[If developed themselves] What resources did you draw on in developing the lesson?

1b) (If not apparent) Can you tell me what course you taught this lesson in?

2) Now I would like to ask you to describe what you did during the lesson itself. Can you please walk me through the lesson in as much detail as possible? [approximately 5 minutes]  
Prompt for details, specific examples, and motivations—What exactly did you do? Why did you do that?

3) When you think about teaching kids about inequality, were you happy with how the lesson went? Why? If you taught it again, would you do it more or less the same or would you teach it differently? If differently, in what ways?

- 4) For this lesson, what specifically did you want students to know or understand about economic inequality?
- 5) Can you tell me about a particular time that the lesson seemed to achieve one of the goals related to economic inequality (if it did achieve at least one of your goals)? What happened? Can you describe it?
6. Can you tell me about a particular time that the lesson did not go as you had planned? What happened? Can you describe it?
- 7) Was this particular lesson related to a broader unit or set of lessons or course themes or was there a different reason you taught it, like a connection to current events? If it was related, how?
- 8) We have been talking about one particular lesson on economic inequality. Are there other ways that you have introduced lessons on economic inequality to this class? If yes, can you describe these?
- 9) Do you teach different levels of this same class (regular/honors/AP/remedial/etc)? If so, do you address this topic of economic inequality differently and/or more often across these levels? If so, how? Why?
- 10) Have you experienced any obstacles in your efforts to teach about economic inequality, for example because of curriculum guidelines or school rules or because it is a controversial topic? If so, can you describe a particular time this happened?

**Now I would like to ask you a few questions about your role as a teacher generally.**

11. Why do you think it's important to engage young people in lessons about economic inequality?

Prompts: What do you want students to know about EI?

In what ways might **your** students use that knowledge and information?

12. What are some experiences you have had that shape your ideas regarding teaching about economic inequality?

Prompts: For example ... Experiences growing up, experiences as an undergraduate or graduate student; experiences in professional organizations; experiences in community organizations, unions, or religious organizations.

13. That is all of our formal questions. Before we end the interview ...Is there anything else that you would like to share about the lesson we talked about or your efforts to teach about economic inequality?

**APPENDIX C: *Learning About Inequality* Proposed Second Round Interview Protocol (Rogers & Westheimer; additional mathematics teacher questions by Raygoza in italics)**

Hello. My name is \_\_\_\_\_. I am part of the research team working with UCLA Professor John Rogers and University of Ottawa Professor Joel Westheimer on a study of what students learn about contemporary social and political issues, such as economic inequality, in their high school classrooms. Thanks for speaking with us again. We really appreciate it. Does this time still work for you? The interview should take about 30-40 minutes. (If yes, proceed. If no, ask for an alternative time to call back.)

I'll remind you of some of the same background we went over last time:

- Your answers will be confidential—we will not report your name or the name of your school or school district.
- If you do not want to answer any of the questions, just let me know and we will skip the question.
- I am planning to audio-record the interview. If you like, we would be happy to provide you with a transcription of the interview so you can check it for accuracy.

Can we proceed with the audio-recording? [If teacher declines, our interviewer will type responses as the interview proceeds.]

Are you ready to begin the interview?

**I. Classroom experiences this year**

A few of these questions are short-answer or yes/no questions that we're asking everyone, but then I'll also ask you to elaborate if you want. I'll start with a couple of short-answer ones.

For these close-ended questions there is no right or wrong answer. We're just interested in getting a picture of what discussions of EI are looking like in classrooms across the country.

Last summer when we spoke, we talked about a lesson you taught on economic inequality. We're interested to know whether you've taught any lessons on economic inequality this year.

- 1) During this academic year, have you taught about economic inequality:
  - a) about as much as last year
  - b) more than last year
  - c) less than last year
  - d) not at all this year?
- 2) During this academic year, have you taught about economic inequality in relationship to any of the following current events:
  - a) the presidential election (YES/NO)
  - b) the presence of lead in Flint Michigan's drinking water (YES/NO)

Can you describe how the topic arose and what you did in the lesson?



c) issues related to immigration or refugees (YES/NO)

- 3) Did any of your lessons this year present *explanations* for *why* some individuals or groups have more income or wealth than others or why such inequality is growing? (YES/NO).

If yes, can you give me an example of that?

- 4) Did any of your lessons this year discuss economic inequality (or its effects) as just or unjust, moral or immoral? (YES/NO)

If yes, can you give me an example of that?

- 5) Did any of your lessons this year ask students to compare different viewpoints or perspectives on economic inequality?

If yes, can you tell me about that?

Prompt: Did your students engage different sorts of data, evidence, or stories?

- 6) We're curious about how you might deal with the tension between sharing or not sharing your own beliefs about economic inequality when teaching about it. For example, some teachers say that they try not to let students know their beliefs about inequality, what causes it and what if anything should be done to address it, and so on, while others are more likely to share their positions/beliefs. How do you tend to handle this tension?

Can you remember a time when you did share a belief about inequality with your students? Can you tell me about that time?

Was there ever a time this year when you thought about sharing your belief but decided not to? Can you walk us through your thinking?

### **Teacher's Background**

Now I have a few questions about your own experiences. Again, there are a couple of short-answer questions at the beginning.

- 7) About how often do you come across stories about economic inequality as you read, listen to, or watch the news? (NEVER/MONTHLY/WEEKLY/MORE THAN WEEKLY)?
- 8) Can you think about a time when your reading or following the news informed the way you teach about economic inequality?
- 9) About how often do you talk about issues of economic inequality with colleagues at school? (NEVER/MONTHLY/WEEKLY/MORE THAN WEEKLY)?

If NOT "NEVER," ... Do you plan together? Can you give me an example?

- 10) About how often do you talk about issues of economic inequality with friends and family outside of school? (NEVER/MONTHLY/WEEKLY/MORE THAN WEEKLY)?
- 11) About how often do you participate in civic, political, or religious groups that address issues of economic inequality? (NEVER/MONTHLY/WEEKLY/MORE THAN WEEKLY)?
- 12) Can you think of a time when talking with people about economic inequality or participating in your groups informed the way you teach about economic inequality?
- 13) Teachers define economic inequality in lots of different ways; some have thought about it a lot while others haven't thought about it much. We're curious about how you define it. When you hear about economic inequality, what does that term mean to you?  
Possible follow-up: To the extent you feel economic inequality is a problem, why is it a problem?

### Students

My final set of questions are about your students. The first question is about the diversity of student backgrounds in your class(es).

- 14) Were there times this year when you were teaching about economic inequality, when you were aware of the different backgrounds of your students? Are some of your students from wealthier or poorer backgrounds, for example? Did this awareness affect your teaching in any way? When you are discussing economic inequality, do students tend to bring up their own backgrounds, their family situations, and so on?

*Is how you think about this related to the class being a math class? Because some people would say because it's math you don't need to bring in the personal or human dimension and others would say that math actually does have an important personal or human dimension*

15. *What knowledge or understandings or skills do you think are important for students to have in relation to economic inequality?*

*What mathematics understandings or skills are important?*

*In lessons about economic inequality, are there particular things you hope students gain awareness of?*

*How do you view mathematics as playing a role in that awareness?*

*Why do you think it's important for your students to become more aware?*

*What are you hoping students will do (if anything) about economic inequality after this class is over?*

*Are there ways you hope mathematics is part of or informs what they do?*

For interviewer to think about in relation to this question: Are the students becoming better informed (knowing stuff will help change things)? Are the students working to

improve their own individual standing in society (poorer students will make more \$ and that will change things)? Are they acting with empathy or charity toward those who have less (wealthier students will give back more)? Are they participating in efforts to change policies, politics, etc. (structural changes in laws or policies will help to reduce economic inequality)?

*16. For my next question - and this may be a question not often asked of math teachers - are there ways you hope your students will, now or in the future, engage civically in powerful ways?*

*17. I'm also wondering how you think about what it means for students to engage in mathematics in powerful ways.*

*-How does the "good mathematics student" problem solve?*

*-What are you or your students doing in class when you're really pleased with how students are engaging in mathematics?*

*-Some people would say mathematics is a creative and flexible process of inquiry, while others would say mathematics is more rational and follows procedures to find a right answer. How do you think about what it means to do mathematics?*

*18) Returning to learning about issues of economic inequality in mathematics,*

*-does mathematics learning happen before the lesson, or during it, or both?*

*-should students guide the mathematics and/or should the teacher guide the mathematics?*

*-some people argue (and others disagree) that mathematics brings objectivity or neutrality. What do you think?*

\* \* \*

Is there anything else you would like to share before we end?

## APPENDIX D: Multinomial Logistic Regression

### Predicting Teaching about Economic Inequality: Likelihood ratio tests from multinomial logistic regression

<b>Predictor</b>	<b>Chi-Square</b>	<b>Degrees of Freedom</b>	<b>Significance</b>
Social class growing up	4.328	4	.363
Race	3.659	2	.161
Gender	10.431	2	.005
Years teaching	1.304	4	.861
Took courses in undergraduate or graduate that addressed economic inequality	18.186	2	.000
Political self-identification	14.176	4	.007
<i>Engage</i>	13.005	4	.011
Gap between the rich and everyone else in the U.S. has increased in last 20 years	2.995	2	.224
Gap between rich and poor is a problem	1.002	2	.606
People can get ahead if willing to work hard	4.078	2	.130
Hard work no guarantee for success	1.677	2	.432
Economic system unfairly favors the wealthy	.390	2	.823
Reduce poverty by raise taxes on wealthy and expand programs for poor	.564	2	.754
Course	24.430	12	.018
Class designation (e.g. honors, regular) of the class they reported on	8.821	8	.358
How much control they have over course textbooks	16.711	2	.000
How much control they have over course content	5.831	2	.054
How much control they have over course curricular pace	3.495	2	.174
Extent to which school administrators supportive	4.545	2	.103
Extent to which colleagues share beliefs	.670	2	.715
Percentage of students on free or reduced lunch at school	5.546	4	.236
How characterize political learning of community where teach	6.553	4	.161

Percentage of people who voted for Obama in school's region	10.097	8	.258
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**Predicting Teaching about Economic Inequality: Parameter estimates from multinomial logistic regression**

			95% Confidence Interval	
	Significance	Odds Ratio	Lower Bound	Upper Bound
<b>Comparing Teaching about economic inequality “never” to “occasionally”</b>				
Social class growing up (upper/upper middle class vs. lower/lower middle class)	.227	.548	.207	1.454
Social class growing up (middle class vs. lower/lower middle class)	.787	1.103	.542	2.247
Race (White vs. People of Color)	.083	.431	.166	1.116
Gender (male vs. female)	.490	.800	.425	1.507
Years teaching (1-3 years vs. 11 or more years)	.874	1.071	.458	2.506
Years teaching (4-10 years vs. 11 or more years)	.631	1.199	.572	2.515
Took courses in undergraduate or graduate that addressed economic inequality (yes vs. no)	.001	2.825	1.518	5.258
Political self-identification (liberal vs. conservative)	.961	.979	.423	2.267
Political self-identification (moderate vs. conservative)	.086	.515	.241	1.098
<i>Engage</i> (low vs. high)	.205	.556	.224	1.380
<i>Engage</i> (moderate vs. high)	.938	.963	.371	2.496

Gap between the rich and everyone else in the U.S. has increased in last 20 years (agree vs. disagree)	.136	.506	.206	1.239
Gap between rich and poor is a problem (problem vs. no/small problem)	.630	1.228	.531	2.840
People can get ahead if willing to work hard (agree vs. disagree)	.374	1.423	.653	3.101
Hard work no guarantee for success (agree vs. disagree)	.799	.910	.441	1.880
Economic system unfairly favors the wealthy (agree vs. disagree)	.564	.795	.365	1.733
Reduce poverty by raise taxes on wealthy and expand programs for poor (agree vs. disagree)	.809	.917	.456	1.845
Course (Algebra vs. other)	.848	.897	.294	2.737
Course (Statistics vs. other)	.842	1.149	.295	4.469
Course (Calculus vs. other)	.366	.540	.142	2.055
Course (Geometry vs. other)	.145	.369	.096	1.410
Course (Algebra 2 vs. other)	.220	.416	.103	1.688
Course (Pre-calculus vs. other)	.523	.569	.101	3.217
Class designation (regular vs. other)	.698	1.248	.409	3.806
Class designation (honors/AP vs. other)	.324	1.841	.547	6.196
Class designation (special education vs. other)	.328	.462	.098	2.170
Class designation (remedial/intervention vs. other)	.219	.456	.130	1.596

Control over content (no/minor vs. moderate/great deal)	.000	.263	.125	.553
Control over textbook (no/minor vs. moderate/great deal)	.028	2.127	1.084	4.175
Control over pace (no/minor vs. moderate/great deal)	.408	.743	.368	1.501
Administrators supportive (agree vs. disagree)	.037	2.431	1.057	5.592
Colleagues share beliefs (agree vs. disagree)	.489	.694	.246	1.953
Free or reduced lunch (low percent vs. high percent)	.871	1.070	.471	2.430
Free or reduced lunch (mid percent vs. high percent)	.229	1.607	.742	3.477
Characterize school community where teach (liberal vs. conservative)	.271	.618	.262	1.458
Characterize school community where teach (moderate vs. conservative)	.050	.503	.253	1.000
Percent of Obama voters in region (lowest to highest)	.659	1.223	.501	2.985
Percent of Obama voters in region (low to highest)	.076	.412	.155	1.099
Percent of Obama voters in region (mid to highest)	.388	.653	.248	1.719
Percent of Obama voters in region (high to highest)	.145	.468	.168	1.301
<b>Comparing Teaching about economic inequality “never” to “often”</b>				
Social class growing up	.671	1.246	.451	3.443

(upper/upper middle class vs. lower/lower middle class)				
Social class growing up (middle class vs. lower/lower middle class)	.912	1.046	.474	2.304
Race (White vs. People of Color)	.134	.439	.149	1.290
Gender (male vs. female)	.019	2.244	1.139	4.420
Years teaching (1-3 years vs. 11 or more years)	.419	.676	.262	1.745
Years teaching (4-10 years vs. 11 or more years)	.707	.858	.386	1.908
Took courses in undergraduate or graduate that addressed economic inequality (yes vs. no)	.000	3.814	1.864	7.804
Political self-identification (liberal vs. conservative)	.011	3.562	1.331	9.532
Political self-identification (moderate vs. conservative)	.107	2.093	.853	5.136
<i>Engage</i> (low vs. high)	.013	.297	.114	.773
<i>Engage</i> (moderate vs. high)	.893	.935	.350	2.498
Gap between the rich and everyone else in the U.S. has increased in last 20 years (agree vs. disagree)	.171	.481	.168	1.372
Gap between rich and poor is a problem (problem vs. no/small problem)	.564	.755	.291	1.962
People can get ahead if willing to work hard (agree vs. disagree)	.261	.608	.255	1.448
Hard work no guarantee for success (agree vs.	.215	.610	.280	1.333



disagree)				
Economic system unfairly favors the wealthy (agree vs. disagree)	.639	.804	.324	1.997
Reduce poverty by raise taxes on wealthy and expand programs for poor (agree vs. disagree)	.461	.746	.342	1.628
Course (Algebra vs. other)	.829	.867	.237	3.174
Course (Statistics vs. other)	.033	5.408	1.147	25.502
Course (Calculus vs. other)	.573	.636	.131	3.074
Course (Geometry vs. other)	.856	.870	.192	3.934
Course (Algebra 2 vs. other)	.585	.627	.118	3.340
Course (Pre-calculus vs. other)	.539	.525	.067	4.106
Class designation (regular vs. other)	.432	1.669	.465	5.983
Class designation (honors/AP vs. other)	.456	1.711	.418	7.006
Class designation (special education vs. other)	.710	1.385	.249	7.713
Class designation (remedial/intervention vs. other)	.951	1.044	.260	4.192
Control over content (no/minor vs. moderate/great deal)	.001	.252	.113	.562
Control over textbook (no/minor vs. moderate/great deal)	.770	1.116	.534	2.333
Control over pace (no/minor vs. moderate/great deal)	.248	1.584	.726	3.458
Administrators supportive (agree vs. disagree)	.507	1.375	.536	3.528
Colleagues share beliefs (agree vs. disagree)	.989	.992	.321	3.064

Free or reduced lunch (low percent vs. high percent)	.132	.500	.203	1.232
Free or reduced lunch (mid percent vs. high percent)	.962	1.020	.454	2.291
Characterize school community where teach (liberal vs. conservative)	.425	1.456	.578	3.665
Characterize school community where teach (moderate vs. conservative)	.628	.826	.380	1.793
Percent of Obama voters in region (lowest to highest)	.147	2.144	.765	6.012
Percent of Obama voters in region (low to highest)	.875	1.090	.371	3.208
Percent of Obama voters in region (mid to highest)	.885	.920	.298	2.836
Percent of Obama voters in region (high to highest)	.924	.947	.313	2.868

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