AN ABSTRACT OF THE DISSERTATION OF

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Issues of injustice in society (e.g. racism, classism, sexism, ableism) are perpetuated in and through educational opportunities, including mathematics learning (Freire, 1970/2000). Those that are committed to disrupting the interlocking systems that create disparities and oppression in mathematics education are considered to be "pursuing justice." Pursuit of justice can involve a variety of different conceptions of justice, where conceptions involve the recognition of the problems that need to be solved, ideas about what solutions look like, and how researchers, teacher educators, and teachers may make progress in achieving it. While there has been increased attention on justice in the mathematics education field since the turn of the century (Berry III et al., 2020; TODOS, 2020; Wager & Stinson, 2012), the products of this attention (e.g., research on classroom interactions, identification of justice-oriented practices, curriculum centering social issues) take up varied conceptions of justice. I posit that an understanding of the range of conceptions of justice that exist in mathematics education literature can help identify trends in how the field can continue to problematize and generate solutions for future work. This qualitative

dissertation study, presented in two manuscripts, collectively examines conceptions of justice in K-12 mathematics education.

The first manuscript explores the conceptions of justice present in the research literature regarding justice in K-12 mathematics education. When manuscript authors frame problems around justice and interpret solutions, they draw upon and construct *Discourses*, which are cultural and social frames that constitute meaning. This manuscript answers the research question, *what are the Discourses of Justice in the K-12 mathematics education literature?* My systematic analysis of the research, teacher education, and practitioner literature that used justice as a key construct resulted in the identification of three *Discourses of Justice (Empowerment, Transformation,* and *Democracy)* and three themes regarding how they are invoked in the literature. The findings of this study offer insight into the ways *Discourses of Justice* function within manuscript arguments and across manuscript audiences to motivate and construct different conceptions of justice. Implications from this manuscript call for understanding how the *Discourses of Justice* in the literature are invoked by other members of the field to inform action toward justice.

The second manuscript answered the research question, *how do educators construct their conceptions of justice?* I utilized activity theory (Leont'ev, 1981; Engeström, 1987) and Mediated Discourse Analysis (Norris & Jones, 2005; Scollon & Scollon, 2004) to unpack how educators draw upon *Discourses of Justice* and other mediational means to construct their conceptions of justice in interviews. In a strategic series of semi-structured interviews of educators working in a social justice-oriented educational program, the analysis revealed that each of the four educators

constructed multiple conceptions of justice at a time. Some of these conceptions drew upon *Discourses of Justice* that call for system-level transformation, but most attended to interactional shifts that impacted individuals in their conceptions of justice. As the educators constructed these conceptions across their interviews, they invoked mediational means that embodied their a) personal experiences and belief systems and b) institutional responsibilities and agency. My analysis suggests that these two sources represent key features of the activity system that support educators' conceptions of justice. Personal experiences and institutional responsibilities afford and constrain educators' conceptions of justice, as well as the mediational means they invoke. This manuscript motivates further exploration of the mediational means that educators draw upon in their conceptions of justice and how these may work as mechanisms to advance particular goals and actions to achieve a more just system of mathematics education.

The two manuscripts that comprise this study present a perspective on the conceptions of justice available within the field of mathematics education as represented in the literature that specifically identified justice and from four educators working within one justice-oriented educational setting and how those conceptions of justice provide implications for action. An implication of this study is for increased awareness regarding the (lack of) attention paid to system-level conceptions in justice work. In particular, this study advances the importance of leveraging a multi-layered and nuanced conception of justice that supports the connection of individual action to systemic impact. The findings in this study present evidence that these conceptions are challenging for manuscript authors and educators to take up. Yet, there is a need

to uncover mechanisms through which stakeholders throughout the mathematics education community can build awareness and attention to systemic features of justice in their work. Justice is a systemic problem that requires systemic solutions. The second implication of this study is a motivation for collective action to achieve a more just mathematics education. As the findings from this study motivate a call for systemic action toward justice, a need for research and practice to encompass the work of collectives arises as well. Cultivating networks of support and expertise within and across stakeholders in mathematics education, and extending to community organizers and activists outside of mathematics education, is one step forward toward understanding and pursuing nuanced, complex, and systemic conceptions of justice in mathematics education.

# What Do We Mean By "Justice"?: An Examination of How Justice is Conceptualized in K-12 Mathematics Education

by
Megan E. Brunner

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Megan E. Brunner, Author

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# Chapter 1 - Introduction

## Motivating a Study on Conceptions of Justice in Mathematics Education

The current state of the world and of education has made visible and exacerbated inequities regarding race, class, gender, and ability (Martin, 2019; Nicol et al., 2019; TODOS: Mathematics for All, 2020). Social, cultural, and political power structures that result in such inequities are interwoven with the system of education (Freire, 1970/2000; Apple, 2017). The pursuit of justice cannot be held separately from the work of educators and educational researchers; justice is an inherent part of mathematics teaching and learning (Aguirre et al., 2017; Confrey, 2010; Martin et al., 2010; Thanheiser & Sugimoto, 2020).

Mathematics education scholars have been grappling with the role of teaching and learning in disrupting injustice for many years (Crespo et al., 2022). As Gloria Ladson-Billings claims, "[working toward justice] is just good teaching!" (1995a). Along with Culturally Relevant Pedagogy (CRP, Ladson-Billings, 1995a, 1995b, 2000), justice work in mathematics education has been spurred by the frameworks of Critical Mathematics Education (CME, Frankenstein, 1983, 1990, 2013) and Teaching Mathematics for Social Justice (TMfSJ, Gutstein, 2003, 2005, 2016). These frameworks collectively argue for the role of mathematics education in preparing students to thrive outside of schools, and for students to have the agency to change society to allow thriving to occur (Freire, 1970/2000). The frameworks also recognize the role mathematics has in creating and sustaining inequities – through perpetuating hierarchies of ability and intelligence that create barriers to opportunities for learning and power (Ladson-Billings, 1995a), as well as through the ways mathematics is applied in society (Skovsmose, 2012). Teaching and learning mathematics, in the foundational frameworks for the field, can be

considered justice-oriented when it not only supports students in developing critical mathematical skills and understanding, but also attends to preparing students to analyze, interrogate, and disrupt inequitable systems and practices using mathematics as a tool (Frankenstein, 1990; Gutiérrez, 2009).

Current research on justice in mathematics education has expanded upon the principles of these frameworks to articulate specific goals for student learning and aligned teaching practices (e.g., Bartell et al., 2017). Curricular resources that incorporate appropriate social issues for rigorous, grade-level mathematical exploration have been developed (e.g., Berry III et al., 2020; Gutstein, 2003, 2016) and tensions in instruction have been identified (Gutiérrez, 2009; Gregson, 2013; Kokka, 2015; Martin et al., 2010). Across the research and practice products to advance justice, researchers, teacher educators, and teachers have articulated their own understandings of the purposes of justice in mathematics education and how these goals can be achieved. Clarifying the impact of individuals' conceptions of justice can provide insight for the field regarding the implications for suggested resources, practices, or principles that can afford progress toward justice.

How actors (persons who are committed to justice in mathematics education) engage in the work of research, teacher education, and teaching can be seen as a process of conceptualizing an object to work toward and leveraging available mediational means to inform action oriented toward that object (Leont'ev, 1981; Engeström, 1987). Consider that an educator who conceptualizes justice as achieving equitable participation in classroom discourse may draw upon means for encouraging participation (e.g., setting sociomathematical norms for group work, Yackel & Cobb, 1996) or tools to track participation across student demographics (e.g., EQUIP, Reinholz & Shah, 2018).

These conceptualizations, means, and actions are not unique to the individual, rather, they are informed by the social, cultural, historical, and political contexts in which they occur. These contexts include culturally constituted ways of perceiving the world and interpreting meaning, also known as Discourses (Gee, 2000, 2008). Discourses manifest in mathematics education through the conceptions of goals for teaching and learning that inform one's actions (Reinholz & Wilhelm, 2022). That is, as an educator or researcher discusses justice, they situate their work – whether consciously or unconsciously – amidst the ideas of the field. The threads of connection between an actor's conceptions of justice and the Discourses available in the field provide insight into opportunities for innovation and exploration.

Achieving justice requires a multi-faceted approach that acknowledges the intersecting systems of power which uphold inequities and oppression. I argue that understanding the conceptions of justice in the field and the relationships between conceptions, means, and actions provides insight into how mathematics education can be more authentically and explicitly attentive to issues of justice in schools and in society.

**Research Questions and Manuscript Overviews**

This study documented the conceptions of justice articulated in the field's literature base and how conceptions are developed through actors' practice. To do so, I asked the following questions regarding conceptions of justice in K-12 mathematics education:

1. What are the Discourses of Justice in mathematics education literature?
2. How do educators construct conceptions of justice in mathematics education?

Addressing these questions served as a foundation for research on connecting actors' conceptions of justice to the progress they made in practice. This study consisted of data collection and analysis from two sources: (1) a systematic review of the literature on justice in K-

12 mathematics education and (2) a series of interviews with four educators who were committed to justice in mathematics education in their current work. Data collection occurred from 2020-2021 and analysis was ongoing throughout the process. For this study, I constructed two manuscripts aligned to each of the research questions.

***Manuscript 1***

The first manuscript, titled *Discourses of Justice in Mathematics Education: A Systematic Review of the Literature*, addressed the first research question. This paper was an analysis of the collection of literature on justice and K-12 mathematics education. In order to holistically explore the Discourses available in the field, the reviewed literature included empirical manuscripts, theoretical manuscripts, and practitioner manuscripts. Through my analysis, I constructed an organizational framework (*Discourses of Justice)* to distinguish the trends of how justice is discussed by manuscript authors. The three *Discourses of Justice* I established are differentiated by the levers for achieving justice they proposed: interactional change through individual empowerment, institutional transformation within structures and systems, and ideological shifts across cultural perceptions of the purpose of education. This manuscript was an analysis of how these *Discourses of Justice* were invoked across the literature base. I attended to how *Discourses of Justice* functioned within different sections of the manuscripts reviewed to set up problems of study, theorize about the components of justice, and interpret findings and implications for the manuscript audience. I also discussed how these patterns vary across types of manuscripts; these differences provided unique implications for the ways that the manuscript audiences of researchers, teacher educators, and teachers had access to *Discourses of Justice.*

***Manuscript 2***

Understanding how the literature base conceptualized justice calls us to wonder how the Discourses of Justice invoked by manuscript authors were drawn upon by educators to inform their own conceptions of justice; the second manuscript takes up this inquiry. Titled *Teachers' Conceptions of Justice in Mathematics Education: A Mediated Action Approach*, this manuscript addressed the second research question regarding how educators constructed their conceptions. In this manuscript, I used tools from Cultural-Historical Activity Theory (Leont'ev, 1981; Engeström, 1987) and Mediated Discourse Analysis (Norris & Jones, 2005; Scollon & Scollon, 2004) to analyze a strategically designed series of interviews with four educators working in a justice-oriented educational setting. The analysis unpacks how educators drew upon Discourses of Justice and mediational means in their conceptions of justice. I attended to the various means and Discourses that arose in the educators' narratives; I discussed how the educators invoked means and Discourses that elucidated their individual subjectivities and their institutional affordances and constraints. Findings from this manuscript highlighted processes for constructing conceptions of justice, mechanisms for attending to system-level considerations of justice, and features of the activity system that come forward in educators' conceptions. This manuscript provided implications for exploring additional resources and processes that may advance justice-oriented action in mathematics education.

## Positioning Myself as Researcher

I situated this study within a sociopolitical paradigm for research (Gutiérrez, 2013). A sociopolitical paradigm acknowledges the role of "knowledges, power, and identities as interwoven and constituted in and through sociocultural and sociopolitical discourses" (Stinson & Walshaw, 2017, p. 9). Research within this paradigm aims to unpack and deconstruct power

and oppression in mathematics teaching and learning. There is no one truth, but rather, individuals are constantly constructing meaning through interactions. This dissertation study investigated how manuscript authors and educators constructed meaning regarding justice; I did so in order to contribute to the disruption of inequities in mathematics education.

I recognize that my own positionality shaped my purpose for embarking on such research, as well as the ways I engaged with others within this work. I am an able-bodied, cisgender, white woman in education, who was raised in a middle-class household and community. I have attended predominantly white institutions (PWIs) that actively displace Indigenous people to occupy their lands throughout my educational trajectory, even as I attempt to disrupt white supremacy in my research and practice. My teaching experiences as a faculty member at an educational non-profit program, which serves students from historically marginalized communities and intentionally hires Black, Latin*, Asian, and other People of Color as faculty to guide the program's vision of teaching and learning, have greatly shaped what I consider as justice in mathematics education.

The question of what justice entailed was one that I have reflected upon and revisited throughout my scholarly journey. My evolving understanding of my own positioning in each educational space I enter, my awareness of the privileges and biases I carry with me through the world, and the biases that remain unconscious to me, have impacted each stage of this dissertation study. My biases come forward in what I tend to consider familiar or normative, especially with regard to the research problem under study.

The goal of this research was not to present the "truth" or the "ideal" scenario, but rather to convey how the actors in my research (manuscript authors and educators) conceptualized justice. As a researcher, I employed additional tools to support my inquiry and analysis in

achieving validity (Creswell, 2011; Maxwell, 2013). To achieve this goal, I stayed close to the data across my analysis for both manuscripts. In the first manuscript, I coded large sections of text to gather surrounding context for the authors' interpretations of justice. I aimed for a preponderance of evidence in establishing the three *Discourses of Justice*. In the second manuscript, I similarly included context when applying codes to ground my analysis in the educators' meaning. I also employed member checks with my participants to ensure the educators felt that their stories were being told authentically and appropriately, without excluding connections or ideas that were important to their understandings of justice (Maxwell, 2013; Saldaña, 2013). I worked closely with Dr. Rebekah Elliott across both manuscripts to clarify codes and themes. Dr. Elliott further supported me in establishing the structure for each manuscript and linking the data as evidence for my claims. In each manuscript, I detail further specific instances of how my intersectional identities (Crenshaw, 1991) shaped my data collection and analysis.

**Limitations and Significance of Dissertation**

This study was limited by the focus across data collection and analysis on the term "justice." In my systematic review, literature that did not explicitly discuss "justice" was excluded from the analysis, such as that which describes "liberation" (Davis, 2018) or critiques "anti-Blackness" (Martin, 2019). This allowed the focus of analysis to highlight the meanings the field attached to the term "justice," however, it limited the perceptions of inequity in mathematics education research. With respect to the interviews with educators, a similar challenge regarding the scope and carving out justice-specific conceptions limited the generalizability of this study. As the educators discussed their justice-oriented conceptions and teaching, they naturally invoked images of their typical classroom environments and

instructional practices; these were not always clearly separated from their articulation of justice (or needs for justice). Thus, the analysis focused only on the sections of interviews that explicitly connected the educators' talk to "justice." Further limitations were discussed in the relevant chapters of this study. However, the limitations discussed here draw attention to the significance of this study and its implications for future research.

The manuscripts in this dissertation study were designed to complement each other. The first manuscript established the *Discourses* (i.e. cultural framings that shape meaning-making) present in the literature on justice in K-12 mathematics education. The second manuscript considered how educators conceptualize and work toward justice in their praxis; it recognized how educators' conceptions of justice drew from and built upon the Discourses available in the field. Together, the manuscripts present evidence regarding the types of conceptions of justice that were constructed and elaborated on across the field of mathematics education. This study contributes to the field's understanding of justice in mathematics education and motivates future research and practice regarding the role of conceptions in cultivating systemic action toward justice.

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# Chapter 2 –

## Discourses of Justice in Mathematics Education: A Systematic Review of the Literature

## Introduction

Social justice in mathematics education has been a long-standing and evolving conversation among researchers (Gutiérrez, 2002, 2013; Ladson-Billings, 1995, 2021; Martin, 2007, 2019; Secada, 1994), teacher educators (Aguirre et al., 2017; Bartell, 2013; Bartell & Meyer, 2008; Felton-Koestler, 2017, 2019; Wager & Stinson, 2012), and teachers and administrators (Gutstein, 2006, 2012; National Council of Supervisors of Mathematics & TODOS: Mathematics for All, 2016). Each of these stakeholders has wondered, what does it mean to do social justice work in mathematics education? How does one teach mathematics, prepare teachers, or conduct research in a way that serves social justice goals? Researchers, teacher educators, and teachers look to the literature for insight and inspiration on their next steps towards justice. Thus, it is essential to be able to parse what members of the field perceive as justice and the connected actions they suggest to make progress towards those aims. This paper presents the results of a systematic review of the literature on justice to answer the questions, (a) what are the ways justice in K-12 mathematics education is described and worked towards? and (b) how are these framings of justice invoked across the literature base?

As the field engages in conversations regarding justice in math education, various terminology is invoked to problematize the state of mathematics education and identify focal points for change to occur. These terms include culturally relevant pedagogy (Ladson-Billings, 1995a, 1995b, 2000), critical mathematics education (Frankenstein, 1983, 1990, 2013, Skovsmose, 1994, 2018), and teaching mathematics for social justice (Gutstein, 2003; Gutiérrez,

2013). Each of these frameworks consists of overarching principles that outline visions of justice and practices associated with those principles to inform action. As researchers, teacher educators, and teachers work to understand and create a more justice math education, they take up these theoretical foundations, combine them, and extend them to include new contexts, aims, and practices. Evolving understandings of justice can lead to challenges in understanding goals for possible instructional innovations; stakeholders may focus on different perceptions of justice or practices to guide their work.

Researchers claim that teachers' classroom practice is entangled with their visions of justice (Adiredja & Louie, 2020; Bartell & Meyer, 2008; Gutiérrez, 2002; Horn, 2007). Teachers' visions of just mathematics education (whether implicitly or explicitly) shape how they notice and interpret interactions in the classroom and influence the instructional practices they enact (van Es et al., 2017). By extension, a researcher's vision of a research problem regarding justice, which shapes their research design, is entangled in their vision of justice. Similarly, the actions of a teacher educator to shape justice-oriented teacher education, such as the readings they assign or the pedagogies they introduce, are entangled in their visions of justice. Explicitly describing visions of justice and the connected practices and actions present in the literature base provides a foundation to unpack the ways researchers, teacher educators, and teachers work towards a more just mathematics education. Parsing these perceptions and practices can identify facets of justice that need more attention in research and practice; it also provides a lens to understand which stakeholders have access to certain ways of thinking about and pursuing justice.

This study aims to link the visions of justice and suggested practices and actions that currently exist in the literature on justice in K-12 mathematics education. I present an

organization of these connected visions and practices resulting from a systematic literature review of K-12 mathematics education research regarding justice. First, I overview foundational literature on justice in K-12 mathematics education. Then, I articulate the theoretical underpinnings of Discourses as a way to connect visions of justice and the actions taken to achieve that vision (Gee, 2000, 2008). I discuss my methods for selecting relevant literature and the coding process I applied, through which I found three different Discourses of Justice in K-12 mathematics education research. I present each Discourse of Justice and detail how it is invoked across the research base. Finally, I propose implications for research and teaching based on the current status of Discourses of Justice in the field.

## Literature Review: Foundational Frameworks of Justice in Mathematics Education

Several frameworks theorize what it means to achieve a more just mathematics education in K-12. As Gates and Jorgensen (2009) posit, a framework for social justice attends to certain features of the education system and is influenced by the particular contexts and goals of the author. Here, I present a few of the frameworks that have advanced work toward equity and justice: *Culturally Relevant Pedagogy* (Ladson-Billings, 1995a, 1995b, 2000, 2006, 2021; Leonard, et al., 2010; Thomas & Berry, 2019), *Critical Mathematics Education* (D'Ambrosio, 2012; Frankenstein, 1983, 1990, 2012, 2013; Moses & Cobb, 2002; Skovsmose, 1994, 2018), and *Teaching Mathematics for Social Justice* (Gutstein, 2003; Gutiérrez, 2013; Kokka, 2015; Larnell et al., 2016; Stinson & Wager, 2012). For each framework, I present critical features situated in the author's goals. I connect these features to suggested pedagogical strategies promoted to achieve the framework's aims. Understanding the ways foundational frameworks of justice in K-12 mathematics education connect goals, features, and pedagogies will provide a

foundation to unpack the different perspectives on justice currently articulated in the K-12 mathematics education research, teacher education, and practitioner literature.

## Culturally Relevant Pedagogy

Culturally Relevant Pedagogy (CRP) (Ladson-Billings, 1995a, 1995b) arises from the relationship between education and culture across classroom interactions, institutional, and societal contexts. There was – and is – a need for teachers to understand the cultural experiences of Black and African American students to support their learning and growth effectively. CRP consists of three propositions, each connected to an idea of what justice provides. The first proposition, academic success, outlines the need for students' mathematical competence and academic skills to be active members of society (Ladson-Billings, 1995a, 2000; Moses & Cobb, 2002). The second proposition, cultural competence, refers to the capacity of students to "maintain cultural integrity" (1995b, p. 476). Students should have the agency to center and celebrate their culture while being mathematically successful to enact this proposition. This proposition opposes the traditional school environments' tendency to perpetuate whiteness and oppress the positive expression of other cultures. CRP's third component is critical consciousness, which implores teachers to support students in acknowledging, understanding, and critiquing social inequalities. Again, Ladson-Billings (1995a) connects the third component to the role of education in preparing students for active citizenship. She argues that this combination of propositions for student learning results in a pedagogy committed to individual and collective empowerment (Ladson-Billings, 1995a, Leonard, et al., 2010).

### *Teaching Practices Aligned with CRP*

Asset-based perspectives on student capacity to develop agency and positive identities align with CRP and its related teaching practices. Teaching practices associated with the

proposition of academic success in the literature include setting high expectations for student engagement and rigorous content (Ladson-Billings, 1995a, 1995b, 2000; Thomas & Berry, 2019). To advance the idea that learning is not only for building mathematical skills but also to develop life-long curiosity and competence, teachers may explicitly situate tasks and academic goals within metacognitive processes of learning (Ladson-Billings, 2006). Teaching practices that align with the proposition of cultural competence involve "work[ing] back and forth between lives of their students and the life of school" (Ladson-Billings, 2006, p. 36). This may include activities that build rapport with families and communities, similar to those advocated for building funds of knowledge (Moll, et al., 1992) or community relations (Aguirre et al., 2013). Legitimizing languages (Ladson-Billings, 1995a, 2000; Moschkovich, 2013; Planas & Civil, 2009) and cultural values from diverse community groups throughout curriculum and classroom interactions can serve to disrupt White and monolingual normative practices and broaden notions of what is seen as mathematical (Ladson-Billings, 2006; Martin, 2019). Supplementing the curriculum to include contexts that relate to students' experiences and interests (Ladson-Billings, 1995a, 2000, 2006) and developing students as leaders in classrooms and schools coincide with CRP propositions of cultural competence and academic success (Tate, 1995). By recognizing students' cultural values and personal strengths as valid and robust parts of the school system and learning processes, these two propositions focus on the empowerment of the individual (Ladson-Billings, 1995a).

The third proposition of critical consciousness requires an awareness of local and societal inequities by both teachers and students. Developing this awareness involves exploring resources, understanding multiple perspectives on societal and historical phenomena (Ladson-Billings, 1995a), and discussing how knowledge is constructed. Both students and teachers are

responsible for critiquing the structures that shape human experiences through questioning and mathematical analysis (Ladson-Billings, 1995a, 2000, 2006). Communicating this exploration and critique are critical to communities and stakeholders in the systems and can lead to social action and righting injustices (Tate, 1995; Ladson-Billings, 1995a, 1995b). Critical consciousness is necessary to challenge the inequitable social organization and to achieve the ideal of democracy (Ladson-Billings, 2000). This proposition of CRP shifts the focus from empowering individuals to empowering a collective, leading to increased participation in the structuring of our society (Ladson-Billings, 1995a, 2000).

**Critical Mathematics Education**

Critical Mathematics Education (CME) is another framework for K-12 mathematics teaching that targets the development of mathematical literacy to combat structural inequities around power and participation in society (Frankenstein, 1983, 1990). In this framework, mathematics is recognized as a barrier to jobs and careers in STEM fields (Tanase & Lucey, 2017), corresponding to access to economic and political power (Leonard & Moore, 2014). Skovsmose and Borba (2004) acknowledge five concerns of CME to attend to the structuring role of mathematics and its resultant inequities. These concerns are the "social and political aspects of learning mathematics," the access to rigorous mathematics for all individuals, the "use and function of mathematics" in both everyday life and advanced applications, the development of a "democratic forum" in a classroom environment, and the development of learners as critical citizens (Skovsmose & Borba, 2004, p. 207). These five foci act as an outline for what justice can and should provide when achieved. As Skovsmose (1994) summarizes, "to be literate is a necessary condition for being part of the workforce. But literacy also opens for a reaction to contradictory aspects of social life. Literacy is, so to say, a double-edged sword" (p. 38). Moses

and Cobb (2001) argue that mathematical literacy is the "launchpad" to "organizing for systemic change" (p. 6) and rectifying those contradictory and unjust conditions of the world.

### *Teaching Practices Aligned with CME*

CME aims to develop mathematical literacy to improve public use and communication of mathematical ideas in society. Mathematical literacy, or as others call it, mathematical power (e.g., Gutstein, 2003) or "mathemacy" (e.g., Skovsmose, 1994), involves the capacity for one to understand a complex problem mathematically, engage in problem-solving processes, and analyze and leverage mathematical representations to communicate solutions effectively (Frankenstein, 1983, 1990). Classroom math tasks should be complex without clear-cut solution methods (Frankenstein, 1983) to provide students the opportunities to develop problem-solving skills of recognizing areas for exploration, identifying important information, and evaluating their processes of reasoning as they solve. Interdisciplinary projects or activities are another way to mimic the real-world complexities of applying mathematics. Interdisciplinary tasks incorporate mathematics and social issues to be investigated; in this way, CME can prepare students to communicate relevant mathematics using critical perspectives.

Students' development of critical perspectives for analyzing and deconstructing social injustices through CME leads to active, critical citizenship (Skovsmose & Borba, 2004, p. 207). Critical citizens are consumers of mathematics in everyday scenarios; they can acknowledge and critique the assumptions made in the curriculum or arguments (Frankenstein, 2013). Awareness of the ways mathematics is used to promote particular policies or perspectives is part of mathematical literacy towards citizenship. Teachers should incorporate opportunities for students to work with data and construct arguments towards different points using the same data set and explore how mathematical reports can illuminate patterns or hide trends in data (Frankenstein,

2013). Critical citizens can extend their awareness of the power of mathematics to dissect public mathematics to reveal underlying assumptions (Frankenstein, 2013). Teachers should aim to incorporate opportunities for students to construct problems, analyze them, and present alternative solutions. This notion of critical citizenship requires explicit attention to mathematical power and social injustices. Critical citizens also need experience participating in "democratic forums" (Skovsmose & Borba, 2004, p. 207); the creation of democratic learning environments in schools aims to break down barriers of power so that students and teachers can engage in learning together (Bond & Chernoff, 2015; Frankenstein, 1983, 2013; Larnell et al., 2016). Deconstructing traditional hierarchies in mathematics classrooms could include positioning students as inquirers and authors of problems and solution methods.

**Teaching Mathematics for Social Justice**

The framework of Teaching Mathematics for Social Justice (TMfSJ) (Gutstein 2003, 2016) builds on the work of Freire (1970/2000), Skovsmose (1994, 2018), and Frankenstein (1983, 2013). TMfSJ takes up three goals for education that prepares students to recognize political and economic influences and power dynamics that shape society, leading to participation in democratic spaces (Apple, 1992, Gutstein, 2003, 2016). First, TMfSJ argues that for students to construct a more just society, they need to build awareness of societal injustices and the sociopolitical dynamics that shape their worlds (Gutstein, 2003). Awareness occurs through problematizing and analyzing phenomena using mathematics. Second, TMfSJ connects awareness to the need for action via student agency. Students need to see themselves as capable of influencing the organization of society to move towards change (Gutstein, 2003, 2007). Finally, TMfSJ acknowledges that these goals cannot be achieved without attending to students' social and cultural identities. Students need to be supported as developing citizens (Gonzalez,

2009) while being validated for their personal and community experiences and values (Gutstein, 2003, 2006). There are many iterations of TMfSJ that articulate slightly different versions of the goals for achieving this vision of justice (e.g. Kokka, 2015; Gonzalez, 2009; Larnell et al., 2016; Stinson & Wager, 2012). The belief that links all of these frameworks under the label of Teaching Mathematics for Social Justice is that mathematics should be taught in a way that supports students to develop critical consciousness and use their awareness to challenge injustices and disrupt the status quo (Stinson & Wager, 2012).

### *Teaching Practices Aligned with TMfSJ*

The first goal for social justice is developing *conscientização* (Freire, 1970/2000), and its associated disciplinary objective focuses on the role of mathematics in understanding the sociopolitical dynamics of the world (Gutstein, 2003). Instructional practices aligned with this objective include supporting students to use mathematics to unpack relationships between phenomena in everyday life. Teachers are responsible for posing questions that direct students to explore issues in their worlds that are not just personal but systemic (Gutstein, 2003). Tasks should be situated in real-world data or scenarios and students should be invited to analyze structural inequities with mathematics as an analytic tool (Gutstein, 2003, Larnell et al., 2016). The second goal of social justice is for students to develop social agency, and in the mathematics-specific context, this is seen in developing mathematical power or literacy (Gutstein, 2003; Frankenstein, 1983, 1990). Mathematical power is connected to students' agency to develop one's voice and advocate for their learning. Teachers must commit to incorporating problem-posing pedagogies, which give students authority to identify or construct problems, ask questions to explore complex scenarios, and then propose alternatives (Freire, 1970/2000; Gutstein, 2006, 2007). These tasks must also allow students to advocate for

themselves and their families, using mathematics to construct meaningful change (Gregson, 2013). Students and teachers should work together to unpack complex sociopolitical scenarios and understand how institutions and structures shape their lives (Gutstein, 2003, 2006).

The third goal of social justice is to support the development of positive social and cultural identities; within mathematics teaching, the objective is to change students' relationship with mathematics and develop mathematical identities (Gutstein, 2003; Aguirre et al., 2013). Teaching practices that align with the third mathematical objective involve creating learning environments where students see mathematics as relevant and valuable (Ladson-Billings, 2000). What is considered relevant mathematics can also be an opportunity to connect students to the mathematical knowledge held within their families and communities (Barajas-López & Larnell, 2019). Shifting the authority in the classroom from teacher to students may include setting explicit norms for inquiry and collaborative learning environments, validating emotional and personal responses to the process and content of learning mathematics through a social justice lens, or promoting student leadership in the classroom or school (Gregson, 2013; Gutstein 2003). Kokka (2015) distinguishes the work needed to create a shared classroom community of learners from the practices typically associated with reform efforts (such as those articulated by Rubel, 2017); social justice mathematics invokes a critical investigation of power structures within schools and society, carried out by students and teachers together, to disrupt inequities and redesign their learning environments (Kokka, 2015).

**Synthesizing Across the Foundational Frameworks**

These three frameworks (CRP, CME, and TMfSJ) for moving towards justice in K-12 mathematics education serve as foundational knowledge for much of the current research base. These frameworks arose out of the need to acknowledge the cultural, social, and political factors

Table 1.
Comparisons of the principles and practices outlined in CRP, CME, and TMfSJ frameworks.

| Framework | Principles | Practices |
|---|---|---|
| CRP (Ladson-Billings, 1995a, 1995b, 2000) | ● Academic success<br>● Cultural competence<br>● Critical consciousness<br>● Civic engagement | ● High expectations (engagement & content)<br>● Rapport with families and communities<br>● Legitimizing languages<br>● Use student interests as contexts for math<br>● Students as leaders in the classroom<br>● Tasks require students to critique structuring features of society<br>● Communicate with stakeholders to right injustices |
| CME (Frankenstein, 1983, 1990, 2013) | ● Social and political aspects of learning mathematics<br>● Access to rigorous math for all individuals<br>● Use and function of mathematics<br>● Development of a democratic forum in the classroom<br>● Development of learners as critical citizens | ● Social and political issues as context and content<br>● Democratic learning spaces<br>● Positioning students as experts and authors of problems (and solutions)<br>● Shift power dynamics in learning environments<br>● Center data, analysis, and argumentation |
| TMfSJ (Gutstein, 2003, 2006, 2016) | ● Develop conscientização<br>● Use mathematics to understand sociopolitical dynamics<br>● Develop social agency<br>● Develop mathematical power<br>● Develop positive social and cultural identities<br>● Develop mathematical identities | ● Pose questions regarding systemic factors that influence students' everyday experiences<br>● Support students in asking questions and advocating for their communities<br>● Construct mathematics that is meaningful for students<br>● Provide opportunities for students to make changes and develop solutions to social issues |

in mathematics teaching and learning. All three honor the relationship between individual empowerment and institutional change in pursuing justice goals. Each framework also connects to a vision of justice serving democratic ideals for participation in society. The teaching practices

and implications for research and teacher educators also attend to education's individual, institutional, and democratic ideals, albeit to different extents (Table 1).

Berry III and colleagues (2020) argue that CRP sets the stage for considering culture, CME identifies what it might entail, and TMfSJ argues for how teachers can work towards it. Leonard & Moore (2014) agree that social justice work explicates the role of action more thoroughly than CRP. As researchers continue to develop understandings of what justice is and how to achieve it, they build upon these three foundational frameworks and extend them into new contexts and questions. At times, researchers draw upon a single framework and aligned practices; at others, they create combinations of principles from across the three frameworks to organize their ideas of justice and articulate teaching practices.

Understanding how the foundational frameworks of CRP, CME, and TMfSJ have evolved throughout current research and practice can identify areas for future exploration and principles that can be further explicated. To trace the ways conceptions of justice have evolved across contexts and history, I leverage the lens of Discourses (Gee, 2000).

## Theoretical Lens: The Role of Discourses in Constructing Meaning

People use language and other forms of communication to build on those that come before them, which serves to construct sets of meaning or interpretation. Gee (2000, 2008) identifies these sets of meaning as Discourses, where invoking a Discourse can identify one as a certain type of person. Invoking a specific Discourse involves not just language (written or spoken) but also "…language, other symbolic expressions, and 'artifacts,' of thinking, feeling, believing, valuing, and acting" (Gee, 2000, p. 109). These features are considered discourses, or "stretches of language in action" (Gee, 2008). As one uses certain phrases, behaviors, or upholds certain values (discourses) in an interaction, they draw upon Discourses to contextualize their

meanings. Discourses can be seen not only in interactions but also in writing, such as research literature. When making an argument across a manuscript, an author uses certain phrasings, ideas, and literature to call upon a particular set of meanings. The ways authors use "stretches of language" in a manuscript take up and simultaneously add to the Discourses at hand. Invoking a particular Discourse can help position the researcher towards a specific audience or align their work with other researchers in the field.

**Visions of Justice**

Discourses can be recognized through the beliefs, values, and goals one insinuates and the actions, or practices, one engages in towards those goals (Gee, 2000, 2008). In this study, I consider the beliefs, values, and goals one holds about the future of a more just mathematics education as their "vision of justice" (Hytten & Bettez, 2011; Picower, 2012). A vision of justice can encompass the reasons justice is needed (i.e., the injustice being addressed), the things justice should provide or lead to, and the critical features of justice seen as necessary. It is essential to note the difference between "visions of justice" and "visions" connected to research on teacher noticing. "Teacher vision" or "professional vision" refers to the frame of reference that teachers bring to bear as they engage in or reflect on instances of instruction (Goodwin, 1994; Sherin, 2001; van Es & Sherin, 2008). Teacher vision shapes what teachers notice in interactions and how they attend to it (Mason, 2002).

Visions of justice refer to the overarching perspectives one holds for what education should look like in a more just world. Visions of justice include macro-level considerations about value systems and perspectives that one considers regarding mathematics education: in part, the answers to questions like, *what is the purpose of learning mathematics? What does it mean to be successful in mathematics?* These values and beliefs are communicated through micro-level

interactions as one takes action to achieve their goals (Ryve, 2011). The other component of Discourses is the practices that align with certain beliefs, values, and goals. Practices include the habitual actions of instruction and the pedagogical strategies one might engage in to achieve a teaching goal (Lampert, 2010). Practices may be of various grain sizes, but they are action-oriented and implementable in contextually situated ways. Practices may not be aligned with any one set of beliefs, values, and goals (visions of justice). The combination of visions of justice and the practices one sees as serving that vision are what constitutes a Discourse.

**Conveying Meaning via D/discourses**

D/discourses (Gee, 2000, 2008) coordinate the ways language is used to construct and negotiate meaning, where language involves not just speech and text but also actions, practices, and ways of interacting. Discourses are sustained through the cultural, political, and institutional recognition that happens within interactions due to the ways individuals portray and perceive themselves and others (Gee, 2000). As individuals interact with others, they invoke parts of Discourses that give insight into the meanings they are conveying and the ways they want to be perceived.

Discourses may be invoked in a few ways. First, we can *revoice* stretches associated with a particular Discourse. Revoicing aligns intended meanings with the histories and prior uses of that phrasing (Bakhtin, 1981). In research, revoicing occurs through citations or quotations to support an argument; in teaching, revoicing may come through discussing specific pedagogical resources or goals an educator holds for a lesson or task. For example, when talking about social justice teaching, Gregson (2013) cites Gutstein (2006) and uses the acronym “TMfSJ” throughout her manuscript. This aligns her research framework and own definition of social justice teaching with Gutstein’s conception of teaching mathematics for social justice as

composed of reading and writing the world with mathematics through rich, authentic tasks about social issues. Framing one's work alongside others who use similar language in their research and teaching raises a set of meanings from which to interpret their current argument.

Another way Discourses might be invoked is through similar cues of meaning explicated through new stretches of language (e.g., talk and action), otherwise thought of as *refracting* (Bakhtin, 1981). "For Bakhtin, what one means is always a product of both the meanings words have 'picked up' as they circulate in history and society and one's individual 'take' or 'slant' on these words (at a given time and place)." (Gee, 2000, p. 115). The power of refracting is vital to acknowledge, as Discourses are enacted within interactions; individuals draw upon available Discourses but fit the context in a given moment. Refracting, then, serves as a reauthoring of the socially accepted ways of being recognized as part of a frame of meaning within a specific situation. Thus, a researcher may articulate a version of Gutstein's (2006) notion of social justice pedagogical goals and Mirra's (2018) notion of critical civic empathy to draw attention to power dynamics with white students learning about justice (Kokka, 2020). Here, the researcher uses a specific discourse around the development of critical empathy to support students in taking action, refracted to the particular context under study. As existing Discourses are leveraged in interactions, the bounds of what gets recognized as aligning with those Discourses are expanded. In research, authors position themselves within different Discourses through their citations of other scholars' work or by using terminology or methodologies that communicate their perspectives on justice and teaching and learning.

**Negotiating Available Discourses towards Objectives**

As the field develops more language and perspectives on just mathematics education through revoicing and refracting, it is essential to pay attention to how one gains access to

different Discourses. Discourses are drawn upon in interactions to evoke socially and culturally recognized frames of meaning. However, not all Discourses are socially and culturally recognized by all members of society (Gee, 2008). Suppose someone is part of a community group that recognizes combinations of discourses to signal certain meaning. In that case, they may read these combinations of discourses in that way in other contexts as well. Vice versa, if someone is not a part of that cultural community, that Discourse would not be available to them to draw upon during their in-the-moment sense-making. One might imagine that for a teacher who has never come across Gutiérrez's (2009) notions of equity, interacting with another teacher who refers to "teaching students to play the game so that we can change the game" (Gutiérrez, 2009, p. 6) would not automatically cause the first teacher to understand the frame of reference being invoked, since that equity Discourse is not available to them.

Discourses are political in the power dynamics they serve to create (Gee, 2000; Gutiérrez, 2013) and historical, as the meanings of "stretches of language" have evolved as they are refracted and revoiced in new contexts. As Gee (2000) states, "we are talking about recognition as a social and political process...rooted in the workings of people's (fully historicized and socialized) minds" (p. 111). Researchers, teacher educators, and teachers will naturally have access to certain Discourses, while others may not be available to them because of their contexts and identities. The Discourses one has available will influence how one negotiates them in moment-to-moment interactions. The available meaning-making systems one holds will lead someone to notice different features of interactions and interpret them through different lenses. The various Discourses researchers, teacher educators, and teachers have access to will cause other problems to stand out that are perceived as requiring attention and solutions across the mathematics education system. To solve the perceived problem, one sets goals to work towards,

whether explicitly or implicitly. The available meaning-making systems influence the perceived problems and the resultant goals for teaching or research for the stakeholders involved.

Discourses are macro-level frames for sense-making that get recognized in interaction through combinations of practices, behaviors, values, and tools, among other features. Drawing upon certain Discourses can support utilizing specific tools or practices to achieve objectives. A teacher who conceives of justice as transforming the ways mathematics is taught and learned within schools to be more humanistic (Aguirre et al., 2013) may be more likely to use non-routine tasks that develop and draw upon students' reasoning and community-based resources than someone who draws upon a different Discourse in their framing of just mathematics education. Thus, Discourses link perceptions of situations to the actions one may take toward an objective; in pursuing a goal of a more just mathematics education system, the Discourses available to an actor will shape the perceptions of justice they hold and the actions they see as necessary to achieve it. Likewise, having a certain vision of justice may influence the practices that one sees as accessible at a given moment.

For example, if a teacher is working within a deficit Discourse, how they interpret student work and measure success in learning mathematics will look different from how a teacher may assess student understanding from an asset-based perspective (Adiredja & Louie, 2020). A teacher who conceives of justice as a process of students' development of critical questioning to unpack the societal issues around them may focus on inquiry and problematizing via a task on environmental problems such as oil-fracking (Hendrickson, 2015); a teacher who conceives of justice as supporting students in feeling like they belong in mathematics may prioritize creating a learning environment where all answers are valued for their mathematical contributions (Aguirre et al., 2013). While all are valid ways of pursuing justice in teaching, each teacher is working

within a different frame of a just mathematics education (Gee, 2000). I propose that as a result of drawing upon different Discourses, these teachers may utilize similar practices and at other times, draw upon very different teaching practices. This study argues that connecting visions of justice and the methods that achieve those visions will help researchers, teacher educators, and teachers more clearly communicate their education goals regarding justice and identify areas for future exploration.

Identifying the Discourses that are available across the field of K-12 mathematics education research and teaching can be challenging. So, how do we begin to understand the Discourses of Justice in the field? This study aims to identify Discourses of Justice in K-12 mathematics education literature as a starting point for understanding the available and active Discourses in the field. Thus, this study explores the questions:

1. What are the Discourses of Justice in the literature on justice in K-12 mathematics education?
2. How does the literature on justice in K-12 mathematics education invoke Discourses of Justice? What implications does this have for future research and teaching?

## Methodology

Systematic literature reviews provide a synthesis of the research base on a topic to present arguments for new perspectives or provide insight for future research (Petticrew & Roberts, 2006). This literature review synthesizes research on justice in K-12 mathematics education to present an argument for using *Discourses of Justice* as an organizational and analytical lens in future research and practice. In this section, I detail my selection criteria for literature included in the data set for this study. I also present my analytic methods, based on

Gee's (2000, 2008) work on Discourses, and articulate how these methods were systematically applied to the data set, resulting in identifying three *Discourses of Justice*.

**Researcher Positionality**

Systematic reviews and meta-analyses do not often contain disclosure of researcher positionality statements or recognition of the bias that the researcher brings to the analysis of the literature. However, my role as the researcher in selecting and analyzing the literature on justice in K-12 mathematics education is unable to be bracketed off (Saldaña, 2013). First, I came to this study with my own understanding of what justice leads to and entails in practice. This understanding has been developed across my responsibilities as a teacher of middle grades students in a demographically diverse area, a teacher educator of secondary mathematics teacher candidates, and a researcher learning to use sociopolitical and critical perspectives and methodologies. I am also a white woman who comes from a middle socioeconomic status background. These responsibilities and identities have shaped what I consider justice, both consciously and unconsciously. To mitigate the limitations of my perspectives, this study included utilized inclusion/exclusion criteria based on explicit terminology used in describing the studies (Petticrew & Roberts, 2006); the analysis revolved around direct quotations from the literature, and my analytic memos tracked the evolution of my understandings and personal reflections regarding the data (Saldaña, 2013).

**Identification of Literature**

To identify literature relevant to the construction of Discourses of Justice, I set a series of selection criteria (Petticrew & Roberts, 2006). Initially, these criteria included limiting results from 2000 or later and excluding dissertations or speeches/presentations without accompanying papers. I chose the starting date of 2000 given that Gutiérrez (2013) identifies the turn of the

century as when the sociopolitical perspectives on research in education occurred. Further, one of the seminal works on TMfSJ was published in 2003, which ignited much of the research on social justice and mathematics teaching. Then, I searched the Education Resources Information Center (ERIC) and Google Scholar to look across general education and mathematics databases. The ERIC search used the terms "mathematics" AND "justice" to yield 409 initial results. The Google Scholar searches used search terms: equity OR justice AND "mathematics education" OR "math education," resulting in 1090 potential sources. After duplicates were removed, the total initial results across search engines were 420 papers.

Subsequent rounds of criteria were applied to the initial results to narrow the focus and applicability of selected papers to answer the research question (Petticrew & Roberts, 2006; Yolcu, 2019). First, I read each text's title, abstract, and keywords for specific attention to mathematics and justice. Manuscripts that did not explicitly discuss mathematics and justice in at least one of the title, abstract, or keywords were excluded. This narrowed the field of literature to 149 total texts.

Then, I skimmed the entire body of the remaining manuscripts for definitions of justice and an explicit focus on teaching mathematics in grades K-12. Texts that were considered to have a theorization or description of justice included those that used Teaching Mathematics for Social Justice (Gutstein, 2003, 2006) as their theoretical background; those that defined justice as part of another framework, such as Hernandez and colleagues' (2013) description of justice as a critical feature of their conceptual framework on culturally responsive teaching; and those that explicitly connect ideas of justice to other terminology that is used throughout a manuscript, such as D'Ambrosio & D'Ambrosio (2013), who align the terms justice and peace in their theoretical argument. Texts that did not explicitly theorize or define justice were excluded. For example,

Meister (2017) actively discusses institutional and individual actions towards "equity" and against "injustices" but never defines justice, and so this manuscript was excluded from the data set. I also excluded manuscripts that did not explicitly connect to K-12 mathematics education at this stage. This meant that articles discussing a teacher educator's self-study of justice pedagogies and articles focused on the mathematical work of undergraduates were excluded. In contrast, articles that explored how pre-service K-12 teachers were engaged in the work of justice in mathematics teaching were included. The two exclusion criteria in this round review narrowed the data to 106 papers.

Finally, I read each of the remaining 106 manuscripts in full (Petticrew & Roberts, 2006). I used this stage first to exclude any papers that did not reach the previous criteria for inclusion upon closer inspection (Gray et al., 2021). In this round, I also excluded manuscripts from the same author or group of authors which leveraged the same articulation of justice. Since this systematic literature review aims to identify the Discourses of Justice in use in K-12 mathematics education literature, I needed to see the nuanced ways that authors discuss justice. Removing an author's multiple manuscripts highlighting the same ideas ensured that the themes that emerged were based on the breadth of work, not an "oversampling" from an author. Papers by the same author(s) that used different conceptualizations or identified additional features connected to justice in mathematics education were preserved. For example, three articles by Kokka were included in this analysis: one articulated social justice mathematics as a framework (2015), one built upon this framework to interweave trauma-informed healing justice (2019), and one leveraged a specific principle of the original framework to unpack critical civic consciousness (2020). On the other hand, Gutstein has authored multiple papers regarding his conceptualization of TMfSJ; I included the most recent, detailed theorization of this framework (2016) and his

accompanying practitioner-focused article (2013) about how mathematics teachers can apply this framework with students since these two manuscripts targeted different audiences. This round of exclusions resulted in 65 manuscripts remaining in the data set.

In my reading of the data set, I kept notes on additional texts that were regularly cited in social justice research but had not been identified in my initial search results; I reviewed each of these texts using the exclusion criteria laid out above and five additional manuscripts passed each stage and were added to the data set. Thus, the data set for this study consisted of 70 total manuscripts focused on K-12 mathematics education and justice.

### *Limitations*

Any systematic literature review must place boundaries on the research focus and selected literature to answer the research questions (Petticrew & Roberts, 2006). However, this naturally leads to an exclusion of indirectly related literature. In limiting this systematic review to K-12 mathematics education publications which explicitly define justice, two main groups of literature may have been excluded yet are still essential to the ways justice is discussed. First, in restricting searches to manuscripts that use the term "justice," research that uses language such as "anti-blackness" or "liberation" is not included in this analysis (e.g. Martin, 2019). There is a possibility that manuscripts using such terms provide different understandings of the inequities perpetuating harm in mathematics education and the solutions to create change. Second, by privileging Discourses that exist in published manuscripts, this study excludes the ways that Discourses of Justice are enacted in interactions through spoken word and actions. In particular, this study lacks a full representation of teachers' voices and ideas regarding justice; while I attempted to include practitioner manuscripts, many teachers do not take part in the publishing process as a way to share their ideas. Based on these two limitations, I remind the reader that this

study aims to provide a new conceptual framework for understanding the ways that justice is discussed and pursued in mathematics education, and once established, this framework can be applied and expanded to include the necessary nuances and ideas from these groups of literature and persons, among others.

## Analysis of Manuscripts

### *Identifying Demographic Information*

The first phase of analysis involved coding the data set for demographic information. Across this set of 70 manuscripts around justice in K-12 mathematics education are papers targeting different audiences, as mentioned above. Since Discourses gather additional meaning as they are invoked and acknowledged across different contexts (Gee, 2000; Wertsch, 1991), I chose not to utilize an inclusion/exclusion criterion on the paper audience or journal of publication to understand the ways Discourses function across the literature base. These different contexts provide depth of evidence on the ways Discourses of Justice are invoked by researchers, teacher educators, and teachers focused on justice in mathematics education.

The 70 manuscripts in the data set for this study were categorized by their type of study (empirical, theoretical, practitioner) and target audience (Table 2). Empirical manuscripts (n= 38) detail data collection and analysis to answer a set of research questions. These papers typically are aimed at teacher educators or researcher audiences. Theoretical manuscripts (n= 22) are arguments or essays on justice in mathematics education that do not analyze data or describe teaching activities. These papers typically target researcher or teacher educator audiences. Practitioner manuscripts (n=10) present resources that can be directly incorporated into teaching practice. These papers generally are targeting teachers or teacher educators. All manuscripts,

regardless of categorization, were analyzed using the same methods to elicit the different Discourses of Justice the authors invoked across their arguments.

Table 2.
Analyzed Manuscripts by Audience Categorization.

| | Empirical | Theoretical | Practitioner | Total |
|---|---|---|---|---|
| # Of Manuscripts | 38 | 22 | 10 | 70 |

Along with the identification of each paper as either empirical, theoretical, or practitioner-focused, I coded for the year of publication across all manuscripts (Table 3). For empirically categorized manuscripts (n= 38), I identified the country the data originated from and the grade (K-12) or stage in the profession (in-service or pre-service) of the students or teachers under study (Table 4).

Table 3.
Analyzed Manuscripts by Year of Publication.

| Year of Publication | Empirical | Theoretical | Practitioner | Total |
|---|---|---|---|---|
| 2000-04 | 1 | 1 | 0 | 2 |
| 2005-09 | 4 | 5 | 1 | 10 |
| 2010-14 | 9 | 8 | 3 | 20 |
| 2015-19 | 20 | 7 | 5 | 32 |
| 2020-21 | 4 | 1 | 1 | 6 |
| Total | 38 | 22 | 10 | 70 |

Table 4.
Demographic Information for Empirical Manuscripts.

| Country of Data Origin | Elementary Students | Secondary Students[1] | Pre-Service Teachers | In-Service Teachers | Self-study Teachers | Total |
|---|---|---|---|---|---|---|
| N. America | 0 | 7 | 11 | 8 | 2 | 28 |
| S. America | 0 | 0 | 0 | 0 | 0 | 0 |
| Europe | 0 | 0 | 1 | 3 | 0 | 4 |
| Asia | 0 | 0 | 0 | 2[2] | 0 | 2 |
| Africa | 0 | 0 | 0 | 1 | 0 | 1 |
| Australia | 0 | 1 | 0 | 0 | 0 | 1 |
| Total | 0 | 8 | 12 | 14 | 2 | 36[3] |

[1] Due to different terminology used across countries and grade levels, the "secondary students" category encompasses students ages ten and up.
[2] Turkey was categorized as Asia.
[3] Two empirically categorized manuscripts (Harper, 2019; Yolcu, 2019) are literature reviews or metasyntheses and are not included here.

### *Segmenting Manuscripts into Sections for Analysis*

Once demographic information was identified for all manuscripts in the data set, I segmented each text into sections. The segmentation allows for a more specific coding process instead of describing how Discourses of Justice are used across an entire manuscript. Discourses are often intersecting with other Discourses (Gee, 2000), some related to justice and others communicating non-justice-related meanings. Thus, segmenting the manuscripts provides a narrower focus for coding and allows for patterns around how Discourses are invoked throughout manuscripts in the field. The section descriptions I used to chunk each manuscript were *problem setting*, *theoretical framing*, and *results and implications*. While these sections are aligned with some headers of manuscripts, every paper uses a unique organization for its argument. So, for this study, I provide brief descriptions of my segmentation process.

The *problem setting* section refers to the area of the manuscripts that defines the problem under study. In all cases, this section came at the beginning of the manuscript. In some papers, the problem setting section only included the introduction; in others, a review of relevant research was used in addition to the introduction to set up their locus for exploration. The

*theoretical framing* section provided the conceptual and theoretical grounding for the author's argument or study. When the manuscript included the literature review after the theory presentation, I grouped these paragraphs into the *theoretical framing* section. Finally, the *results and implications* section encompasses any presentation of findings, discussion, and implications for research or practice. Depending on the type of manuscripts, these sections may vary slightly in their contents. Some papers did not provide an apparent outline of their arguments, especially in terms of differentiating between *problem setting* and *theoretical framing*. Many practitioner articles did not have the space to separately introduce these sections; theoretical texts that presented as commentaries or essays did not always provide headings to guide the reader; some empirical manuscripts contained short introductions that did not attend to justice before moving into their literature reviews or theoretical framing. In such cases, I merged the sections as necessary and considered larger chunks of text as I coded.

Manuscripts also did not always provide detail or attention to justice in mathematics education across all three sections – for example, Felton-Koestler (2017)'s theoretical manuscript built a conception of justice as an outcome of his argument; this paper did not receive codes for the *problem setting* or *theoretical framework* section, but does for the *results/implications* section since that is the first time he explicitly names and describes "justice." In cases such as this, I did not apply codes to sections of the text that did not explicitly discuss justice in mathematics education (25 sections across all 70 manuscripts, see Table 12 in Discussion for further details). All papers contained at least one section that was coded, as per the inclusion/exclusion criteria regarding explicit definitions or descriptions of justice.

### *Open Coding to Elicit Text Contributing to Discourses*

To identify the Discourses of Justice (Gee, 2000, 2008) invoked in each manuscript, I coded each full text using a series of analytic questions (Saldaña, 2013). The analytic questions (AQs) I utilized for this stage were derived from Churchward & Willis (2019), who used AQs to identify Discourses around teacher quality (Table 5). These analytic questions correspond to the components of Discourses (Gee, 2000) that together constitute meaning: AQs 1 and 2 illuminate the vision of justice being perceived, in terms of the values and beliefs held about why justice is necessary and what it will provide; AQs 3 and 4 identify the essential principles, features, actors, and relationships seen as constituting justice; AQs 5 and 6 elicit the teaching practices and implications that are presented as moving towards justice in mathematics education.

Table 5.
Analytic Questions.

| **Analytic Questions (AQs)** | **Contribution to Understanding the Discourse** |
|---|---|
| 1. Why is "justice" important? | Articulates the problem needing to be solved |
| 2. What will "justice" provide? | Evidence of the action that should occur |
| 3. Who decides what "justice" is? | Identifies the stakeholders and responsible actors |
| 4. What are the key elements of "justice"? | Clarifies the focus and values |
| 5. How is "justice" assessed or achieved? | Explains what tools and practices will get utilized |
| 6. What implications for "justice" are reported? | Reports challenges and insights for tools, practices, and key ideas |

* Adapted from Churchward & Willis (2019)

I read each manuscript section multiple times and highlighted phrases or sentences that provided answers to each analytic question, color coding for each AQ. It naturally occurred that for many of the manuscripts reviewed in this study, AQs 1 and 2 were often answered in the *problem setting* section of the paper. Analytic Questions 3 and 4 were regularly described in the *theoretical framing* section of manuscripts, and the excerpts corresponding to AQs 5 and 6

predominantly came from the *results and implications* section. There were multiple excerpts for each AQ throughout a manuscript and even across sections. The highlighted text excerpts were then transferred to a spreadsheet, where rows represented each manuscript and columns organized each AQ. Cells of the spreadsheet were filled with all excerpts that answered a particular AQ for a specific manuscript. It is important to note that some manuscripts discussed "justice" in terms of other disciplines or contexts not connected to K-12 mathematics education (e.g., McGee & Hoestetler, 2014, who discuss social justice and social studies teaching in addition to their exploration of social justice and mathematics education). In these cases, I only coded the manuscript sections that were specific to justice and mathematics education.

### *Identifying Discourses of Justice Through Theming*

As this open coding process was completed for each manuscript, I kept memos to track common themes and patterns I noticed in the ways authors discussed justice (Auerbach & Silverstein, 2003). I regularly re-read all the excerpts across all coded manuscripts for each AQ to identify new themes in the data, disconfirming evidence, or divergent ideas in the framing of justice used across manuscripts. After all 70 manuscripts were coded and entered into the spreadsheet, I created themes of the *Discourses of Justice (DoJs)* out of my memo-ed patterns. I then re-read the manuscripts and coded the sections (*problem setting, theoretical framing, and results/implications*) with the *DoJ* descriptions. Coded excerpts that did not align with the descriptions of the Discourses led to revision across the themes until all Discourses were able to be applied to the coded data without outliers (Auerbach & Silverstein, 2003).

The resulting three themes, or Discourses, represented sets of meaning that encompassed answers to all six AQs. Thus, the Discourses include notions of the vision of justice being perceived, in terms of the values and beliefs held about why justice is necessary and what it will

provide, the essential principles, features, actors, and relationships seen as constituting justice, and the teaching practices and implications that are presented as moving towards justice in mathematics education. These Discourses stand apart from one another due to the focus placed on what needs to occur to achieve justice in mathematics education. The *Discourse of Justice as Empowerment (DoJ-E)* centers on the empowerment of individuals in pursuing justice; the *Discourse of Justice as Transformation (DoJ-T)* focuses on taking action to challenge systems, structures, and policies at an institutional level; and the *Discourse of Justice as Democracy (DoJ-D)* identifies a need for ideological change to truly achieve justice in mathematics education.

## Findings: Three Discourses of Justice

It is important to clarify that the *DoJs* identified in the literature are not separated based on the actors pursuing justice, but rather the lever they use to do so. A *Discourse of Justice as Empowerment* can be invoked regarding an individual or a collective, as long as the actor(s) are focused on justice through and by supporting individuals in becoming more empowered. Similarly, a *Discourse of Justice as Transformation* and a *Discourse of Justice as Democracy* do not automatically imply that collective action is occurring, but rather that the actor(s) are attempting to shift policies and systems through their action.

In the remainder of this manuscript, I present the three *Discourses of Justice* in the literature on K-12 mathematics education. I provide an overview of each of the three Discourses, their identifying features, and how these Discourses were evidenced in the literature base (Research Question 1). Then, I explain how these Discourses were invoked across the different sections of manuscripts and connect these patterns to implications for future research and teaching on justice in mathematics education (Research Question 2). A full list of all analyzed

manuscripts and their resultant codes for the *DoJs* they invoked within the *problem setting, theoretical framework*, and *results/implications* sections can be found in Appendix A.

## A Discourse of Justice as Empowerment

### *What a DoJ-E Consists Of (RQ1)*

The *Discourse of Justice as Empowerment (DoJ-E)* represents the set of meanings where justice is advanced through the empowerment of individuals. That is, injustice is apparent when students have access to different opportunities to learn and grow; justice is achieved through individuals becoming more empowered to access those spaces. Examples of excerpts from manuscripts that were coded as attending to justice through a lens on empowerment are presented in Table 6. The examples present some of the ways a *DoJ-E* can arise in a manuscript; across all of the coded excerpts is a focus on individual development creating a more just mathematics education.

A surge of research has focused on the role of student engagement in the classroom and argues that for justice to occur, students must be able to participate fully in all learning opportunities (e.g. Planas & Civil, 2009; Table 6). This work directly confronts the under-representation of Black, Indigenous, and other Persons of Color (BIPOC) students who do not receive equitable opportunities to participate in mathematics classrooms (Aguirre, et al., 2013; National Council of Teachers of Mathematics, 2014). Empowered students will have their identities honored in the classroom environment (de Freitas, 2008; Esmonde, 2014) and be able to take up space in learning experiences (Hand, 2012) via voice and agency. When all students are empowered to see themselves as valuable members of the classroom community and their ideas are treated as such, justice from the *DoJ-E* perspective is achieved. Individual empowerment can also be

Table 6.
Excerpts for Analytic Questions from Example Manuscripts Aligning with a DoJ-E.

| Source | Type | Need for Justice (AQ1,2) | Features (AQ3,4) | Practices to Achieve Justice (AQ5,6) |
|---|---|---|---|---|
| Amidon (2013) | T | ● "Mathematics as intellectual property all students should have access but obviously do not" (p. 20)<br>● "The aim [of the critical features of mathematics as agape] is not to generate students (or teachers) who are disillusioned or frightened by the inequities and problems of the world, but rather students (and teachers) who are confident that change can occur, and to equip them to be instruments for such change" (p. 24)<br>● "If mathematics is used to analyze and critique society, then a vision is needed of an ideal society, and mathematics needs to be part of that vision" (p. 25) | Mathematics as agape is…<br>● "Promoting a relationship between students and mathematics that is functional, meaning students can work with mathematics to achieve success as defined by society" (p. 21)<br>● "a relationship between students and mathematics that is communal... supporting students in sustaining the cultural and linguistic competence of their communities while simultaneously offering access to dominant cultural competence" (p. 22)<br>● "a relationship between students and mathematics that is critical, meaning students can work with mathematics to analyze and question the world" (p. 23-4)<br>● "…relationship between students and mathematics that is inspirational, meaning students can work with mathematics to vision and move toward a better world" (p. 25) | ● **"**Explicitly teach [students] how to participate in the classroom environment...movement toward connecting the students' ways of participating in the world with how they participate within the mathematics classroom" (p. 22)<br>● "To facilitate a relationship between students and mathematics that is communal would not be limited to utilizing community contexts, but as alluded to, would include connecting the students' ways or participating in the world with valued ways of participating in the classroom community of practice" (p. 23)<br>● "Exposing and challenging society...recognize, understand, and critique current social inequities...knowledge beyond mathematics that students need to understand their sociopolitical context" (p. 24) |

| Source | Type | Need for Justice (AQ1,2) | Features (AQ3,4) | Practices to Achieve Justice (AQ5,6) |
|---|---|---|---|---|
| Atweh & Brady (2009) | T | ● "In the minds of many, such importance is given to the subject due to the increasing importance of technology and science, two essential areas in problem solving and raising living standards... At the personal level of the student, mathematics is often justified as opening doors to many careers and courses of further study." (p. 270).<br>● "The challenge is not only to produce competent mathematicians and mathematics users but ultimately to promote "the growth of students as competent, caring, loving and loveable people." (p. 159)" (p. 269)<br>● "Mathematics education can contribute to the ability of students to function as effective citizens in the world. The authors call this a conforming ideal. This is consistent with the dominant justification of mathematics as developing skills and knowledge useful for preparation for work." (p. 270) | ● "Ethics, on the other hand, is concerned with a face-to-face encounter and interaction between people...ethical considerations highlight moral responsibility of one to, and for, the other. This focus on responsibility establishes social justice concerns as a moral obligation, rather than charity, good will, or convenient politics." (p. 268)<br>● "Response-ability [sic] highlights the ability to respond to the demands of our own wellbeing and the ability to respond to the demands of the other." (p. 269)<br>● "Reading the world (at least some aspects of it) is the function of the school, whereas writing the world is often constructed as a possible capacity that might arise later when the students enter the workforce and civil society." (p. 270) | ● "Involve students with shared responsibility for content assessment, the level of mathematics they engage in, and assessment." (p. 269)<br>● "In order for mathematics to contribute to the response-ability of student as citizen, it should attempt to engage the student in meaningful and authentic "real world" problems and activities that not only develop the mathematical capability but also develop an understanding of the social world and contribute to its transformation whenever possible." (p. 274) |

| Source | Type | Need for Justice (AQ1,2) | Features (AQ3,4) | Practices to Achieve Justice (AQ5,6) |
|---|---|---|---|---|
| Planas & Civil (2009) | E | ● "People with less control over the legitimate cultural and social resources in a context need to develop a process of "empowerment" that will enable them to actively participate in the social construction of this context" (p. 393)<br>● "We have argued that students who are empowered by their school experiences develop the ability, confidence, and motivation to academically succeed." (p. 393)<br>● "We wanted [teachers] to assume that one of their main goals when teaching mathematics is to increase their students' actual power, that is, to make students achieve mathematical learning that prepares them not only for future classes but also for personal and social life experiences" (p. 396) | ● "The idea of social justice cannot be rigidly fixed but needs to be interpreted in terms of the diversity of experiences and practices. Our concept of social justice involves: 1) equal access to opportunities to participate in the social construction of reality; 2) freedom in the sense of having access to opportunities to improve the living conditions of individuals and groups" (p. 392)<br>● "We see empowerment as a process of increasing personal and interpersonal power so that individuals can take action to improve their life situation (Gutiérrez, 1995) ...freedom as a responsibility oriented toward an improvement of the living conditions of different groups in order for all of them to gain more control over resources" (p. 393) | ● "Our position towards the teaching of all students, but in particular immigrant students, is based on the development of a mathematics classroom environment that encourages and supports participation and communication" (p. 394)<br>● "…proposing different criteria to be considered in the design of "critical" mathematical tasks. We call them critical because they are designed to reduce the immigrant students' powerlessness in the local school system... we had established four criteria that had to be present in the tasks: (1) to have more than one final outcome; (2) to promote interaction; (3) to allow for the presence of personal and group experiences; (4) to require the use of mathematical concepts" (p. 400) |

developed through cultivating interpersonal skills and emotional intelligence (e.g. Atweh & Brady, 2009; Table 6). Emotions such as love and caring, and less palatable emotions such as anger, are part of learning and interacting with others, and students should be empowered to express all of their emotions in mathematics education spaces (Boylan, 2009; Kokka, 2020). With a greater focus on emotion comes a need to understand the feelings and perspectives of others they are working with. There is also a set of researchers who argue that ethical behaviors and discussions of morality should be incorporated into mathematics learning as ways to understand decision-making and interpret interactions (D'Ambrosio & D'Ambrosio, 2013; Gari & Rule, 2009; Register, et al., 2020). By learning to make decisions that honor one's beliefs and reflect their moral compasses, students can be more empowered in and outside of classroom environments.

Another common thread of *DoJ-E* focuses on the empowerment of students through mathematical capacity. Manuscripts invoking a *DoJ-E* may argue that mathematics is a gatekeeper to accessing further opportunities for learning and power, especially for students from historically marginalized communities (e.g. Amidon, 2013; Table 6) (Gutstein, 2003; Frankenstein, 2013; Martin, et al., 2010). Justice from this lens can be achieved through student development of mathematical power. Student empowerment through mathematical understanding entails developing critical thinking skills (e.g., Gari & Rule, 2009; Nicol et al., 2019), and constructing mathematical arguments and representations (e.g., Gutstein, 2003, 2016; Thanheiser & Sugimoto, 2020). Mathematical power also involves recognizing the ways mathematics functions in society (Frankenstein, 1983; Skovsmose, 1994). As students become more aware of the ways mathematics functions in society, they may become more empowered in their agency to use mathematics (Brelias, 2015; Gutstein, 2003; Nicol et al., 2019).

Acknowledging the non-neutral nature of mathematics is part of becoming a more literate, empowered member of society (Garii & Rule, 2009; Skovsmose, 1994). Students' empowerment as mathematicians results in access to further educational, professional, and social opportunities.

**Instructional Practices.** Instructional practices toward this vision of justice must start with relationship building amongst students and teachers to construct a community of respect and trust (Bond & Chernoff, 2015, D'Ambrosio & D'Ambrosio, 2013). Getting to know one's students and acknowledging the role of relational equity in who feels comfortable participating in classroom activities can support teachers in creating more equitable environments for all. Many scholars suggest focusing teacher learning opportunities on developing classroom talk. Paying attention to who is driving the classroom discourse reveals patterns in who is talking, what mathematical ideas are being discussed, and how peers take up ideas (or not) (Hung, 2015). Those who take up space (Hand, 2012) in classroom talk gain social capital as they are recognized as mathematical and social authorities, which can support the development of agency and self-visualization as leaders and change-makers (de Freitas, 2008; Gutstein, 2003, 2007; Jong & Jackson, 2016). Teachers may shift participation structures in classrooms to disrupt status hierarchies and promote equitable learning opportunities for all (Nava et al., 2019; Panthi et al., 2018). Further, participation in the classroom should normalize the inclusion of emotion and ethics in mathematics. Teachers and students should collaborate to set norms for engagement that involve how to productively express one's feelings and opinions (Boylan, 2009; Kokka, 2019); participants should be encouraged to provide reasoning that is both mathematical and moral as they communicate with their peers (Atweh & Brady, 2009; Register et al., 2020).

Researchers who consider justice from a DoJ-E perspective argue for connecting mathematics learning opportunities to student interests and real-world contexts (e.g., Johnson,

2011; Voss & Rickards, 2016). A DoJ-E may also entail connecting classroom experiences to the community and familial resources students encounter in their everyday lives. Incorporating and valuing culturally relevant contexts, interests, and beliefs can support students in seeing their full identities as part of the mathematics learning environment (Aguirre et al., 2019; Amidon, 2013; Ladson-Billings, 1995b; Leonard et al., 2010; Planas & Civil, 2009). Connecting academic content to student interests can also support the development of critical thinking skills and problem-solving practices (Garii & Rule, 2009; Gregson, 2013; Johnson, 2011; Turhan Turkkan & Karakus, 2018; Voss & Rickards, 2016). Tasks should engage learners in unpacking complex problems and communicating their thinking to peers (Bond & Chernoff, 2015; Voss & Rickards, 2016). Students must also be supported in interrogating the ways assumptions and beliefs are built into mathematical problems and solutions, as well as the ways mathematics is used in arguments in everyday life (Frankenstein, 1990; Nicol et al., 2019; Nolan, 2009). Building awareness of how mathematics is applied in real-world scenarios and understanding the power mathematics can hold to instigate change or innovation can lead to students' recognition of themselves as agentic mathematicians who can use this power in the future (Frankenstein, 1990; Gutstein, 2003; Ladson-Billings, 1995a).

### *How a DoJ-E is Invoked Across the Literature (RQ2)*

For a manuscript to be recognized as invoking a *Discourse of Justice as Empowerment*, descriptions of justice within a section (i.e., within the *problem setting*, *theoretical framing,* or the *results/implications*) needed to be coordinated around individual empowerment. This Discourse was the most commonly invoked of the three, with 100 percent of analyzed papers (n=70) containing at least one section that referenced this Discourse (Table 7).

Table 7.
Summary of Coding Patterns for DoJ-E by Manuscript Section.

| | Problem Setting | Theoretical Framing | Results/ Implications | Papers with at least One Section | Papers with Across All Sections |
|---|---|---|---|---|---|
| **Total (n=70)** | **57** | **64** | **68** | **70** | **56** |
| Empirical (n= 38) | 30 | 34 | 37 | 38 | 30 |
| Theoretical (n= 22) | 18 | 21 | 21 | 22 | 17 |
| Practitioner (n=10) | 9 | 9 | 10 | 10 | 9 |

Further, this Discourse was consistently invoked throughout manuscripts, with 56 out of 70 papers drawing upon a *Discourse of Empowerment* in every section. Only 13 papers did not base their *problem setting* on a notion of justice framed as empowerment. Almost every single manuscript analyzed in this study leveraged a *theoretical background* (64 of 70) or presented *findings or implications* (68 of 70) that invoked a *DoJ-E*. This implies that many researchers in mathematics education are envisioning justice as empowerment from their initial conceptualizations of the research problems, through their articulation of justice and the theories that guide their study and return to notions of empowerment in their presentation and interpretations of findings. Predominant themes of *DoJ-E* in the literature base make sense, as conversations of justice draw heavily on the foundational ideas of CRP (Ladson-Billings, 1995; Tate, 1995) and its asset-based approach to supporting students in their mathematics learning. *DoJ-E* can also be seen as the most closely related to interactional work, with its focus on relationships and participation; this perspective is often aligned with the unit of analysis of empirical studies and theorizations regarding teaching practice.

## A Discourse of Justice as Transformation

### *What a DoJ-T Consists Of (RQ1)*

The *Discourse of Justice as Transformation (DoJ-T)* represents the set of meanings where justice is advanced through the transformation of structural mechanisms and institutions. That is, injustice is framed as a systemic problem of intersecting inequities; justice is achieved through transforming the mechanisms that uphold these inequities on an institutional level. Examples of excerpts from manuscripts that were coded as attending to justice through a *DoJ-T* are presented in Table 8.

A need for justice via *DoJ-T* can be seen in manuscripts considering how to challenge and transform the hegemonic practices of the discipline of mathematics (e.g. Stavrou & Miller, 2018; Table 8). This goal exists at the level of the institution since what it means to do mathematics is sustained through institutional features and practices. Hegemonic practices shape what is recognized as mathematical activity, as well as mathematics' role in society, and include things like culturally held beliefs and values and norms for behaving in mathematics learning spaces (Povey, 2002). These perceptions around the purpose and nature of mathematics drive goals for learning in the classroom (Felton-Koestler, 2019); they can also limit what and who is valued as mathematical (Atweh & Brady, 2009). Achieving justice can include redefining mathematical activity and who is seen as mathematically successful. Goals for a *DoJ-T* perspective on justice may involve incorporating cross-cultural and de-colonial notions of truth in mathematics, relying on emotional and non-neutral understandings of mathematical activity (Hughes & Laura, 2018; Kokka, 2019).

Table 8.
Excerpts for Analytic Questions from Example Manuscripts Aligning with a DoJ-T.

| Source | Type | Need for Justice (AQ1,2) | Features (AQ3,4) | Practices to Achieve Justice (AQ5,6) |
|---|---|---|---|---|
| Gregson (2013) | E | ● "…advocates of social justice seek to broaden equity goals beyond significant mathematical learning for all groups to include the development of skills for fighting systemic oppression (Gutiérrez, 2002; Gutstein, 006, Martin, 2003; Mukhopadhyay & Greer, 2001; Skovsmose and Valero, 2002). This stance privileges a relational – over a moral or distributive – definition of social justice in which domination and oppression reflect institutional constraints on social groups' self-determination and self-development (Young, 1990)." (p. 165)<br>● "From a critical perspective, outcomes of equitable mathematics education must include the capacity to navigate and reduce social inequity both *with* and *despite* the power of mathematics" (p. 166, italics in original) | ● "…social justice projects and reform-oriented curriculum support and help define one another…mathematically rich curriculum and instruction are essential for social justice teaching…social justice teaching involves instructional features beyond those typically recognized as essential to supportive learning environments" (p. 168)<br>● Social justice goals for TMfSJ: "reading the world with mathematics; writing the world with mathematics; developing positive social and cultural identities" (p. 168)<br>● "Teaching in a manner that puts our students in the leadership of the fight against oppression in the long term" (p. 176-7) | Provides a table coordinating social justice goals of TMfSJ and Instructional Practices, the bullets are:<br>● "Using real situations to understand math concepts and applying math concepts to understand real-world questions,"<br>● "Normalizing politically taboo topics,"<br>● "Developing political relationships with students,"<br>● "Creating a pedagogy of questioning"<br>Other features:<br>● "Good teaching" through viewing students with lens of high expectations; accepts late work, personal contact for help, connected to guardians, responsibilities she holds (p. 179)<br>● helping students confront and make use of mathematics in ways that allow them and other access to just futures (p.167) |

| Source | Type | Need for Justice (AQ1,2) | Features (AQ3,4) | Practices to Achieve Justice (AQ5,6) |
|---|---|---|---|---|
| Kokka (2019) | E | ● "Trauma and chronic stress have been found to negatively impact students' cognitive development... posttraumatic stress is associated with a range of negative effects including anxiety, aggression, depression...in underresourced urban areas, where many children of historically marginalized backgrounds and of immigrant status may live, students may experience even greater severity and higher rates of exposure to trauma due to structural factors such as lack of access to community resources" (p. 1180)<br>● "In addition, students may experience trauma in schools themselves, and mathematics class in particular may be a dehumanizing and traumatizing experience for students" (p. 1181) | ● "Healing justice is a strengths-based framework to improve and nurture well-being that involves transforming institutions and relationships that cause harm to collectively heal and foster hope (Ginwright, 2016)." (p. 1185)<br>● Radical healing is explicitly defined as different than social emotional learning because of its political and social justice goals that include structural analysis of system issues that threaten well-being. Analysis of structural conditions that impact well-being is important to prevent youth from blaming themselves for their own social emotional states." (p. 1185) | ● "A problem engaged students in a number line task...set in a context students had experienced in their own lives, referring to stores in the community. The task also asked students to answer questions aimed to develop their sociopolitical consciousness and invites students to identify and discuss their feelings, a practice suggested by trauma-informed care" (p. 1192)<br>● "Students identified and discussed their feelings...students analyzed structural conditions, such as how the minimum wage does not provide nearly enough income for residents to secure stable housing, understanding how systemic factors influence living conditions. Third, students expressed plans to take action in the community.... students had opportunities to attend to emotional needs and critically analyze relevant social issues" (p. 1193) |

| Source | Type | Need for Justice (AQ1,2) | Features (AQ3,4) | Practices to Achieve Justice (AQ5,6) |
|---|---|---|---|---|
| Stavrou & Miller (2017) | T | ● "Indigenous students are under-represented in mathematics and science-related disciplines and jobs…we emphasize that Aboriginal learners have additional learning barriers and social disadvantages as a consequence of colonization and ongoing racism." (p. 103)<br>● "We believe that if researchers and educators acknowledge the root causes of inequality, then there would be a shift in the literature away from positing a lack of cultural relevance as the reason that Indigenous students are disengaged with mathematics... [the harmful, multicultural] views steer away from solutions based in the sovereignty and protection of land, and dismantling the systems of power that perpetuate economic, social, and political inequality for Aboriginal peoples." (p. 111) | ● "Social justice and anti-oppressive education also means challenging dominations and understanding how schools play a role in perpetuating economic and cultural inequality through regular classroom discourse, student-student and student-teacher interactions, and through the curriculum - especially the ideas taught, what is held to constitute valid knowledge, and how that knowledge is disseminated and assessed in cross-cultural teaching (Aikenhead, 1997, 2001)." (p. 98) | ● "Anti-oppressive and social justice education address issues such as marginalization (Based on gender, sexual orientation, physical and mental ability, immigration status, and so on), cultural and cognitive imperialism (the universalization of a dominant group's culture, experiences, and knowledge)…" (p. 98)<br>● "...needs to be informed by anti-racist and decolonizing education. This involves identifying how race is used in various contexts to name Indigenous peoples as inferior while maintaining that the White culture is the standard of success." (p. 101)<br>● "Decolonization is one particular anti-racism strategy that looks at challenging and breaking down the hierarchy of superior and inferior groups during colonization." (p. 101-2) |

Manuscripts that recognize such injustices often also call for justice through transforming the institutions of schooling and society themselves (e.g. Gregson, 2013; Table 8). There are policies and systems in place that structure what is seen as "schooling"; these systems, such as tracking, have historically racist origins and serve to perpetuate societal hierarchies of power within schools, oppressing students of color and limiting their opportunities to learn (Kokka, 2019; Stavrou & Miller, 2018). Societal power and cultural values influence the conflation of success in mathematics as a marker of intelligence (Ladson-Billings, 1995a); the socially recognized reasons for learning mathematics are also due to societal power and structuring capacity. Learning mathematics is seen as purposeful in getting careers in STEM or accessing higher education opportunities (Felton-Koestler, 2017; Ndlovu, 2011; Tanase & Lucey, 2017). The gatekeeping role of mathematics creates and maintains hierarchies of status and class (Nolan, 2009; Tanase & Lucey, 2017; Thanheiser & Sugimoto, 2020). Disrupting and reimagining social hierarchies of classism, racism, and sexism in society requires shifts in policies around qualifications for higher education or employment opportunities, voting rights, financial freedom, and other structuring mechanisms across local and national institutions (Atweh & Brady, 2009; Larnell et al., 2016; Moses & Cobb, 2002).

**Instructional Practices.** Transformation seems to revolve around the instructional practice of using a "pedagogy of questioning" (Gutstein, 2003). Tasks and contexts from students' experiences, communities, and interests provide connections between students' knowledge and the analytic power of mathematics to form arguments and advocacy. Once local issues are identified, teachers and students can collectively investigate these complex scenarios using mathematics (Alexander & Munk, 2010; Aguirre & Zavala, 2013; Gutstein, 2016; Nicol et al., 2019). Then, students need the opportunity to generate alternative solutions or structures to

the problem at hand and communicate these alternatives to those in power to make change within the institutions (Raygoza, 2016; Rands, 2013; Kokka, 2020). Teachers must balance the exploration of mathematics with the interrogation of the social structures and policies that created the scenario, to support students in developing informed and intentional solutions using mathematics. Instruction should support students in recognizing their agency and continuing to push for change, though it can be challenging for students to see limited changes occur in response to their advocacy (). These tasks are also opportunities to shift what is seen as doing mathematics, from completing calculations to a process of analysis and critique through to communicating results to stakeholders. Teachers may facilitate discussions with students to reframe certain activities as mathematical (Nolan, 2009), as well as posing alternatives and critiquing assumptions about what is true or given in mathematics and society (Hughes & Laura, 2018).

Teachers also need to develop their own conscientização to facilitate effective and critical conversations among students using mathematics. That is, teachers themselves should explore social issues in their communities to understand how racism and classism intersect in public policy to create local inequities (Stavrou & Miller, 2018); they should also develop a critical perspective on the ways mathematics is used to harm others, whether through creating and sustaining hierarchies of power and oppression within the classroom (de Freitas, 2008) or through an awareness of how mathematics can be used in unjust applications to create inequitable societal contexts (Thanheiser & Sugimoto, 2020). Developing conscientização serves as a challenge and a central practice for teachers to invoke as they work towards a DoJ-T. Teachers need to be continuously interrogating their own critical awareness of the world so that they can facilitate conversations with students that lift analyses and solutions to address systemic

problems in local and national communities (Harrison, 2015; Planas & Civil, 2009). It is suggested that the necessary amount of learning about social systems that teachers and students must do to truly provide transformational solutions is more than can be achieved in mathematics class alone (Atweh & Brady, 2009). Many researchers propose long-term projects that evolve in response to student inquiry about the social issue (Bartell, 2013; Esmonde, 2014; Gutstein, 2016), and others note the potential for interdisciplinary courses to support social justice work in education through a more holistic lens on social inequities (McGee & Hostetler, 2014).

### *How a DoJ-T is Invoked Across the Literature (RQ2)*

Fifty-one manuscripts cited a *DoJ-T* at least once across possible sections (Table 9). Of these instances, 43 manuscripts invoked *DoJ-T* in the Theoretical Framing sections (84%). Some of these manuscripts elaborated a *DoJ-T* across all three sections, from their initial conceptualization of a problem through to their results or implications (n= 17).

Table 9.
Summary of coding patterns for DoJ as Transformation, by manuscript section.

| | Problem Setting | Theoretical Framing | Results/ Implications | Papers with at least One Section | Papers with Across All Sections |
|---|---|---|---|---|---|
| **Total (n=70)** | **31** | **43** | **32** | **51** | **17** |
| Empirical (n= 38) | 17 | 24 | 19 | 28 | 12 |
| Theoretical (n= 22) | 11 | 15 | 12 | 19 | 5 |
| Practitioner (n=10) | 3 | 4 | 1 | 4 | 0 |

A *DoJ-T* is most commonly referenced through the explication of theoretical foundations. Ten manuscripts invoke a *DoJ-T* only in their theoretical framework, and not in any other section of their argument. The predominance of *DoJ-T* in the theoretical framework sections of manuscripts, whether in conjunction with other Discourses of Justice or on its own, speaks to the

power of envisioning structural change in mathematics education but highlights some challenges in knowing how to pursue this in practice. Recognizing the need for action at a structural level can be tied back to the foundational frameworks of justice in mathematics education, especially Gutstein (2003) and Frankenstein (1983), who draw heavily on Freirean theory (1970/2000) for transformative action. Common appearances of a *DoJ-T* in the *theoretical framing* sections of the analyzed manuscripts, then, implies that researchers can acknowledge the importance of systemic transformation in justice work by citing such theorists. There are many researchers, however, that do not fully invoke these ideas across their manuscripts or suggest ways to disrupt and deconstruct institutional practices and policies that perpetuate inequities.

## A Discourse of Justice as Democracy

### *What a DoJ-D Consists Of (RQ1)*

The *Discourse of Justice as Democracy (DoJ-D)* represents the set of meanings where justice is advanced through shifting cultural ideologies to achieve democracy in and through education. That is, injustice is seen as the lack of true democracy in governance and distribution of power in society; justice is achieved through an ideological shift regarding the purpose of education, where a just education system is supposed to create and maintain a true democracy. Excerpts from manuscripts that were coded as attending to a *DoJ-D* are presented in Table 10.

The phrase "democratic values" alludes to fairness and inclusion, where all voices are respected and considered in decision-making processes (e.g. Aslan Tutak et al., 2011; Table 10). These values should lead to the construction of a society that affirms the members of the community's identities and is responsive to their needs (Nava et al., 2019; Ndlovu, 2011; Panthi et al., 2018). Mathematics education is seen as an appropriate space to develop the competencies

Table 10.
Excerpts for Analytic Questions from Example Manuscripts Aligning with a DoJ-D.

| Source | Type | Need for Justice (AQ1,2) | Features (AQ3,4) | Practices to Achieve Justice (AQ5,6) |
|---|---|---|---|---|
| Aslan Tutak et al. (2011) | T | ● "Critical educators committed to democratic principles of equality and justice, concerned about raising students with a critical eye to examine social justice in their world. Critical theory in education is about 'liberating, enlightening, emancipating, and empowering'" (p.66)<br>● "The future of critical mathematics education is to combine multiculturalism and equity efforts with a critical perspective in order to overcome stereotypes about mathematics and mathematics teaching and foster democratic values and critical consciousness.... it holds promise for educating citizens for a more socially just, democratic society" (p. 72) | ● "Mathematics literacy requires critical reflection on the ways in which numbers are used to dominate and liberate" (p. 67)<br>● "Critical pedagogy provides a general theory that differs in application for each context because the instruction must be responsive to learners' realities and experiences." (p. 67)<br>● "The role of the teacher is not to save the learners but to equip them to fight the oppression in their world" (p. 67)<br>● "The goal of mathematics education should be to understand the formatting power of mathematics and empower people to examine this formatting power so they will not be controlled by it." (p. 68) | ● "Critical teachers recognize that they must challenge their own and their students' well-established ways of thinking that frequently limit their own potential....critical reflection can lead to critical consciousness, which enables people to understand their lives in new ways and consider ways to change systems that routinely oppress particular groups." (p. 66)<br>● "Through dialogue, students generate and examine problems from their own lives and work collaboratively to construct solutions. The question of many is how a problem-posing pedagogy is conducted." (p. 67)<br>● "Dialogue between the teacher and the learner is the means by which learners construct meaning about the world and how to make it a better place for all people. teacher stimulates questioning but does not impose views on students" (p. 67) |

| Source | Type | Need for Justice (AQ1,2) | Features (AQ3,4) | Practices to Achieve Justice (AQ5,6) |
|---|---|---|---|---|
| Leonard & Moore (2014) | E | ● "Democratic ideals should be central in teacher education... teachers (as well as teacher educators) need to understand their role in existing in systems of power and privilege" (p. 76-77)<br>● "Prepare teachers who can teach all students well...so that as adults, all are able to participate in the economic and political life of the country" (Villegas, 2007, p. 237, cited on p. 77)<br>● "Teaching for social justice allows children to see for themselves just how critical mathematical knowledge is when it comes to informed citizenship, higher education, and access to economic power (Gutstein, 2006; Leonard, 2009; Wager & Stinson, 2012)... " (p. 89) | ● "Social justice as 'equal access to opportunities to participate in the social construction of reality and...access to opportunities to improve the living conditions of individuals and groups' (Planas & Civil, 2009, p. 392). This does not define political life (i.e. citizenship); it instead allows individuals to define it for themselves....does not simply affirm economic participation but assumes there are systems in place that deny that participation." (p. 77) | ● "Example of a math lesson that makes links to SJP is as follows: one teacher used Google Maps to show how neighborhood resources were related to income. Implications regarding transportation, food choices, and food quality were then discussed in a whole group setting" (p. 78)<br>● "These students engaged in democracy and citizenship as they voiced concerns about their school and community. Students can develop individual and social agency when they engage in activities that challenge the status quo." (p. 79)<br>● "Democracy in education will be evident when teachers use social justice pedagogy to engage students in contextually rich and meaningful mathematics tasks that empower students to think critically and take action in their school or community." (p. 89) |

| Source | Type | Need for Justice (AQ1,2) | Features (AQ3,4) | Practices to Achieve Justice (AQ5,6) |
|---|---|---|---|---|
| Raygoza (2019) | T | ● "Large sectors of the population of the world today… are excluded from the political, economic, and cultural life of society. Large sectors of the population do not have access to full citizenship. Some do not have access to basic needs for survival... with this state of the world. A new world order is urgently needed. Our hopes for the future depend on learning - critically - the lessons of the past" (p. 21)<br>● "... teaching mathematics should be to support young people to be critical and active participants in their democracy... '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 the mathematics classroom' (Gutstein & Peterson, 2013, p. 4)" (p. 26) | ● "Westheimer and Kahne (2004)...[they] argue that there are different visions of developing students as civic actors, and such visions are political in that they include particular perspectives on societal inequality and how people could improve society. In other words, the curricular and pedagogical decisions made by teachers advance a vision of the kinds of democratic citizens young people could become." (p. 28)<br>● "a combination of characteristics of the participatory citizen and social justice-oriented citizen are required to prepare young people to participate in a democracy, because these conceptualizations assume a greater focus on collective action than individual action... the social justice-oriented citizen believes that "citizens must question, debate, and change established systems and structures that reproduce patterns of injustice over time (p. 240)" (p. 28) | ● "In the mathematics classroom, [participatory citizens] might look like students using mathematics as a tool to inform voters on policies relevant to inequality or as a tool in "participatory budgeting", a process through which citizens exert control over governmental budgets" (p. 28)<br>● "Whereas a personally responsible citizen would donate to a food drive and a participatory citizen would organize it, the social justice-oriented citizen is exploring the role of social movement and grassroots organizing to challenge systemic injustice" (p. 29)<br>● "Mathematics teachers can explore ways to develop their students as civically engaged mathematics students by bringing these conceptions of different kinds of citizens to the mathematics classroom and asking them, "what kind of mathematics student would you like to be?" (p. 29) |

and characteristics that will allow students to engage in democratic environments (Brelias, 2015; Leonard & Moore, 2014). To be a fully participating member of society, one must be involved in decision-making by developing or being able to critique the quantitative arguments (Register, et al., 2020; Thanheiser & Sugimoto, 2020). This is seen as participating in "civic discourse" and can lead to "collective self-governance," where every citizen's voice matters in issues of social organization (Kokka, 2019, p. 779). Further, without widespread mathematical literacy in the community, mathematics can continue to be used in ways that negatively impact marginalized communities, and the lack of social agency by the public can undermine democracy (Brelias, 2015).

Some researchers identify the increasing diversity and globalization of society, specifically, the economy, as the driving force behind needing to prepare active citizens (e.g. Raygoza, 2019; Table 10). Economic power and political power are influential in the contribution of a person to society; a socially just mathematics education will promote economic participation and citizenship of all people, involving disrupting the current systems in place that marginalize or limit citizenry (Leonard & Moore, 2014; Stinson, 2004). Full citizenship involves persons having the power to contribute to societal values and priorities, sharing responsibilities in fairly constructing society (Bond & Chernoff, 2015; D'Ambrosio & D'Ambrosio, 2013; Tanase & Lucey, 2017). Citizens are not just passive members of society, then, but are critical analysts of the power dynamics that result from and contribute to inequitable policies and institutional structures (Hernandez et al., 2013; Leonard & Moore, 2014). Leveraging critical awareness toward creating a democracy in which all members of society can participate fully (Leonard et al., 2010; Nava et al., 2019; Ndlovu, 2011) is an aim of a *DoJ-D* in mathematics education. I see this trend of a *DoJ-D* as evidence that phrases like "democracy," "citizenship,"

or "civic/political engagement" are connected to broader ideologies around the role of education in preparing students to be meaningful participants in society.

**Instructional Practices.** The beliefs teachers hold about the role of education in preparing students for life outside of school will inform the practices they take up and the learning environments they create. Specifically, teachers' understandings of what it means to be a "good citizen" will guide how they pursue preparing students for citizenship and civic engagement (Raygoza, 2019). Outside of Raygoza's (2019) explicit characterization of forms of citizenship that may be supported through mathematics education, there is not much detail on what constitutes citizenship or civic engagement in the field. There are, however, suggested teaching practices that are loosely referenced as connecting to preparing future critical citizens. Constructing democratic spaces, whether in society or classrooms involves reflecting on the ways democratic ideals around participation shape norms for engagement (Brelias, 2015). Cultures of inquiry and discussion are essential to promote listening (Boylan, 2009) and openness to multiple perspectives on complex topics (Panthi et al., 2018). Through problem-posing and humanizing pedagogies (Freire, 1970/2000), members of the classroom community can practice negotiating social norms that acknowledge the power dynamics and cultural influences in a learning environment (Nava et al., 2019).

Instruction that serves to develop future critical citizens provides opportunities to challenge the status quo, thereby building individual and social agency (Leonard & Moore, 2014); this can occur through curriculum targeting specific social issues or through inquiry explorations of data representations in everyday life (Tanase & Lucey, 2017). One way that power dynamics and cultural influences might arise in instruction involves validating non-dominant mathematics and family and community knowledge (Gutiérrez, 2002; Nolan, 2009;

Stinson et al., 2012). Tasks should invite critique of the role of mathematics in societal issues and inequities, such as the assumptions made in textbook problems or the established ways of "doing mathematics" that may limit considerations of what counts as mathematical. Social issues should be relevant and contextualized within the students' local communities, but also provide a lens to consider structural inequities and the intersecting mechanisms that perpetuate these issues (Simic-Muller et al., 2015). It is necessary to critically analyze the power dynamics in society as well as in the mathematics used to make arguments or propose solutions (Register et al., 2020). Discussions should be had around personal attitudes and beliefs that shape our perspectives on sociopolitical topics of exploration. Environments should be crafted with care, in ways that invite all students to engage with rigorous mathematics and begin to develop agency in their learning (Nava et al., 2019).

These democratic teaching practices and norms for environments provide opportunities for students to develop their mathematical competencies and dispositions in ways that will support their future interactions in democratic societies. One way to attend to all of these components effectively is to incorporate interdisciplinary projects or courses (Atweh & Brady, 2009). Interdisciplinary learning opportunities could provide the time and space to explore power, political, and social dynamics that interact to create inequities in society alongside the rigorous mathematics necessary to construct alternative paths. Interdisciplinary methods serve to support the development of critical citizens who can unpack arguments and policies using mathematics and promote innovations that create more fair and inclusive societies (McGee & Hostetler, 2014).

***How a DoJ-D is Invoked Across the Literature (RQ2)***

The *DoJ-D* was the least likely of the three Discourses to be invoked across the research base. The *DoJ-D* was found in 28 unique manuscripts (Table 11). Papers often leveraged notions of justice via democracy when constructing their problems for research (n= 19) or in discussing the implications of their arguments (n= 17).

Table 11.
Summary of coding patterns for DoJ as Democracy, by manuscript section.

| | Problem Setting | Theoretical Framing | Results/ Implications | Papers with at least One Section | Papers with Across All Sections |
|---|---|---|---|---|---|
| **Total (n=70)** | **19** | **14** | **17** | **28** | **7** |
| Empirical (n= 38) | 11 | 5 | 10 | 15 | 3 |
| Theoretical (n= 22) | 7 | 8 | 6 | 11 | 4 |
| Practitioner (n=10) | 1 | 1 | 1 | 2 | 0 |

A further 14 papers mentioned *DoJ-D* in their theorization of justice. However, only seven papers invoked *DoJ-D* across every section, which implies that 13 of the 28 total articles referencing *DoJ-D* only utilized this Discourse in one section and did not carry this thread consistently across their argument. Very few manuscripts link ideas from a *DoJ-D* from an envisioned end for a more just society through to suggestions to achieve that end (e.g. Leonard et al., 2010; Raygoza, 2019). This scattered invocation of the *DoJ-D* implies that authors are only picking up pieces of the notion of justice as an ideal democratic society as opposed to weaving it throughout their manuscripts and are not consistent in their communication of how justice and democracy are linked.

**How Do the Three Discourses Work Together?**

While Discourses can function across sections of a manuscript to thread a storyline of justice, they do not always work alone. Understanding which *DoJs* appear together can provide nuance for the potential for expanding research and practice so that stakeholders may take up new conceptions of justice. Table 12 provides an overview of where co-incidence occurs within the analyzed manuscripts. There are a series of instances in which no *DoJ* is identifiable within a section, with 16 of the 70 analyzed papers not making an explicit connection to justice in the *results/implications* section.

Table 12.
Number of Discourses in each section, across all manuscripts

| | Type of Manuscript[1] | Problem Setting | Theoretical Framing | Results/ Implications | Total Sections |
|---|---|---|---|---|---|
| **0 Discourses** | | **7** | **2** | **16** | **25** |
| | Empirical | 4 | 2 | 6 | 12 |
| | Theoretical | 3 | 0 | 5 | 8 |
| | Practitioner | 0 | 0 | 5 | 5 |
| | | | | | |
| **1 Discourse** | | **31** | **27** | **22** | **80** |
| | Empirical | 16 | 13 | 12 | 41 |
| | Theoretical | 8 | 6 | 6 | 20 |
| | Practitioner | 7 | 8 | 4 | 19 |
| | | | | | |
| **2 Discourses** | | **21** | **31** | **26** | **78** |
| | Empirical | 12 | 19 | 17 | 48 |
| | Theoretical | 6 | 11 | 9 | 26 |
| | Practitioner | 3 | 1 | 0 | 4 |
| | | | | | |
| **3 Discourses** | | **11** | **9** | **6** | **26** |
| | Empirical | 6 | 4 | 3 | 13 |
| | Theoretical | 5 | 5 | 2 | 12 |
| | Practitioner | 0 | 0 | 1 | 1 |
| Total | | 70 | 69* | 70 | 209 |

[1] $n_e$=38; $n_t$=22; $n_p$=10
*Alexander & Munk (2010) didn't have a clear delineation of a theoretical framing section

It is almost equally common for there to be one *DoJ* as it is for there to be two *DoJs* invoked within a section. These are more than three times as likely to occur as it is for a section to invoke all three *DoJs* in a section, which happened only 25 times across the possible sections of all analyzed papers.

Of the 80 sections that only contained one Discourse, 71 of them were instances of *DoJ-E*, including all but one of the *results/implication* sections (21 out of 22; Table 12). A *DoJ-T* appeared as the sole Discourse in a section eight times, and these occurrences were mostly in the *problem setting* section of the analyzed manuscripts. In these papers, the opening argument of the research need for a more just mathematics education was framed around transforming society and schools to be more just and equitable environments. A *DoJ-D* appeared just once by itself, also in the *problem setting* section of a paper (Brelias 2015). The predominance of *DoJ-E* as a stand-alone Discourse is not surprising. Empowerment can be seen as the initial stages of considering ways to influence justice work in mathematics education, focusing on interpersonal relationships and development. Practices that support student empowerment are well documented in the field and the foundational frameworks, especially in the ways CRP and TMfSJ get taken up in research (Gregson, 2013; Leonard et al., 2010). Much of the research literature may invoke a *DoJ-E* because it is within the scope of action for teachers and teacher educators; empirical studies also often use methodologies that collect and analyze data from interpersonal interactions, which can forefront a *DoJ-E* for researchers.

For those sections that invoked two Discourses, 62 of those sections consisted of *DoJ-E* with *DoJ-T*. There was one instance of *DoJ-T* and *DoJ-D* appearing together without a *DoJ-E* (in the *problem setting* section; Yaro et al., 2020), and all other instances of two Discourses in the same section were *DoJ-E* and *DoJ-D* (15 of 78; Table 12). This evidence suggests that when

authors lift their narrative regarding justice to focus on institutional spaces, they also attend to interpersonal interactions and student learning. A *DoJ-E* is a necessary foundation from which additional institutional change can arise (Gutiérrez, 2009; Gutstein, 2003; Ladson-Billings, 1995b). It also seems that a *DoJ-E* is more easily connected to a *DoJ-T* compared to a *DoJ-D,* or that this connection is more available to authors. Authors often were able to connect the role of student learning and agency as mathematicians with their potential to use mathematics as a tool to provide solutions and advocacy in their communities (e.g. Aguirre et al., 2019) when research reported on the actions taken by students and teachers to transform their society, this was evidence of both *DoJ-E* and *DoJ-T*. Such an example accounts for many of the co-incidences of these two Discourses and aligns with the ways Gutstein (2003) discusses goals for the transformation of society.

It was the most common for all three Discourses of Justice to appear together in the *problem setting* section of a manuscript, closely followed by the *theoretical framing* section (Table 12). There are only two papers, out of the 70 analyzed, that invoked all three *DoJs* consistently across their argument sections: Bond and Chernoff (2015) and Kokka (2019). This shows that it is challenging for authors to link understandings of justice and practices to achieve it across individual, institutional, and ideological levels. Even though all three of the foundational frameworks on justice in mathematics education (CRP, CME, and TMfSJ) invoke attention to student empowerment, the transformation of inequitable institutions, and preparation for ideals of a democratic society, these interwoven arguments are not refracted in full in the literature. This may be because it is too much to hold onto in one empirical study or theoretical argument. However, these connections are possible, and even when not able to equally attend to all three *DoJ* in a manuscript, I argue that authors should work to situate their main Discourse on

justice with the other two Discourses. If researchers can communicate visions of and practices to achieve justice that connect interactions (*DoJ-E*), institutions (*DoJ-T*), and ideologies (*DoJ-D*), stakeholders across the educational system may benefit from such nuanced understandings of justice to inform their work.

## Discussion

In this section, I present differences in how types of manuscripts – *empirical, theoretical,* and *practitioner* – and their respective audiences have access to different *DoJs*, and how *DoJs* appear in combination with one another across manuscripts to develop nuanced descriptions of justice. Together, these ideas articulate how *DoJs* function to uphold certain perspectives on justice in research and practice and provide insight into future areas for exploration.

### Who Has Access to Which Discourses?

The articles analyzed in this study fall into three main categories: empirical, theoretical, and practitioner manuscripts. These categories are written for different audiences, for a variety of purposes. Most notable, empirical manuscripts provide evidence of theory connected to practice and can inform researchers and teacher educators in their practice. Theoretical manuscripts propose extensions of ideas and identify questions for future exploration by researchers. Typically, practitioner articles present ideas to inform teachers and teacher educators' classroom practice, such as pedagogical strategies or curricular innovations. Table 13 provides an overview of patterns in how *DoJs* are used within these categories of manuscripts that can illuminate what audiences have access to which *DoJs* in their writing, and what that access means for the pursuit of justice as a field.

Table 13.
Coding Data by Audience Categorization.

| Type of Manuscript[1] | Discourses of Justice | Problem Setting | Theoretical Framing | Results/ Implications | At Least One Section | Across All Sections |
|---|---|---|---|---|---|---|
| Empirical | | | | | | |
| | Empowerment | 30 | 34 | 37 | 38 | 30 |
| | Transformation | 17 | 24 | 19 | 28 | 12 |
| | Democracy | 11 | 5 | 10 | 15 | 3 |
| Theoretical | | | | | | |
| | Empowerment | 18 | 21 | 21 | 22 | 17 |
| | Transformation | 11 | 15 | 12 | 19 | 5 |
| | Democracy | 7 | 8 | 6 | 11 | 4 |
| Practitioner | | | | | | |
| | Empowerment | 9 | 9 | 10 | 10 | 9 |
| | Transformation | 3 | 4 | 1 | 4 | 0 |
| | Democracy | 1 | 1 | 1 | 2 | 0 |

[1] $n_e$=38, $n_t$=22, $n_p$=10

***Empirical***

Empirical manuscripts consistently used a *DoJ-E* throughout their arguments (Table 13). A *DoJ-T* appears most commonly in the *theoretical framework* sections of empirical manuscripts but is not integrated across all parts of the studies. A *DoJ-D* is sporadic and is most often found in the *problem setting* or *results and implications* sections to justify the need for and importance of the particular study. Further, empirical manuscripts contain fewer instances of zero *DoJs* than expected (Table 13); this makes sense because researchers and researcher-teacher-educators have to be intentional about connections to justice (using at least one *DoJ*) to publish empirical studies. Empirical manuscripts account for most of the instances of one *DoJ* (51%) and two *DoJs* (62%) used in a section, compared to theoretical and practitioner manuscripts. It is especially common for *theoretical framework* and *results/implications* sections in empirical manuscripts to take up two *DoJs* together. This is evidence that researchers and teacher educators are regularly using all three DoJs across their arguments, though not always all in combination. These patterns

imply researchers and teacher educators have attempted to extend notions of justice via individual empowerment to include transformation and democracy.

### *Theoretical*

Theoretical manuscripts also show evidence of researchers using all three Discourses across their arguments. Each of the *DoJs* appears often: 100% of theoretical manuscripts invoke a *DoJ-E* at least once, 86% use a *DoJ-T* at least once, and 50% use a *DoJ-D* at least once within a manuscript (Table 13). However, neither a *DoJ-T* or *DoJ-D* appear consistently across theoretical manuscripts, with only 5 papers using a *DoJ-T* in every section and only 4 papers using a *DoJ-D* in every section of their arguments. Further, half of the sections that invoked all three *DoJ* sections appeared in theoretical papers, even though theoretical manuscripts account for only 31% of all reviewed manuscripts (22 out of 70). The theoretical manuscript sections contained one *DoJ* less often than expected. Based on these patterns, theoretical manuscripts tend to invoke more than one Discourse at a time. This shows that the different Discourses may all be considered as part of the authors' understanding of justice and that the manuscripts combine varied *DoJs* to expand possible connections between them and construct nuanced arguments for attending to justice.

### *Practitioner*

Practitioner manuscripts are focused on communicating practices to use with students directly to teachers and teacher educators. Table 13 shows that while sometimes these types of manuscripts justify the need for (*problem setting*) and/or define justice (*theoretical framework*) using a *DoJ-T* (4 papers) or a *DoJ-D* (2 papers), these perspectives are not often present in the results/implications sections, where the authors talk about practices to use in the classroom. Further, a disproportionate amount of the sections using zero *DoJs* showed up in practitioner

manuscripts. Five of the ten analyzed practitioner manuscripts did not invoke any explicit notions of justice in their *results/implication* sections. There was also an overrepresentation of sections with one *DoJ* in practitioner manuscripts: seven practitioner articles used only one *DoJ* in setting up a problem of practice, and eight of ten manuscripts used one *DoJ* in their definitions of justice (*theoretical framework* section). On the other hand, practitioner articles are underrepresented in articles using two *DoJs* (5% of all instances) and three *DoJs* (4% of all instances) within a single section. This evidence suggests that practitioner audiences are mainly gaining access to a *DoJ-E*, and suggested pedagogies for pursuing justice in the classroom are not being linked to system-level ideas from *DoJ-T* and *DoJ-D*.

**Summary of Audience Access**

*Discourses of Justice* connect visions of justice and the practices to achieve those visions into sets of meaning. The *DoJs* one has access to can inform how they perceive problems, the solutions they envision to rectify those problems, and the actions they see as necessary to achieve those solutions. People gain access to *DoJs* through interactions with others' ideas, including through reading research. Looking at the presence and combinations of *DoJs* available to researchers, teacher educators, and teachers has implications for the progress of the field in what problems and solutions we envision or propose (theory), in what mechanisms and interactions we study (empirical), and what we do with students (practitioner).

If a specific *DoJ* is present across all sections of a manuscript, the authors are committed to attending to that level (individual, institutional, or ideological) in their understanding of justice; they are linking together literature from the existing research using that *DoJ* with their own aligned understandings and bringing these ideas into new contexts, often suggesting actions to achieve the goals of justice they articulate. The consistency of a *DoJ* across a manuscript

argument is how clearer connections are built between visions of justice and practices to achieve it.

Further, combinations of *DoJs* within sections would represent authors communicating multi-layered understandings of the problem of justice. Justice in mathematics education is a cultural, social, and political problem, and it requires attention across individual, institutional, and ideological levels (NCSM & TODOS, 2016). The foundational frameworks of CRP, CME, and TMfSJ recognized this in their articulations of principles and practices (Frankenstein, 1983; Gutstein, 2003; Ladson-Billings, 1995a). When manuscripts include all three *DoJs* within a section, it represents a holistic perspective on the challenge of achieving justice and the type of action it will take to achieve. Combinations of *DoJs* also represent authors recognizing the connections between these layers – understanding how individual action impacts institutions and can reify or disrupt certain practices and structures; recognizing how institutional and cultural beliefs and practices can influence individuals' perceptions of what is possible or necessary. We need multi-layered understandings of the injustices in mathematics education (and in society) to be communicated across research and practice to outline stakeholders' agentic scope of action, to inform action towards our goals, and to continue to re-evaluate the visions of possibility for more just mathematics education.

**Implications**

A *DoJ-E* appeared consistently in all three types of manuscripts, including in their *results and implications* sections. This shows that a *DoJ-E* is predominant and normalized in the ways the field considers justice, across all audiences. Researchers, teacher educators, and teachers have access to these ideas, and there are a variety of documented practices to serve goals of justice framed through a *DoJ-E* (e.g. Gutstein, 2003; Ladson-Billings, 1995a, 1995b). However,

ideas of justice via empowerment must also be connected to systematic understandings of justice. Future research should attend to the various ways teachers can empower students to build identity and agency as mathematicians and members of society, while also looking to connect these interpersonal shifts to broader system-level change.

A *DoJ-T* is partially integrated in the conversations around justice in mathematics education; transformation is called for across the foundational frameworks of justice (CRP, CME, and TMfSJ), in no uncertain terms (Gutstein, 2003; Frankenstein, 1990; Ladson-Billings, 2000, 2021). Yet, the field, and especially not practitioners, do not have access to these Discourses as commonly or consistently through the literature base. A *DoJ-T* requires that educational stakeholders either have or recognize the need to have an awareness of systems of power and mechanisms that work (through individual actions) to perpetuate inequities; this awareness can inform intentional action to shift such mechanisms. However, it is challenging for teachers and other stakeholders to build this awareness (Harrison, 2015; Tanase & Lucey, 2017). Teacher education and professional development should consider how to support teachers in developing critical consciousness and understand the ways their students' experiences in schools vary depending on intersecting identities and systems of power. Research on justice in mathematics education should look to sociological theories to supplement their understandings of justice with more explicit attention to institutional and ideological power reified in structures and systems.

A *DoJ-D* is present in the foundational frameworks of justice, especially in Culturally Relevant Pedagogy's notion of civic engagement to develop a critical mass of citizens working to redistribute power (Ladson-Billings, 1995a) and Critical Mathematics Education's tenet regarding the political aspects of learning mathematics towards creating democratic learning

environments and societies (Frankenstein, 1990, 2013). These aims of justice are echoed across the empirical and theoretical literature but are not prevalent in manuscripts that reach a practitioner audience. This suggests that the field is still unsure as to how to work towards a vision of justice as *Democracy* and how to explicate this work in addition to the other goals of justice they pursue. Teacher educators and professional development (PD) leaders should work to situate pedagogies amongst their overarching principles of practice in methods courses and PD opportunities to help facilitate the connections between individual action and ideological perspectives for more just mathematics education. Research in this area should intentionally incorporate interdisciplinary theoretical and methodological frames that similarly draw out relationships between democratic ideals of society and learning mathematics that are ongoing or attenable in K-12 classrooms.

This study analyzed existing publications and their use of *DoJs*. Future research can extend this theoretical and analytical lens to examine what *DoJs* teachers use and how they use them to support their practice towards goals of justice. Implications for practice need ways to understand how *DoJs* are entangled with one another and how to situate teacher educators and teachers' work amongst these perspectives. Developing shared understandings within actors' (researchers, teacher educators, and teachers) organizations, departments, and communities of professional learning can help intentionally organize the next steps for practice and connect across expertise. Finally, these actors and their communities should consider the implications of how their use of particular *DoJs* shape stakeholder and public perceptions of why justice is needed and what it entails; the field should continue to cultivate networks that understand justice as a complex, interwoven process that requires collective, system-level change.

## Conclusion

This study is a systematic literature view that uses Gee's (2000) notion of Discourses to identify visions of justice and their aligned implications for practice present in research on justice in K-12 mathematics education. The resulting *Discourses of Justice* (*Empowerment*, *Transformation*, and *Democracy*) from my analysis represent articulations of justice that attend to different levers of change (the individual, the institution, and ideologies, respectively). This manuscript posits that these *Discourses of Justice* are invoked inconsistently across research arguments and audiences; there is a notable lack of connection between visions and practices that pursue justice at a systemic level across the literature base. The findings of this study identify opportunities for researchers, teacher educators, and teachers to intentionally connect their understandings of justice across micro, meso, and macro systems and explore actions that can disrupt and reconstruct unjust institutions and ideologies so that the field can progress towards a more just mathematics education.

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# Chapter 3 –

## Teachers' Conceptions of Justice in Mathematics Education: A Mediated Action Approach

## Introduction

Social justice in K-12 mathematics education research and practice has been evolving for decades. The goals of social justice mathematics have been disputed and discussed for years (North, 2006), with scholars recognizing that stakeholders in the educational system may hold differing and varied perspectives on what "justice" is supposed to achieve (Wager & Stinson, 2012). Researchers have articulated a swath of theoretical frameworks and pedagogical practices that serve specific goals for justice (e.g., Frankenstein, 1983; 2013; Gutstein, 2003, 2006; Kokka, 2015; Larnell et al., 2016). However, this research is noticeably missing teachers' voices and perspectives on justice (Raygoza, 2020). While some studies explore justice-related teaching practices to understand how educators negotiate classroom interactions (e.g., Gregson, 2013), this research does not adequately explore teachers' conceptions of justice and the resources they leverage to achieve these in practice. I contend that teachers' conceptions of justice should anchor research exploring what justice entails in mathematics education.

This study contributes to the evolving research base on social justice in mathematics education by presenting how four educators construct their conceptions of justice. Teachers' conceptions of the purposes and means of justice will influence their practice (Leonard et al., 2010; Raygoza, 2020). Understanding how teachers construct their conceptions of justice provides insight into the resources and contexts that afford justice-oriented teaching. Depending on how a teacher conceives of justice, they may invoke different resources (such as curricular materials) or leverage socio-political, cultural, and historical features (e.g., agency in their role or

personal experiences) to drive their action toward their goals. Centering narratives that articulate how teachers come to conceptualize and pursue justice in praxis can positively advance the field's understanding of justice in mathematics education.

In this qualitative interview study, I explore how four educators construct their conceptions of justice in mathematics education. I present patterns regarding the resources these educators leveraged in their conceptions and discuss how certain types of resources have the potential for promoting teacher awareness of and action toward nuanced and systemic conceptions of justice.

## Literature Review

This manuscript presents how teachers conceive of justice, including how they see themselves enacting it in praxis and their resources. I will review three research areas to situate this study within the existing literature on K-12 mathematics education and social justice. First, I provide an overview of key features of justice in mathematics education; these features serve as a foundation against which we can understand how teachers conceive of justice. Then, I review the literature on pre-service teachers' conceptions of justice, including the resources pre-service teachers (PSTs) utilize in their learning about justice; teacher education literature is the primary source of research on developing conceptions of justice. Finally, I present the studies that discuss in-service teachers' conceptions of justice in mathematics education; this study extends from these foundations.

### Discourses of Justice in Mathematics Education

There are a variety of frameworks and definitions of social justice in mathematics in K-12 education (North, 2006; Wager & Stinson, 2012). Across these frameworks, there are three

trends, or *Discourses of Justice*, of how justice is conceptualized in K-12 mathematics education (Brunner, 2020, in press, Paper 1). I leverage the three *Discourses of Justice* to describe key features of justice currently identified in mathematics education literature.

### *Justice as Empowerment*

The *Discourse of Justice as Empowerment* (*DoJ-E*) refers to the conceptions of justice that describe empowering students as mathematicians, learners, and individuals. Teaching (mathematics) for social justice involves supporting students to make sense of scenarios and advocate for themselves and their communities (Chubbuck & Zembylas, 2009; Kokka, 2019). Much research on socially just mathematics teaching advocates for incorporating students' funds of knowledge, communities, and families into math classrooms (Cochran-Smith, 2004; Hernandez et al., 2013). Teachers should develop relationships with students and their communities and allow these relationships to inform how they design learning opportunities and support students (Kokka, 2015). Utilizing curricular resources and participation strategies that elicit student perspectives and experiences can center student thinking and provide relevant connections for the mathematics at hand (Ladson-Billings, 1995a). Helping students make such connections underlies the importance and applicability of mathematics outside of school experiences and across cultures.

Many theorizations of justice (e.g., Teaching Mathematics for Social Justice, Gregson, 2013; Gutstein, 2003) aim to support students' development of mathematical power, agency, and identities. Research on justice calls for high-quality mathematics instruction for all students (Gonzalez, 2009; Gutiérrez, 2009a, 2009b). Teachers may enact different pedagogical strategies to invite students to "read the world with mathematics" (Gutstein, 2003, p. 44). However, the most commonly mentioned practice in the literature base is using problems from authentic

scenarios in student communities. These tasks aim to promote student engagement in critical mathematics skills of analyzing and reasoning, often involving creating or critiquing arguments with evidence (e.g., Aguirre et al., 2019; Berry III et al., 2020; Gutstein, 2013, 2016; Rubel et al., 2017). By incorporating real-world scenarios, teachers aim to stoke students' empowerment in using mathematics as a tool to understand the world (Frankenstein, 1983, 1990).

### *Justice as Transformation*

The *Discourse of Justice as Transformation* (*DoJ-T*) consists of conceptions of justice that promote the transformation of institutions, structures, and policies to rectify systemic inequities in mathematics education. Most commonly, research that invokes such conceptions of justice argues for mathematically analyzing systemic issues and leveraging those findings to take concrete action (Leonard & Evans, 2012). Mathematics is a critical tool for understanding one's power and positioning in society, and students should use it to change those structures and systems and create a more just society (Frankenstein, 1983; Gonzalez, 2009; Gutstein, 2003). To contextualize social issues, teachers need to develop their socio-political consciousness before teaching (Harrison, 2015; Chubbuck & Zembylas, 2009; Kokka, 2015, 2019; Martin, 2007; Davis & Martin, 2008; Bartell, 2013). Teachers should pose questions that specifically invite students to analyze sociopolitical and structural conditions that cause social inequities instead of focusing on individual impacts or experiences (Kokka, 2019; Gutstein, 2003; Yeh & Otis, 2019). While many frameworks for social justice mathematics necessitate attention to "making inequity, power, and activism explicit in the curriculum" (Leonard & Moore, 2014, p. 85), finding the time and resources to authentically incorporate social analyses can be challenging (Bartell, 2013; Brantlinger, 2013; Gutstein, 2003; Harper, 2019). Critics of practice-based teacher education research warn that focusing on teaching practices may obscure the complexities of

deconstructing the racist and oppressive structures of mathematics education (Barajas & Larnell, 2019; Harper, 2019; Martin, 2019; Philip et al., 2019; Zeichner, 2012). It is acknowledged that attending to racism and oppression in mathematics requires systemic approaches and transformation (National Council of Supervisors of Mathematics & TODOS, 2016; TODOS, 2020). However, there is a need for more research that articulates how teachers work towards authentic, nuanced institutional analyses in their mathematics classrooms.

### *Justice as Democracy*

Finally, a *Discourse of Justice as Democracy* (*DoJ-D*) encapsulates the conceptions of justice that rest on shifting ideological perspectives regarding the purpose of mathematics. Literature that invokes a *DoJ-D* describes a more just educational system in which students participate as active members in an ideal democratic society. To achieve this notion of justice, teachers must support students in developing the democratic values of fairness and inclusion in interactions (Aslan Tutak et al., 2011). Mathematics learning spaces can foster collaborative decision-making (Register et al., 2020); students can learn to regulate power dynamics and respect each other's perspectives and voices through group work and project-based learning opportunities (Kokka, 2019; Thanheiser & Sugimoto, 2020). Research that promotes this conception of justice argues that leveraging critical awareness toward creating a democracy in mathematics classrooms that all students can participate in fully (Leonard et al., 2010; Nava et al., 2019) prepares them to create an ideal societal democracy in the future and achieve true justice.

The three *Discourses of Justice* (*Empowerment, Transformation,* and *Democracy*) represent categories of conceptions of justice that are well-defined in the literature. The literature base has established these categories of conceptions; the empirical research reviewed thus far has

utilized them to explore, discuss and compare teaching practice against. However, we must turn to research on pre- and in-service teacher learning to understand how these conceptions are constructed by educators.

**Pre-Service Teachers' Conceptions of Justice**

As reported in the literature, PSTs share some common conceptions of justice. First, PSTs typically welcome the idea that mathematics should be culturally relevant and interesting to all students (Jackson & Jong, 2017). PSTs usually describe this as occurring through word problems that frame mathematics in "culturally relevant" contexts (Garii & Appova, 2013). PSTs also recognize that mathematics learning is an emotional, personal, and power-laden journey (Boylan, 2009; Jong & Jackson, 2016); teachers need to be responsive to student needs and cultivate positive learning environments (Felton-Koestler, 2017). Some PSTs were able to recognize that mathematics intersects with societal problems and that these social issues could be appropriate contexts for learning (Garii & Appova, 2013; Leonard & Moore, 2014); others struggled to see how math and social issues could be combined in schools (Garii & Rule, 2009; Tanase & Lucey, 2017). One study of PSTs showed they could articulate conceptions of mathematics as non-neutral, math classrooms as political spaces where meaning is negotiated, and mathematics has structuring power (Thanheiser & Sugimoto, 2020). The PSTs conceptions of justice attend predominantly to issues of student empowerment in specific learning environments. Some PSTs attended to institutional and societal power that shapes learning as part of their conceptions of justice.

While teacher education research provides insight into what PSTs consider as relating to justice work in mathematics education, these studies have also identified challenges PSTs face in understanding how to act on these conceptions in practice. Pre-service teachers struggled to

articulate actions they could take supporting the above features of conceptions of justice (Garii & Appova, 2013; Leonard & Moore, 2014). Developing nuanced and personalized understandings of what it means and looks like to engage in social justice mathematics teaching is complex work (Garii & Rule, 2009; Tanase & Lucey, 2017; Simic-Muller, 2015). PSTs need multiple opportunities to analyze and take up conceptions (understandings and practices) related to justice in mathematics education. In particular, the PSTs needed more language and explicit support to extend ideas of justice past awareness of interactions with individual students to consider disrupting systems and patterns of injustice in mathematics education and schooling (Leonard & Moore, 2014; Boylan, 2009).

While PSTs showed increased ability to identify injustices in classroom interactions, they needed more support to recognize their role in perpetuating inequities in schools. Some teacher educator-researchers worked with their PSTs to develop analytic tools for identifying such patterns of oppression and connected teaching practices (deFreitas, 2008; de Freitas & Zolkower, 2009; Yow, 2012). Simic-Muller and colleagues (2015) noted that many of the PSTs in their study struggled to identify teaching practices they could incorporate to address power dynamics and social injustices. However, one PST in their study drew upon their non-education experiences to inform potential actions they may take in the classroom.

The literature on PST learning about mathematics teaching for social justice provides insight into common conceptions of justice that form early in teaching journeys and challenges to explicating and enacting nuanced conceptions of justice. This research identifies types of resources that impacted PST learning, including curricular materials, analytic tools to identify inequities, and personal histories. This study extends these findings to explore in-service teachers' resources as they construct their conceptions of justice.

**In-Service Teachers' Conceptions of Justice**

Most studies on in-service mathematics teacher practice towards justice use a preconceived framework for justice to describe teachers' work without attending to how the teachers make sense of justice work. Four studies attend to teachers' conceptions of justice and resultant practice with varying detail and foci (Bartell, 2013; Gonzalez, 2009; Felton-Koestler, 2019; Raygoza, 2020); I provide a brief review of each paper to contextualize the specific body of research to which my study contributes.

Bartell (2013) described teacher conceptions of justice to demonstrate how their understandings and practice evolved through professional development. The teachers' conceptions generally aligned with trends in the literature: they understood how mathematics could act as a gatekeeper for students and thus prioritized learning rigorous mathematical concepts and skills. The teachers also recognized that mathematics could be a tool to understand social inequities and aimed to support students in seeing the purpose and power of mathematics to influence change. The teachers became more explicit in their conceptions of socially just mathematics teaching throughout the professional learning opportunity; however, they still struggled with articulating specific actions they could take in their teaching to achieve these goals. Bartell described teacher conceptions as context to discuss how teachers' enactments of social justice lessons diverged from their goals for instruction. The teachers' conceptions of justice were presented without describing how these conceptions were elicited or identified by the researcher. Bartell's (2013) study provides a foundation to consider how teacher conceptions connect to instructional practice; my study extends Bartell's (2013) findings to explore how teachers construct their conceptions and the resources that support such construction.

Gonzalez (2009) was interested in teachers' identity development as math teachers and agents of change through professional learning experiences. The teachers in this study discussed social issues as a context for mathematics, where students could analyze and understand trends using mathematics. The teachers aimed for students to develop class and racial consciousness and see math as an avenue for social change. The teachers focused on empowering their students as agents of change and considered how students could experience their agency within their classrooms. While the teachers in this study were developing a curricular unit incorporating justice as part of the professional development, they did not see their current math instruction as in pursuit of justice. Thus, the study did not explore what instructional practices teachers saw aligned with their conceptions of justice. In contrast, this manuscript centers the voices of teachers who currently engage in social justice mathematics teaching to understand how they invoke resources in their active construction of conceptions of justice.

Raygoza's (2020) study explored teacher experiences and commitments to justice as critical educators and agents of change. Raygoza considered how teachers' conceptions of justice informed their enactment of justice-oriented pedagogies. Teachers' commitments to justice included empowering students as mathematicians and agentic members of their communities and teaching mathematics in conceptual and relevant ways. The teachers in this study advocated for an interdisciplinary approach to learning mathematics and spoke to the power of collaborative communities of teachers that challenge and sustain their work. However, Raygoza doesn't focus the analysis of teacher commitments on the resources or features of the participants' contexts that afford or constrain them; the findings establish teachers' voices and trends in conceptions of justice. I build on Raygoza's (2016) study by situating teachers' conceptions within an activity

system, considering how they construct these conceptions of justice and the resources they leverage.

Finally, Felton-Koestler (2019) explores how one teacher's beliefs about mathematics teaching shift across a professional learning experience, including their conception of justice. The teacher in this study fore fronted a conception of justice as exploring controversial topics or relevant social issues using mathematics. Felton-Koestler makes an argument, which I draw upon heavily in this study that beliefs serve to "constrain or enable particular teaching actions" (2019, p. 156). Felton-Koestler describes how the teacher shifted to incorporate this conception of justice into their teaching; this study identifies mechanisms in the professional learning experience that supported this evolution. Felton-Koestler (2019) found that by having examples of tasks that fit her current mathematics content and ideas of appropriate topics for students to explore, the teacher felt supported in making changes to her pedagogies and beliefs. This study offered a connection between a teacher's conception of justice and their actions and drew attention to features of the professional learning environment that supported the instructional change. I extend Felton-Koestler's (2019) argument regarding the connection between conceptions and action and turn attention to the resources teachers draw upon to construct those conceptions.

## Theoretical Framework

The study reported in this manuscript contributes to the research literature on justice in mathematics education teaching. I argue that teachers' conceptions of justice should anchor research that explores what justice entails. Understanding how teachers construct their conceptions of justice provides insight into the resources and contexts that afford justice-oriented teaching. To analyze the ways teachers construct their conceptions of justice, I draw upon two

theoretical frameworks: Cultural Historical Activity Theory (Leontiev, 1978; Engeström, 1987, 1990) and Mediated Discourse Analysis (Norris & Jones, 2005; Scollon, 2001; Scollon & Scollon, 2004). Cultural-Historical Activity Theory provides the overarching framework to understand teaching as an activity oriented towards the object of justice. Mediated Discourse Analysis extends this framework to consider how teachers construct these conceptions of justice.

**Objects and Object-Conceptions Which Orient Activity**

The object of activity, in its simplest form, is the "true motive" for what occurs (activity) (Leontiev, 1978, p. 62). All activity is oriented toward some end; that end is culturally and historically evolved and dialogically related to the means to achieve it. An example: a teacher may believe that their students should learn to work together to solve problems; their instruction will be oriented toward that goal, and the instructional practices they will enact to create such learning opportunities will have developed out of the teacher's own learning experiences, their teacher preparation program, and the research on group work and interactions the teacher has access to, among other factors. According to Engeström (1987), in any activity, an individual will experience some dilemma or contradiction, which raises a need for action (Miettinen, 2005). As an individual experiences a need, they are also beginning to conceive a solution that involves a shift in action and motive (Miettinen, 2005). An object is the orienting feature of that solution, driving the activity to occur; however, due to the iterative and evolving nature of activity, it can never be fully achieved (Engeström, 1999).

As individuals and systems progress towards an established object, the "need" will shift in response; what is considered justice will constantly evolve depending on the state of mathematics education. Objects are both material and socially constructed and can only be grasped through how they are conceived and acted upon by individuals. Objects can be seen

through three corresponding facets: (a) “a thing to be acted upon,” (e.g., a recognition of injustice), “an objectified motive” (e.g., the change of a system), and “a desired outcome” (e.g., a more just system of mathematics education) (Foot, 2014, p. 10). However, persons may perceive each of these facets slightly differently and be more oriented toward one or another – the result is an individual’s object-conception.

An object-conception “entails a dialogical interaction between aspects of the subject’s personal experience and [their] relationship to the community of significant others with whom the object is pursued, and cultural-historical properties of the object” (Foot, 2002, p. 8). Differences in object-conceptions are partly influenced by that person’s habitus (Bourdieu, 1977). A person’s habitus may include personal and professional experiences, position within power structures, roles and responsibilities within the system under focus, physical location and cultural features, personal characteristics, and values (Bourdieu, 1977; Christiansen, 1996, Foot, 2002, 2014). Thus, individuals may perceive different features or reasonings in pursuing a shared, ill-defined object.

Seen in terms of justice in mathematics education, individual teachers and researchers identify different acting points for their understanding of what justice entails. A teacher may bring a dehumanizing interaction from their own K-12 math learning journey, which may inform the focus they bring to doing justice work. Likewise, a researcher who works to understand how learning mathematics can support students’ success outside of schools may bring that lens to their conception of just mathematics education. These object-conceptions are informed by individual perspectives but also arise from historical and cultural trajectories of activity. That is, what it means to do mathematics teaching has evolved across time, as have ideas of the purpose of education (Dewey, 1923; Schiro, 2013) and other guiding factors, such as the ways teachers

and students interact in learning spaces (National Council of Teachers of Mathematics, 2014). These different trajectories can inform what individuals see as essential and necessary to pursue justice.

### *Reifying Object-Conceptions through Mediational Means*

Since object-conceptions are ill-defined and enacted in a moment, they become identifiable through the tools and resources that mediate meaning-making and action (Foot, 2002). Mediational means capture snippets of collective experiences that have developed and imbued with meaning across historical, political, and social contexts (Vygotsky, 1978). These means include physical objects or psychological tools (Scollon, 2001; Wertsch, 1991, 1994). Physical means can consist of items like lesson plans or curricular materials, the physical arrangement of a classroom, or the policies that structure interactions in a school, such as assessment and grading practices. Psychological tools are concepts, systems of meaning, or ways of behaving. These can include processes for critical self-reflection or a belief in what it means to do mathematics in K-12 schools.

Teachers can invoke different mediational means, depending on their environments, habitus, and object-conceptions. Whether physical or psychological, mediational means "manifest certain patterns of affordances and constraints concerning the actions that can be taken through their use" (Norris & Jones, 2005, p. 50) based on the histories and ideologies of their development and prior use (Foot, 2014). A particular mediational means may make it more possible for a teacher to enact a specific teaching practice or center their values on education; one's object-conception of justice may lead to certain mediational means as appropriate compared to others that do not serve similar goals. For example, suppose your vision of just mathematics teaching revolves around students' engagement in rigorous mathematics. In that

case, you may be more likely to draw upon open-ended task designs (physical mean) or consider goals for productive group work from Complex Instruction (psychological mean); these tools may feel more appropriate than a tool that could constrain student engagement.

Through adaptation or incorporation of mediational means to achieve a goal, new purposes, motives, and intentions for actions may arise; object-conceptions may shift in response (Miettinen, 2005). I present here an extended example to illustrate. Bartell and colleagues (2017) identified the psychological tool of a set of teaching practices that support student learning of the Standards of Mathematical Practice. This set of practices was developed through repeated use of classroom teaching practices and research that connects them to student learning and the embodiment of math practices. One way this tool could become a mediator of action is if it guides or informs a teacher's enactment of a particular task to focus on student critiques of mathematical arguments. The authors suggest that this mediational means may also be co-opted to serve goals of equity and justice and present potential shared features of these two foci. However, teachers would have to negotiate the historical origins of the set of practices – in particular, the neoliberal approaches to education that led to the development of the SMPs, which contradict conceptions of justice – to co-opt it for a new goal (Barajas-Lopez et al., 2019).

**The Role of Discourses in Shaping Activity**

The object-conceptions, goals, and motives one holds are steeped in the problems and need states they perceive (Miettinen, 2005). Need states and perceived problems arise through the lenses one uses to interpret the world. These lenses, or Discourses, are sets of values, beliefs, meanings, intentions, and socially constructed practices (Gee, 2000, 2008). Discourses function to shape the meaning we interpret from interactions, as well as the ways we interact with others. Discourses are socially constructed and culturally held; over time and throughout interactions,

certain combinations of behavior, talk, and other languaging (known as little-d-discourses) come to be recognized in a specific way and at least in other community groups that share these perspectives. For example, when a person in mathematics education uses the phrase, Teaching Mathematics for Social Justice, they are often recognized by others in the community as a type of person who considers power and understands Freirean foundations for pedagogy, given the history of TMfSJ research and practice.

As people talk and interact, they create combinations of discourses that evoke Discourses of meaning. Discourses shape, implicitly or explicitly, the types of actions or frames of reference for sense-making that are available to a person. Discourses can trigger noticing particular features or challenges in a system or interaction; invoking certain Discourses can influence how teachers problematize injustice in mathematics education. In this study, I consider the Discourses of Justice discussed in the literature review section (Brunner, 2020, in press, paper 1) that teachers invoke to construct object-conceptions of justice. Further, the Discourses available to a person can shape goals for action and the resources that help achieve them; teachers' goals for instruction can echo a particular perspective or set of values. Thus, Discourses are a valuable tool for understanding how one's actions are related to social, cultural, and historical frames of meaning and purpose (Engeström & Escalante, 1996; Foot, 2002).

**Research Questions**

I contend that teachers in their journey of pursuing justice in mathematics education are involved with constructing and understanding an object of justice, which then informs their goals and actions for teaching. As they work towards this object-conception, they invoke a variety of mediational means and Discourses of Justice that further articulate their understanding of the vision and afford or constrain their progress. Thus, this study explores how teachers working in a

justice-oriented educational institution narrate their conceptions of justice in mathematics education and the resources they draw upon to enact these conceptions in practice. In particular, this study attends to the following research questions:

1. How do educators who identify as "committed to social justice" construct their object-conceptions of justice in mathematics education?
    a. What mediational means do the educators leverage in constructing object-conceptions of justice in mathematics education?
    b. What Discourses of Justice are invoked as the educators construct their object-conceptions?

## Methodology

To investigate the research questions on educators' construction of object-conceptions of justice about resources and Discourses, I conducted an interview study of educators from a justice-focused educational summer program serving diverse youth and communities within a large urban area.

### Study Context and Participants

The study took place in a non-profit educational summer program with a mission of social justice education called Sunshine Summer Program (pseudonym). This program's mission centers on the joy and learning of students from historically underserved and minoritized communities in a large urban area of multiple counties and cities (approximately 8 million people) in the western region of the United States. Founded about 35 years ago, Sunshine Summer Program serves over 2,000 middle grades students each summer at 15 locations located within ethnically, racially, linguistically, and socio-economically diverse communities across the

large urban area. Sunshine Summer Program locations are intentionally situated in communities to support students and their families in meaningful educational experiences.

Sunshine's curriculum prioritizes community assets and knowledge with locations tailored to the needs of student populations. This priority is evident in the design of experiences, such as Family Night and school application workshops, and the staffing of program locations with mostly teachers of Color, often from the students' home communities. The program's hiring process focuses on teachers or future teachers, often alumni of the program, who are interested in supporting the students within their community and are committed to justice in education and society. The program's impact is measured through internal longitudinal data collection from students and families; the program reports that more than 95% of all students who attend Sunshine continue to other opportunities for higher learning (Sunshine Summer Program, 2022a).

The four educators in this study worked at Sunshine Summer Program for 9.5 years on average and taught for between seven and 19 years outside of Sunshine. Two educators are currently mathematics teachers in the program (summer employment), though one (Kevin) has previously been in a leadership role. Some teachers are involved in additional program activities throughout the academic year, but these duties are not accounted for here due to their irregularity and volunteer, case-by-case basis. The teacher participants in this study are also employed as full-time teachers during the academic year in schools in the same large urban area. The other two educators are currently in leadership positions in Sunshine and were previously classroom teachers. Leadership team members are employed by the program for the entire year, developing the next iteration of program design and curriculum, analyzing data on effectiveness, supporting

students and communities through events and resources, and recruiting both teachers and students.

Educators from Sunshine were recruited via multi-phased online communication. An initial email was sent to current and recently employed Sunshine mathematics teachers in August of 2020. This email resulted in two volunteers (Eliza and Kevin). In a second recruiting phase, an invitation was extended to Melissa, a member of the Sunshine leadership team. When asked about other Sunshine employees (teachers or leadership) whose work was related to justice-oriented mathematics education, Melissa suggested a second leader, Morgan. This purposive sampling process (Creswell & Plano Clark, 2011) allowed me to identify participants who were relevant to the topic of study and recruit other participants.

Table 14.
*Participant demographics.**

| Participant Pseudonym | Age | Identities[1] | Years Teaching Outside of Sunshine | Years at Sunshine | Years in Leadership at Sunshine |
|---|---|---|---|---|---|
| Eliza | 54 | White/European, Cis female | 19 | 4 | 0 |
| Kevin | 28 | White/Caucasian, Male | 7 | 8 | 3 |
| Melissa | 45 | Filipino American, female | 7 | 9 | 9 |
| Morgan | 35 | White, cis, heterosexual, Jewish, male | 10 | 17 | 3 |

*All data reported as provided at the time of data collection
[1]Interviewer asked the open-ended question: “how do you identify?” Participant responses are recorded verbatim.

This study occurred during the COVID-19 global health pandemic and the resurgence of racial justice protests and awareness in the U.S. This study does not address these phenomena and how they impacted educators' conceptions. Still, they are undoubtedly part of the social,

cultural, and political contexts that shape their teaching and conceptions of justice. Further, the recruitment process requested volunteer participation in an unpaid, multi-hour discussion of justice and education, which required participants to take on a significant emotional burden and physical labor of completing the 3-5 hours of interviews. The recruitment process occurred in the late summer of 2020 when many schools determined the format and modalities for the coming academic year of teaching. This was a time of uncertainty and overwork for many teachers across the U.S., and the recruited teachers were no different. While not creating any explicit connections, I hypothesize that these overlapping and interrelated challenges influenced the availability of recruitment of mathematics teachers from the Sunshine Summer Program. In particular, I note that while the majority of Sunshine's teaching faculty identify as People of Color (Sunshine Summer Program, 2022b), the two teacher participants who responded to recruitment materials both identify as white.

**Positionality**

I am a white, cisgender female and a young emerging scholar raised in a middle-class culture and environment. I have known that I wanted to be a teacher from an early age and eventually decided on teaching mathematics because a teacher helped me see the power of mathematics in everyday interactions. Throughout my undergraduate and graduate learning journey, I have had various emotions and relationships with mathematics as a discipline; I have been pushed away and shown I am unwelcome in math spaces. I have also found joy through collegiality and exploration of challenging problems. These experiences have shaped the type of teacher and scholar I wish to be and the learning environments and relationships I want to cultivate.

I am deeply involved with the research site and the participants of this study. I had taught at Sunshine Summer Program for seven consecutive summers, beginning when I initially received my teaching credential and continuing until the current year. I fully endorse the mission of this program and see its work as essential to the type of person and educator I have become. Due in part to the mentoring from colleagues and supervisors, one of whom is a participant in this study, I have developed my conceptions of what it means to pursue justice in mathematics education and education more broadly. During my tenure as a program employee, I did not work at a site with any of the study educators; however, I have interacted in a group environment with all the study participants, especially during remote teaching. In addition, I worked with the leadership team (including Melissa and Morgan) for approximately three years. During this time, I participated in the program's internal leadership development program, which included attending quarterly leadership meetings to analyze program data and identify goals for teaching and learning for my location's staff in the coming summers. In addition to this participation, I have created and reviewed curriculum resources and given feedback on the program's professional development opportunities for mathematics teachers.

These features of my identity led to inherent tensions in my scholarship across both data collection and analysis. My professional relationships with study participants and established long-term program employment positioned me as a knowledgeable math teacher committed to social justice. However, power dynamics were at play as I negotiated my role as a researcher with participants since I'm a colleague and am supervised by one or more of the study participants. These power dynamics may have created an environment where participants had to take on vulnerable positions to answer questions about their perspectives on justice. To ease

these tensions, I explicitly framed each interview as an opportunity to learn from and with each other.

Throughout the interviews, my participants regularly mentioned features of the Sunshine Summer Program and people with whom I was familiar. As a researcher, these moments required me to step outside of my insider knowledge to probe deeper into the connections my participants described. I created memos immediately before and after each interview to reflect on how I was reacting to the topics discussed as a teacher and member of the program (Saldaña, 2013). These memos supported me in tracking the sense-making of my participants as they wove together features of justice and their teaching, invoking different Discourses and mediational means. I aimed to approach my data collection and analysis from a place of humanity and understanding. I tried to center my participants' experiences and share their ongoing explorations of complex, power-laden topics.

**Data Collection**

The data for this manuscript consisted of an initial questionnaire and two interviews with each participant. The semi-structured interviews (Appendices A & B) first unpacked participants' written questionnaire responses (administered September 2020), which included closed-ended demographic questions and three open-ended questions: a question each on their definitions of justice and equity and a question a brief description of their typical math classroom. The first interview with each participant occurred between September and October of 2020, and each lasted approximately 90 minutes (80-90 minutes). This interview allowed the educators to speak about their personal histories with the Sunshine Summer Program and their commitment to justice in mathematics education. They were provided with their written definition of justice and asked to explain, add on, or clarify its pieces until they were individually

satisfied that we established a clear description of their definition of justice. I similarly pressed participants to describe their typical mathematics teaching as they attended to justice.

The second set of individual interviews used in this analysis occurred from the end of May until the beginning of July 2021 and lasted between 60 and 90 minutes. The second interview used a focal video clip of teaching (National Council of Teachers of Mathematics, n.d.) to elicit participants' reflections. The video clip was selected because of the teacher's use of effective mathematics teaching practices while also offering opportunities for study participants to consider different facets of justice (classroom interactions, racial dynamics, contexts for mathematics, etc.). This method of video-based interviewing used a shared, neutral artifact to illuminate aspects of the participants' conceptions of justice that may not have arisen from reflective questioning (Tobin, 2019; Tobin et al., 2009).

Participants in the second interview were invited to watch the video clip all the way through and share what stood out to them about the teaching. They watched the clip again and discussed what they saw in terms of their current definitions of justice. In addition to identifying moments of teaching and classroom features that they saw as potentially attending to justice, the participants were asked to hypothesize about what they might want to change or know more about to make the video more closely aligned with their ideal of justice.

**Data Analysis**

Audio recordings of the interviews (8 total) were transcribed. After I transcribed each interview, I paused to memo about (a) personal connections to the data and (b) create a summary of the content of each conversation (Saldaña, 2013). Transcriptions were then uploaded into MAXQDA (VERBI Software, 2021) for analysis. I conducted a four-phased qualitative, inductive coding analysis involving deductive coding in phase four.

### *Coding Processes*

My first phase involved segmenting the data using structural codes aligned with the interview protocol questions (Saldaña, 2013). All related probes and extensions of topics under each original question were included in the same segment. These segments spanned turn-taking, pauses, and long responses by the participant. To focus my analysis on the areas of the interviews discussing the participants' notions of justice teaching, each segment was reviewed, and I selected the segments which explicitly identified "justice" in initial interview questions for in-depth analysis. This analytic stage resulted in 22 total identified segments from the four participants, varying in length from two to 19 minutes.

My theoretical frameworks of Cultural-Historical Activity Theory and Mediated Discourse Analysis also served as analytic lenses to parse the data. I first read over the 22 segments and memoed to capture the overarching purpose of the question and response. I then followed Scollon & Scollon (2004) in identifying the "mediated actions" or specific moves and practices the educators identified as part of their descriptions of just mathematics education. Mediated actions elucidate participants' understandings of justice through how they are seen in action (Norris & Jones, 2005) and serve as the unit of analysis for Mediated Discourse Analysis (Scollon & Scollon, 2004). The unit of analysis included the specific move or practice, any additional meaning around its purpose, and any acknowledgment of outcomes from the practice. For example, Morgan begins a response by raising the need for teachers to have anti-racist lenses; he extends this idea by clarifying what an anti-racist lens entails, how that would help teachers reflect, and why this is an essential practice for teachers to embody. Then, he pivots and identifies that he also wants all teachers to be committed to listening deeply to students. This is a new but related mediated action and thus warrants a new unit of analysis in coding.

Once excerpts were coded into mediated action units, I engaged in the third phase of inductive coding to identify the mediational means driving the action. First, I re-read each coded unit to determine the specific move or action the educators focused on (Scollon & Scollon, 2004). I coded for the mediational means that negotiated these actions: physical means, or objects that the educators identified as part of the action, and psychological means, or values, concepts, and meaning systems that shaped what the educators saw as justice (Norris & Jones, 2005). The text coded in this phase could be a phrase or a sentence. For example, Eliza reflects on the video clip in Interview 2 by pointing out that the teacher "was actually able to get someone on the minority opinion to stand up and share, and then the other person be so respectful, and the kids be so respectful while they were sharing, that to me was like, okay, this, this classroom feels empowered." I coded this excerpt as psychological means and memoed that this means seemed to be Eliza's concept of respect and belonging. Eliza had some concept of what respect means and looks like, and the teaching from the video clip "fit" with that concept, which mediated her interpretation of it as pursuing justice.

After coding for mediational means, I initiated a fourth phase: coding the same analytic unit for Discourses. Discourses can be overt or implicit in one's talk (Scollon & Scollon, 2004), but they are instances that allude to cultural values, beliefs, and frames of meaning. Discourses become apparent across the coordination of talk, means, practices, and beliefs (Gee, 2008), so this layer of codes was applied to larger sections of text (multiple sentences) within the mediated action unit. I applied the code "Discourse" to phrases of talk that answered analytic questions such as "why are the educators saying those things together?," "why do they believe these actions are important?," or "how automatic or unconscious are these actions or means?" (Scollon

& Scollon, 2004). These questions elucidated the unspoken cultural values or perspectives that the educators were enacting.

I intentionally did not initiate coding for Discourses with the framework for *Discourses of Justice* I identified (Paper 1) so as not to overlook any other *Discourses of Justice* that might arise in conjunction with their object-conceptions. However, once the first pass of coding for Discourses was complete, I returned to review the analytic units for the second part of this phase. I applied the deductive coding scheme using Brunner's (Paper 1) framework for Empowerment (focused on individuals), Transformation (focused on institutions), and Democracy (focused on ideologies). The coded Discourses that did not fit within this categorization structure were then re-read to understand how they were related to visions of justice. Many of these Discourse excerpts were relevant to teaching and learning but not explicitly connected to these specific educators' conceptions of justice in mathematics education. One set of Discourses did, however, repeatedly arise concerning ideas of justice in mathematics education; this is presented in the findings and discussion as the *Discourse of Systemic Oppression*.

**The Discourse of Systemic Oppression**. A *Discourse of Systemic Oppression* is not necessarily specific to perspectives on justice in mathematics education but can often be found in conjunction with those conceptions. This Discourse refers to a set of values, perspectives, behaviors, and language (among others) that reflect a deep understanding of the role of systemic oppression, especially white supremacy, in structuring all human interactions. This Discourse includes a problematization of the current oppressive power structures in society, grounded in a historical understanding of how whiteness has structured the hierarchical organization of power. For example, teachers may draw upon a *Discourse of Systemic Oppression* to inform their recognition of mathematics as a barrier that keeps Black and Brown people, people experiencing

poverty, or non-binary people (among other minoritized groups) out of positions of power in society (Martin et al., 2010). Addressing issues such as these involves a lens that attends to systemic oppression, connecting individual behaviors and practices to the systems of power that have informed, and continue to perpetuate, disparate experiences and opportunities in education and society.

### *Analysis Processes*

Once I applied the three layers of codes (actions, means, and Discourses), I re-read the entire interviews and added my evolving understanding of these educators' perspectives to my analytic memos. This process re-grounded me in the participants' overall perspectives on education and their commitments to justice and highlighted any instruction features that may not have been explicitly connected to their ideas of justice in math teaching. I created a list of mediated actions for each participant and organized them into categories based on themes (Saldaña, 2013). The more predominant themes appear as the anchors for the participants' narratives below. Then, I returned to the analyzed segments and looked for commonly occurring mediational means and Discourses of Justice. These were similarly organized into categories to capture their content and then connected back to the mediated action segments to see their mediational effect on the participants' understanding of or action towards justice.

I mapped out the connections between actions, means, and Discourses of Justice to identify overlapping relationships and foci for each participant's notions of justice. I used these connections to create synthesized narratives of each participant's existing object-conceptions that highlighted the predominant features in each category, showed how the participants talked about their practice, and shared the educators' primary goals for achieving justice in mathematics education (Reissman, 2008). I present these narratives below. In constructing these narratives,

patterns began to arise across the ways the participants articulated working towards their goals for justice. I noted which mediational means were invoked and towards which ends; I did the same with Discourses of Justice. Close readings of these findings revealed that the educators invoked specific types of mediational means and Discourses of Justice as they constructed their object-conceptions.

### Limitations

The identified object-conceptions of justice and related means and Discourses for each participant are not static labels of these educators' understanding and practice. This study aims to acknowledge the relationships between these three constructs and understand how they may afford or constrain one's pursuit of justice in mathematics education. These ideas arose in the context of the interviews and the socio-political, cultural, and historical context of the teachers' reflections on their understanding of justice and their narratives around teaching. The participants were allowed to read and comment on their personal descriptions, narratives, and general analysis of means and Discourses. This member-checking humanizes the research process, attempts to minimize the power discrepancies between researcher-learner and participant, and gives the participants another opportunity to provide feedback, clarity, and insight into their understandings (Saldaña, 2013).

## Findings

The findings of this study are presented in the following format to honor the complex, interwoven nature of the participants' existing object-conceptions of justice. First, I present an overarching narrative of participants' object-conceptions of justice. These narratives are composite representations of the ideas the educators advanced across their interviews; I use the

participants' own language in these narratives to best represent their conceptions (Note: I do not provide specific quotations in the narrative sections to streamline readability). Then, I share an analysis of the mediational means and Discourses of Justice invoked in the participant's object-conception. Direct quotes from the interviews are provided throughout the analysis as evidence. This pattern is repeated for all four educators who participated in the study.

**Eliza**

Eliza worked at Sunshine for four years across a 20-year spread as a science and math teacher. During the academic year, she works as a middle-grade math teacher at a local charter school teaching a majority white, high SES student population. Before working at Sunshine, she was the educational resources coordinator at a charter school. Eliza started working at Sunshine due to a personal connection with one of the creators, who knew of her interest in education and learning. After her first summer as a science teacher at Sunshine, she entered a credentialing program. Eliza worked at Sunshine for two consecutive summers while gaining her credential and then continued to her professional academic year employment as a math teacher at her charter school. She returned to Sunshine when a previous co-teacher moved into a leadership role and personally invited her back to serve on staff. At the time of study participation, Eliza had been a math teacher at Sunshine for two more consecutive years, including one in a virtual environment due to the COVID-19 pandemic.

***Object-Conceptions of Justice***

Eliza sees her job as a social justice math teacher helping students "see the mathematician within." An explicit assumption in Eliza's talk is that all children are mathematically brilliant, complex humans. In these opportunities, Eliza explicitly names the "math skills" the students are using and developing to help students see mathematics as more than just calculations. Sometimes

this comes through curricular problems that invite exploring features of interest in their neighborhoods, spurred by books and magazines. Other times, Eliza cultivates students' math identities through online games like the NY Times tile games (The New York Times Company, 2022) or artistic connections, such as thinking about perspective and proportional reasoning.

Eliza also notes that a socially just classroom that honors each student's individuality is dependent on productive and supportive relationships. When discussing her teaching, Eliza describes her role as a facilitator of these relationships. Her responsibility is to (help students) figure out what they each need and want out of math class. This responsibility is framed, in part, through an understanding of the role math plays in granting access (or not) to society. Facilitating relationships also depends on Eliza's critical consciousness and her positioning of herself as "an old white lady math teacher" in a role of power and status. She recognizes that even students interested in mathematics may not want to interact with her due to the racialized experiences students have had in and outside of the classroom. She notes that it is not always possible for her to connect with students because she can't force a relationship upon them but still wants them to grow as math learners and individuals. Eliza notes that it is useful to have the support of her co-teacher, who is often a program alum and person of color who is closer to the students' ages when filling students' needs. Above all, she tries to honor the needs of her students and treat them with respect.

Eliza also sees a need for awareness of injustices in the world and the discipline when considering mathematics for social justice. Again, projects exploring and comparing features of neighborhoods can elicit conversations about why and how those differences came about. Eliza also raises awareness of injustices when talking about the historical and white-washed development of methods and theorems:

> Math is relevant to every, you know, to social justice issues and society as a whole, right. There's a tendency in the Western, uh, classic education kind of thing, to kind of treat certain things as pure, or certain things as rational. And you know, I try to just, I try to call BS on that. You know, it's all political, it's all - like numbers have been used to hurt people. Numbers have been manipulated. And math itself has been used as a bludgeon, right? It's been used to keep women out of certain professions. It has been used to keep Black people out of certain professions. It's been used as a bludgeon. And even, you know, this idea of, uh, stereotyping young Asian people, math is used for those stereotypes as well…I'm trying to make sure that I'm helping the kids see that without too heavy of a hand…I try to make it very like, um, kind of just embedded in my conversation. Like it's just kind of part of what we talk about. Like, when we talk about this, we need to talk about that, um, normalizing having the conversation about it. (Interview 1, Lines 320-335)

Eliza sees the need for students to recognize the societal and mathematical systems they are a part of. As she introduces new topics and concepts in class, she attempts to layer in a critical conversation about possible uses of mathematics. Eliza regularly names and reframes students' actions as mathematical smartnesses; she also attempts to recognize students as humans whose worth does not depend on mathematical understandings. In these ways, she sees herself as engaging in creating a more socially just mathematics education.

### *Mediational Means*

Eliza consistently references curricular materials as resources supporting her description of social justice teaching. Student engagement in learning about and analyzing inequities in their neighborhoods or other social issues is crucial to doing social justice teaching and learning and often happens through curricular choices (Berry III et al., 2020; Gutstein, 2003). In her academic year position, Eliza recruits curricular materials from magazines and books that show different environments and contexts, such as a book of photographs on food around the world. She uses these organic materials and data to help students generate questions, which launch projects where students explore social phenomena using mathematics. In her teaching at Sunshine, she feels that the curriculum can sometimes be focused on "practical math" to prepare students for future

content; Eliza either adapts the curriculum to allow for explorations of topics that are interesting to students, or she spends more time on the lessons oriented to social justice topics, such as food deserts and generating vertical farms to support their neighborhood food use. Curricular materials, then, are ways for Eliza to articulate her goals for student learning of mathematics and developing understanding and agency around societal injustices. These materials mediate the types of questions she can ask students, their experiences in her classroom, and the opportunities to develop a critical awareness of inequities.

Eliza regularly discusses her identity as a white woman and the power that she holds when positioned as the math teacher in her different teaching environments. Eliza notes that first, she needs to understand her privilege and how she contributes to racist practices in her teaching; then, she connects to de-centering herself to center her students. In doing so, Eliza discusses how her Black and Latinx students should have opportunities to see themselves in the curriculum and social issues they are exploring but that they shouldn't be responsible for helping her understand the experiences of racism and whiteness in their lives. Understanding her positionality and critical awareness of race leads Eliza to distinguish between how she attends justice in her affluent white school and at the Sunshine Summer program. She notes, "if I were at [Sunshine], it would be more of a listening session. How can I give the kids space to mathematize [a current event that highlights justice or injustice] without giving them the burden of needing to teach me about how to respond?" and contrasts this with her work in an affluent charter school, saying, "when I'm talking to kids with privilege, who aren't really aware of their privilege, whose backgrounds are very similar to mine…there's a little bit more ways where I can do some direct instruction." (Interview 2, Lines 598-608). Her reflective and critical consciousness serves as a

mediational means in how she positions herself in relation to students, in the types of resources she leverages for exploration, and in how she approaches her role and power as a teacher.

### *Discourses of Justice*

Eliza's object-conception of justice in mathematics education is closely linked to her understanding of the power system of racism that structures society and her positioning within that system (a *Discourse of Systemic Oppression*). She repeatedly returns to this understanding in specific moments and as a broader guiding principle. Eliza frames her role as a white woman educator within her community at Sunshine as being "able to work with a diverse group of people and really authentically listen to Black voices…it always feels powerful to make sure that I'm exposing my brain to more than just my little, tiny, white bubble." (Interview 1, Lines 249-253). She understands the ways her perspective can fail to include the realities of Black and Brown people and focuses on listening to other perspectives to broaden the lens through which she views the world (Kokka, 2019; Martin, 2019). In terms of student engagement in mathematics, she connects the need for discourse and critical thinking with the power mathematics can have to structure future opportunities: "But I know that, you know, for, for me to be flippant, [saying] 'no, math is all about patterns' is kind of a disservice [to my students] because I know that some of these kids are going to have to do really well, like more than, better than their white colleagues on these tests in order to have the same opportunities." (Interview 1, Lines 607-611). She recognizes the sociopolitical contexts that shape how students and teachers interact within math classrooms and takes responsibility for supporting students in succeeding while also working to change the systems that perpetuate these inequities.

Eliza's awareness of intersecting systems of power and oppression, such as racism and classism, links to her acting through her teaching to transform the discipline of mathematics. She

sees her role as an educator to "increase student awareness of what it means to do mathematics" (Interview 2, Lines 727-728) and help students see mathematical activity as something that can happen through games, drawings, and other activities. Eliza is invoking a humanizing perspective on mathematics that recognizes mathematics as a series of practices and ways of engaging with problems and questions (Goffney et al., 2018; Su, 2020). She speaks to the limiting features of mathematics as a discipline and the harmful hierarchies it can perpetuate; she sees her job as shifting these limiting features and creating a space where mathematics is personal, engaging, and affirms her students' identities.

Finally, Eliza's object-conception of justice regularly invokes a *DoJ-E*. Eliza centers students' empowerment in learning environments as learners and mathematicians when talking about the experiences she wants her students to have. She discusses helping students who have had positive experiences with math maintain that identity, along with supporting students who "just want to get through it" instead see access and "ways to get this done…without feeling like the math is beating up on them." (Interview 1, Lines 632-634). Eliza sees that empowering students to feel like they are capable math learners is central to their achievement in and outside the math class. She also wants math learning to be where students feel seen and heard (Aguirre et al., 2013). Participation may look different to each student and each day, but her classroom is a space where all can show up and feel seen in their full humanity, which is part of creating a system of education for students.

**Kevin**

Kevin has been involved at Sunshine in various capacities for eight consecutive years. During the academic year, Kevin teaches middle grades mathematics at a local Catholic school. Kevin found Sunshine Summer Program when looking for education-related summer

employment before his senior year of college. Kevin saw Sunshine as an opportunity to figure out if he wanted to "go the teaching route" after graduating, and he never left. In his first year, Kevin was an "intern" teacher assisting another mathematics teacher; he became the lead math teacher the following year. After four years at Sunshine, he took on leadership responsibilities for the program, including hiring teachers and overseeing all student experiences for a single location. Kevin returned to teaching mathematics when COVID-19 forced Sunshine to move to a virtual format. At the time of data collection, Kevin was finishing his teaching credential. His previous academic year employment (Catholic and charter institutions) did not require Kevin to secure a teaching license, but his current institution did. His education graduate program explicitly focused on social justice in mathematics, which he identified as cultivating his lens on inequities in the educational system.

### *Object-Conceptions of Justice*

Kevin's perception of justice centers around students' capacity to understand mathematics enough to support them in succeeding in high school and college. He sees mathematics as a school subject that can impede students' future goals of reaching college and is thus focused on making sure all students can succeed in testing based on conceptual understanding and skills. To Kevin, conceptual understanding requires students to see why some mathematical work is correct or makes sense (National Research Council, 2004). He builds opportunities for students to practice specific problems but also emphasizes student explanation of their thinking processes. Kevin regularly uses one-to-one technology supports (such as Khan Academy) to provide individualized feedback and differentiation of skill complexity. He notes that these tools can be responsive to students' learning in the moment, layering on complexity or returning to more foundational skills as students need. Kevin recognizes that it can be

challenging for students to feel successful in future mathematics opportunities when they are unsure or struggling with understanding previous skills and concepts.

Kevin identifies projects, group work, and mathematical discourse as learning opportunities to build conceptual understanding and scaffolding for student thinking. Kevin mentioned that Sunshine's project-based learning approach drew him in. He sees project-based learning as a just and effective classroom design, where students have opportunities to explain their work and explore new scenarios. Kevin doesn't explicitly see project-based learning for justice as requiring exploring social inequities or issues in the community. Still, he considers this learning format as supportive of "real-world" inquiries as time permits, especially when talking about his academic year teaching. When Kevin talks about real-world scenarios, it is in the context of connecting to students' existing understandings as a way to make sense of mathematics. He hopes these connections will help students feel more comfortable working through a problem and give footholds for students to access mathematics.

He also notes that he was glad to be working with communities where he felt the program and his teaching could "make a difference." He connects this goal of education making a difference in students' lives to an awareness of the structural differences in educational resources schools experience; he developed this awareness, in part, due to his time in Jesuit schools. Kevin inherently linked service to underserved communities with data-driven results around student achievement. Understanding that mathematics can be a barrier to future learning, especially for students in under-resourced schools, means that Kevin was committed to supporting students from such communities in succeeding on standardized testing. Kevin also viewed teaching as an opportunity to make a difference in the mentorship and support of students from under-served communities. He described his job as "not just to be a math teacher, but to teach life skills and

teach to the whole person." (Interview 1, Lines 242-245). Kevin recognized that to be a successful mentor, he needed to develop close relationships with students and their communities. He wanted his teaching to be relevant to students' interests and needs and have the potential to make the largest possible impact on his students' lives.

***Mediational Means***

Across Kevin's interviews, he regularly discusses the power of data and measurement of achievement as a tool for helping him know if his version of teaching is socially just. To Kevin, social justice involves students' achievement on standardized testing and passing through grade-level courses to graduate and attend college. Data and achievement measures are mediational means for Kevin's object-conception of justice. The data informs his understanding of students' needs and strengths; these inform his lesson plans and differentiation. Kevin's use of data as a means for his teaching echoes the notion of "success in dominant mathematics" (Gutstein, 2006; Kokka, 2020), or the idea that students are still prepared to succeed in traditional measures even in social justice math courses. Kevin's vision of social justice involves students gaining college access, and data on student achievement is a measure of efficacy in his teaching methods that mediates his goals and actions.

The other mediational mean that arises in Kevin's object-conceptions of justice is his faith-based awareness of privilege and notions of service. Raised in Jesuit schools, Kevin attributes his early attention to inequitable access to resources to his volunteer service work and the recognition of his privilege. Kevin recognizes his privileges as a white, middle-class male and that his educational experiences were different from those of students who attended under-resourced schools. He connects this recognition of inequities to his responsibilities as a teacher. Kevin wanted to work where he could make an impact, be a mentor, and support students who

need guidance. Kevin's notion of service and mentorship, which draws from his faith, mediates how he positions himself in interactions with his students. It shapes the perceptions he holds of students as people who need support and mentoring based on their community contexts. This lens influences what he considers achieving justice and how he measures success.

### *Discourses of Justice*

Unlike some of his colleagues, Kevin does not explicitly connect his notion of social justice to a need to transform the system. His object-conception of justice recognizes the role of mathematics in access to opportunities for learning and power; he sees his role as helping students prepare to overcome these barriers. His responsibilities echo the idea of assisting students in learning to "play the game" (Gutiérrez, 2009b), not to shift the system and the barriers it perpetuates. Instead, Kevin embodies a *DoJ-E* in articulating a social justice conception. His object-conception of justice centers on student achievement in high-quality mathematics. He focuses on student communication of mathematics and reasoning skills, balanced with a foundation in procedural fluency. This focus on the dominant mathematics may lead Kevin away from using social justice contexts as a foundation for math exploration or math as a context for social justice exploration (Garii & Appova, 2013). Kevin sees the opportunities to learn and practice these skills as part of students' empowerment as learners and mathematicians.

Kevin is aware of a *Discourse of Systemic Oppression*, but it is limited in influence on his object-conceptions of justice in mathematics education. While Kevin can identify that he holds certain privileges that his students do not, he is less fluent in the language of racism, classism, and other forms of systemic oppression necessary to identify the particular mechanisms of power and privilege that play out in his teaching. Kevin notes that "when you look at test results or just

honestly like statistics around who typically thrives in math, it's obviously usually like male students, more than female students, like, um, usually white and Asian students more than Black and Brown students. And just being aware of that gap" (Interview 1, Lines 445- 449). He connects this noticing to the idea that these students need more one-on-one support to build an understanding of mathematics so that they can focus on the new grade-level content and previous areas that are less solid. There is an awareness of differences across student experiences and the support they need, shaping Kevin's understanding of social justice mathematics.

**Melissa**

Melissa had worked at Sunshine for nine years on the administrative leadership team. Her position was a year-long job, with responsibilities supporting teacher development and overseeing curriculum development of all subjects. Before Sunshine, Melissa was a high school social studies teacher. She worked for seven years as a classroom teacher (1 year in an alternative school in a large urban city, three years in public schools, and three years at an independent school in a suburban area). Melissa left teaching to work in the education sector of a large non-partisan forum that cultivates community conversations regarding international policy. From there, she transitioned to a leadership role at Sunshine. She had worked with the leadership team over her tenure to continuously revise Sunshine's structure and curriculum to prioritize students' joy and curiosity. Melissa saw Sunshine as a place for students to recognize they belong in an educational setting and for teachers and leaders to construct educational settings that honor the students and their communities in authentic ways.

***Object-Conceptions of Justice***

Melissa's object-conception of justice in mathematics education consisted of three prongs. First, she saw a more just educational system beginning with teachers committed to

seeing all students as having "endless potential." Recognizing all students' brilliance and capacity for growth should drive the development of respect and trust in teacher-student relationships and interactions. Melissa believed that teachers who acknowledge their students' mathematical smartness and capability would hold higher expectations for what they can learn. She said that teachers need to be prepared to check their assumptions and biases about what students are capable of and instead center on students' humanity and brilliance.

In centering students' humanity, Melissa connected to the power of voice for students, especially those from disenfranchised communities. She said from the broader public's perspective, "we don't often hear their voices" (Interview 1, Line 518). Yet, their voices are essential if we are to create an education system that serves all – especially those currently marginalized. Melissa said curricular materials should present diverse perspectives across communities to help students develop their voices and feel represented in mathematics learning. Multifaceted information about mathematics and social issues can help students learn to listen with empathy and find views that feel representative of their own. She also connected voice in the classroom setting to the relevancy of the information to students' lives. Melissa purported that when teachers connect contexts for learning to student interests and experiences, they will feel more supported in speaking up and taking a stance in their learning.

Finally, Melissa's object-conception of justice in math education reflected a vision of the type of mathematics students should be learning. Melissa saw mathematics teaching as a catalyst for young people's preparation to be active members of society. She said, "it's giving students the tools to think critically through this world and feel empowered to make changes and for them to understand reality" (Interview 1, Lines 511-513). She noted that critical thinking skills are essential for all students to learn, including understanding and analyzing complex scenarios and

using data and evidence to make and communicate arguments. Melissa saw compelling opportunities to build these math practices through social-justice-oriented tasks. These tasks can and should allow students to impact change in society and understand their agentic power to influence their communities for good. Through such projects, students can develop the "skills they need to thrive in the world."

***Mediational Means***

Melissa invoked a wide berth of mediational means that informed her sense-making and action toward justice. Melissa spoke of critical growth mindsets as one mechanism that shapes her goals for justice. A growth mindset, to Melissa, understands how the brain functions to develop connections across ideas (Hammond, 2015). A critical perspective on growth mindset situates this within a structural analysis of systems of oppression. Melissa noted

> it's making sure that people understand that a growth mindset is within a context. You can't just be like, 'oh if you practice harder, you're going to just get there.' I think that practice does make things better, but it's not without the rest of the environment… recognizing the oppression in society and trauma and all of the other things. (Interview 2, Lines 492-497)

She said hiring teachers already attuned to the relationship between individual supports and the structural inequities that pervade education is key to success at Sunshine. The critical growth mindset means to her that teachers are "relentless in finding their students." (Interview 2, Lines 224-225). This mindset is a mediational means that filters interpretations of teaching and learning within a cultural, historical, and social lens of power, which teachers' practice can then shape.

The other mediational means that surrounds Melissa's object-conception of justice is that of program design. A few critical features of the Sunshine Summer Program influence (and are influenced by) Melissa's vision of justice. The program's integration of extracurricular activities

and academic content allowed teachers to develop relationships with students outside the math classroom. This can impact respect and humanity in learning interactions and support teachers in connecting content to student interests and strengths (Ladson-Billings, 1995b). Melissa also attributed the program's curriculum with helping students and teachers focus on effective math practices, like critical reasoning and communication. The curriculum at Sunshine was becoming increasingly interdisciplinary and project-based; this provided opportunities for students to analyze social issues and create innovations to solve local injustices using these practices. Finally, Melissa noted the power of assessments in impacting teaching and learning. Sunshine had moved away from pre-and post-assessments, which can mediate how teachers and students think about success in math class. By allowing teachers to form understandings of student needs with the "assumptions and biases pre-assessments can create" (Interview 2, Lines 209-211), they can establish a more productive learning environment that supports students' development of voice and agency.

***Discourses of Justice***

Along with these mediational means, Melissa invoked a variety of Discourses of Justice. First, she echoed a *DoJ-E*, mainly as she spoke to student voice and mathematical brilliance. She saw justice as interwoven with the empowerment of individual students – first through developing identities as learners and active classroom members (Aguirre et al., 2013), then extending that agency to empowerment as mathematical thinkers engaging in critical and complex analysis of social issues (Frankenstein, 1990). Melissa talked about students finding the power to participate in their communities and their classroom learning spaces. She noted that representation is a crucial part of empowerment, where "the [high] percentages of teachers of color and graduates of [Sunshine] in the classrooms…our students can be empowered and feel

like their voices are heard. And that just builds on their empowerment…So that, to me, is an act of social justice" (Interview 1, Lines 614-619). Melissa centered students' experiences and opportunities to step into their creativity and power as part of her understanding of justice.

Melissa briefly situated her object-conceptions of justice within Discourses of Justice as Transformation and Democracy. Transformation, for Melissa, arises in thinking about the programmatic design choices and structures that have been intentionally shifted to create a more humanizing teaching and learning experience. She noted that schools have different hidden curricula in preparing students (Oakes, 1985/2005). She says, "independent schools are not required to be giving tests…there's a lot more project-based learning, a lot more of a focus on critical thinking in independent schools. Why can't that be true for our students in the most marginalized communities in the US? So, yeah. It's undoing that system." [Interview 1, line 578-584]. Melissa explicitly called out that the system needs to change across institutions at the national level, as well as specific mechanisms that exist within individual schools. Melissa referenced a *DoJ-D* when she connects teaching goals to "preparing students to thrive in the world." She is considering schooling as a through-line to the skills and values students need to have to be full and active participants in their communities.

Melissa also invoked a *Discourse of Systemic Oppression* as she constructs her object-conception of justice. She regularly situated her ideas for what justice means in mathematics education within a historical, cultural, and critical perspective on the ways education and society have developed to perpetuate white supremacy. Melissa explicitly identified the role racism plays in teachers' assumptions about student capabilities and the potential for math class (and schooling broadly) to harm students through layering on deficit frames and expectations about their futures. Melissa recognized that Black and Brown students are often placed in environments

that don't provide them the opportunities to engage critically with rigorous and interesting mathematics (Interview 2, Lines 723-729). She also discussed her experiences teaching in different institutional contexts and how the differences in support and resources have shaped her vision of what kids need. Melissa brought, through this Discourse, a focus on students' joy, thriving, and resilience (Love, 2019) as an act of social justice. She recognized that kids need opportunities to process their experiences in an unjust world but also need supportive spaces to work through and despite their various experiences within intersecting systems of oppression.

**Morgan**

Morgan had been with Sunshine for 19 years in various roles at the time of the study. When Morgan first worked at Sunshine, he had just graduated high school; he served as an intern teacher throughout college. Morgan pursued a teaching credential immediately after undergrad and got a job teaching public school in the same area he oversaw at Sunshine. All ten years he was in public schools, he worked at Sunshine. During these years at Sunshine, he taught math, science, STEAM, and Social-Emotional Learning; during the academic year, he taught humanities. Three years ago, Morgan took a full-year role with Sunshine as part of the administrative leadership team. His leadership responsibilities involved supervising all the sites in one city, including student experiences and teacher support. Morgan also worked closely with Melissa to develop the program curriculum.

***Object-Conceptions of Justice***

Morgan's object-conception of justice was grounded in a holistic perspective on education. He was concerned with creating learning environments that embrace all that children are and where they come from; he believed education should not ask or imply that children need to leave part of themselves at the door to succeed. This holistic approach influenced how he

interacted with teachers, students, and students' families. He believed that families should have opportunities to be a part of the classroom community and that students should be able to connect their lived experiences to the academic content. Morgan placed relationships with students as his foundation of justice. He noted that these relationships "should not be superficial," like those based around shared interests such as sports, but should resonate with who people are. While people may not share the same struggle, they can find similarities in their experiences. For Morgan, building those relationships requires listening to students: "it's essential for teachers to be able to listen to kids and hear them and not just say 'cool. You did that thing. Now move on, business, business, business." (Interview 1, Lines 315-317). Instead, these relationships can foster transparency and honesty between teachers and students about working within the system and why certain skills or practices of "schooling" are important. Morgan believed that transparency with students could help them develop agency and authority in their own learning experiences, as well as support the development of critical thinking and reasoning skills that will be of use both in and outside the classroom.

When asked to describe what justice means, Morgan raised the idea of Tikkun Olam, or repairing the world from his Jewish faith. He said,

> I really feel like education and teaching, sort of imparting values around taking care of our community and taking care of each other was central to this idea of Tikkun Olam. The more people are going to be positive and take care of their community, the world is going to be better than if everybody's just like antagonistic and people don't understand how to relate to people who are different than them…so that to me was sort of this social justice lens of 'we're going to do good things for people.' (Interview 1, Lines 534-541)

Morgan saw this principle across everything he did in education, from the ways he expected students to interact with each other in the classroom to the type of social issues he looked to explore in a culturally relevant curriculum. He centered the notion of "taking care of the community" in his conception of justice, which implies needing to create a supportive

community of students and teachers, as well as connecting the classroom community to their larger non-school communities and wellness. Morgan believed that teaching mathematics and attending to justice can create an environment where students learn to interact in ways that support community wellness and care. To create such an environment, students may explore social issues with mathematics and propose alternative scenarios or solutions that could make the world a better place for all people, especially those in their communities.

Finally, Morgan closely and explicitly linked his object-conception of social justice to his understanding of white supremacy and anti-racism. He identified a few key actions that he saw as necessary to deconstruct racist spaces in education, starting with teacher and administrator awareness of the racist history of America and the history of educational systems. This awareness is necessary so that educators have the language and capacity to hold conversations with colleagues and students and to recognize and "squash all overtly racist oppressive things" (Interview 1, Line 564) that occur while teaching mathematics. Morgan raised the importance of critical anti-racist reflection of teachers on their identities: "I want educators to develop an anti-racist lens through which to not just look at themselves, but look at the work they're doing, and the students and families they work with… it's totally critical, especially for white male teachers who come from a privileged background" (Interview 1, Lines 287-293). Morgan's conception of justice through teaching mathematics hinges upon teachers' critical consciousness and reflexive capacity to interrogate biases. Teachers must be ready to learn about the history of their communities and students' communities, as well as practice addressing injustices in the moment to create safe learning environments oriented towards justice.

### *Mediational Means*

The mediational means Morgan invoked to make sense of and act towards justice in mathematics education included centering student thinking and being transparent with students about the educational system. Centering student thinking served a few purposes in Morgan's object-conception of justice. First, this pedagogical practice guided how he designed instruction for student ideas and participation. He noted that "they should be talking more than me" (Interview 1, Line 589). While simple, this statement reflected his priority of building relationships that honor students' agency and perspectives. Morgan recognized that he needed to know his students' current thinking to foster valuable and relevant learning opportunities (NCTM, 2014); he could do so by creating a student-centered classroom. The mediational means of centering student thinking is also connected to his commitment to representing multiple perspectives and voices in classroom discourse and curricular materials. He wanted his students to feel seen and heard; he used diverse curricular materials and various modes of participation to achieve this goal. Course discussions should validate students' emotions and experiences, and the learning environment should be a safe space for vulnerability and care between students and teachers. Centering student thinking and voices allowed Morgan to make sense of his goals for student learning in a more just educational space and informed how he pursues those goals in the classroom.

The other mediational means which stood out in Morgan's discussion of justice in mathematics education is the practice of transparency with students. This practice mediated how Morgan saw his work contributing to breaking apart oppressive systems and how he honored student agency. Transparency about the system could involve conversations with students about why they must take standardized tests – for school measures, not for learning (Interview 1, Lines

322-324). Transparency invites the students to recognize the ways school policies and processes structure experiences in the classroom. This awareness supports students' capacity to discuss and analyze systemic issues and can help students learn to advocate for change that better serves their community (Gutstein, 2016; Kokka, 2020). Further still, Morgan used transparency with students and teachers to explicitly break down racist language, assumptions, and ideas that can arise in classroom interactions (Interview 1, Lines 398-404). Transparency with students involves teachers' critical consciousness to hold these conversations (Bartell, 2013). For Morgan, this awareness and practice was necessary for attention to and pursuit of justice. He saw transparency as supporting students in developing critical lenses and language, building their understanding of their agency to call out racism and oppression in schooling systems.

### *Discourses of Justice*

Morgan's notions of justice rested on various Discourses of Justice. First, he drew upon a *DoJ-E* to describe his understanding of justice. He noted that students need opportunities to process their experiences and identify their resiliency and agency in their lives. The empowerment of individuals is closely connected to their humanity and community well-being as a classroom and a broader community group. Morgan invoked ideas that resonate with Healing-Centered Approaches (Ginwright 1996) as he talked about empowering students to care for each other and make the world a better place. The *DoJ-E* is apparent in his goal to create a classroom community that honors his students' needs. Morgan prioritized students' recognition of the "resiliency they already have" (Interview 1, Lines 301-303) and wanted them to be able to see how to use that resilience to advocate for themselves in their learning journey. He focused his teaching on student development of interaction skills, such as trust and respect for one

another and their experiences, in service of participating in and sustaining a community of care. These priorities align with the values and practices of a *DoJ-E*.

Morgan considered justice in mathematics education as involving a *DoJ-T*, especially transformation of schooling. He invoked the idea that schools value achievement and "cranking out [students as] products" to underlie the idea that the system is impersonal and inequitable to students' needs. While at times Morgan talked about supporting students in learning how to play the game of schooling (Gutiérrez, 2009b), he stated that this serves a bigger goal of "rewriting how education should function" (Interview 1, Lines 895-900). He wanted to create processes for learning involving exploration, feedback, and reflection that honor the multiple avenues and strengths students bring to the classroom learning environment. To Morgan, the transformation of schooling consists of creating classrooms where students don't have to worry about experiencing harm or reliving traumas that traditionally can occur in mathematics learning environments (Interview 2, Lines 282-285). He considered this goal at a system level; instead of focusing on individual experiences with student interactions, Morgan discussed the cultural patterns of student disenfranchisement and systemic issues in schools that can harm students' well-being (Kokka, 2019; Ginwright, 2016). He claimed that mathematics learning should be focused on the more significant contributions of education: developing humans within personalized, responsive institutions that can help each student fulfill their potential. To make this a reality, Morgan described shifting processes of school systems to center time, trust, and care, as opposed to business or banking education models (Freire, 1970/2000).

Finally, Morgan discussed justice in mathematics education through a *Discourse of Systemic Oppression*. Throughout Morgan's talk, he returned to the idea of anti-racist teaching perspectives as necessary for justice (Martin, 2007). This Discourse involves acknowledging the

racist histories of schooling and society, including redlining, poll taxes, and the effects and disparate resources and opportunities racist policies create today (Interview 1, Lines 670-677). Morgan drew upon this Discourse as he explicitly named ways white supremacy shapes society and individual experiences; it also informed his approach to teaching in pursuit of justice. He noted that being able to invoke a *Discourse of Systemic Oppression* is essential for all teachers pursuing justice (Martin, 2007; Martin, 2019; NCSM & TODOS, 2016), especially those with power-laden identities like himself:

> at the center of like being an anti-racist teacher, or especially like a white teacher, or a teacher who doesn't come from the same background or experiences as their students, like it's building relationships is first and foremost, like treating kids like human beings and understanding and trying to understand what their perspective is and where they come from and meeting kids where they're at. And, um, however that played out and not shying away from having difficult conversations like about the world and acknowledging, you know, racist things and racist systems. (Interview 2, Lines 380-388).

Access to a *Discourse of Systemic Oppression* informed how Morgan reflected on the types of spaces he took up in his classroom and within the Sunshine Summer Program. He also used this Discourse when describing the critical awareness he wanted his students to develop (Kokka, 2015). A *Discourse of Systemic Oppression* allowed Morgan to address racism in schools and how he perpetuated hierarchies of power in his practice. He supported his conceptions of justice that attend to transforming institutions.

**Summary of Educators' Object-Conceptions**

Similarities and differences arose across these educators' articulation of their object-conceptions and the use of means and Discourses to achieve them. Table 15 summarizes each individual's key themes and ideas during their interviews. There are commonalities across some features of the educators' object-conceptions: most notably, their attention to mathematical understanding and to relationships with students. However, there are differences in the resources

(mediational means and Discourses of Justice) the educators invoked to articulate these object-conceptions. I briefly explore these similarities and differences.

Three of the four educators hold the object-conception of justice where all students have the opportunity to learn rigorous mathematics that is interesting and useful to students and to societal improvement; they invoked different Discourses of Justice when talking about how to achieve this goal. Eliza claims that part of her job as a justice-oriented mathematics teacher is to expand what students see and count as mathematical; when she talks about doing this work, she mentions interrogating and critiquing the discipline, transforming how the discipline itself is perceived and used (a *DoJ-T*). Kevin speaks to the above object-conception from the perspective that all students are capable of doing grade-level mathematics in complex ways. He believes that this object-conception can be achieved through differentiating activities to provide support where students are, empowering them individually to make sense of the mathematics (a *DoJ-E*). Melissa also articulates an object-conception of justice that involves students learning rigorous mathematics. She believes that critical mathematical skills can help students transform inequitable social systems through analysis and argumentation. She considers students' success in mathematics as foundational for success in the world, in alignment with the broader goal of learning to prepare students to be active members of society (a *DoJ-D*). Morgan does not explicitly discuss an object-conception of justice that requires mathematical competence for all students. However, Morgan does discuss mathematical analysis of social issues in service of repairing the world and one's community.

All four educators privileged the power of relationships with students as essential to justice work. They explicitly stated that building those relationships is essential to the rest of their pedagogies, mediating all the actions they take in the classroom. Productive and supportive

Table 15.
*The Participants' Object-Conceptions, Mediational Means, and Discourses of Justice.*

| Participant | Object-Conceptions (Justice is about…) | Mediational Means (Justice is achieved by…) | Discourses of Justice (Justice is achieved by…) |
|---|---|---|---|
| Eliza | ● Mathematical understanding and identity development<br>● Relationships that promote student agency<br>● Student awareness of inequities in society | ● Critical consciousness<br>● Curricular resources | ● Awareness of power structures & racism<br>● Transformation of discipline<br>● Empowerment of students as mathematicians |
| Kevin | ● Mathematical understanding<br>● Centering student voices<br>● Making a difference within differently resourced schools in the system | ● Achievement data<br>● Faith-based notions of service | ● Awareness of power structures and racism (briefly)<br>● Empowerment of students to overcome math barriers<br>● Empowerment of students as mathematicians |
| Melissa | ● Mathematical understanding to analyze inequities<br>● Centering student voices<br>● Seeing all students as having endless potential and brilliance | ● Critical growth mindsets<br>● Program design features | ● Awareness of power structures & racism<br>● Transformation of schooling<br>● Empowerment of students as mathematicians and as members of society |
| Morgan | ● Tikkun Olam – repairing the world<br>● Relationships that promote student agency<br>● Anti-racist practices | ● Transparency about the educational system<br>● Student thinking | ● Awareness of power structures & racism<br>● Transformation of schooling<br>● Empowerment of students as members of community and humanity |

relationships between students and teachers promote positive learning environments and cultures of inquiry (National Council of Teachers of Mathematics, 2014). In pursuing this object-

conception, each educator leveraged different mediational means. Morgan aims to build relationships with students that are not surface level, but substantial and honest. He does so by inviting families into his classroom and sharing about his own life to humanize himself to his students. Melissa sees productive and supportive relationships as evolving from opportunities for students to have their voices heard in the classroom. She creates these opportunities by designing curricular resources using student interests, with space in the lesson structure for learners to share their prior knowledge and experiences. Kevin considers productive relationships as those which hold all students to high expectations and respectful interactions to maximize learning potential. He takes a strengths-based growth mindset approach to teaching, recognizing students' smartnesses and listening to what they need to inform his teaching. Eliza considers the racial tensions and power dynamics implicated in developing meaningful relationships with students. She centers students' personal goals for their learning experiences, including the types of relationships they want to have with her. In responding to students' goals, Eliza utilizes flexibility in her participation structures, questioning patterns, and her co-teachers' capacity to support students to personalize each student's experiences and develop relationships that fit the students' needs.

Even though there are some similarities in teachers' conceptions of justice, the differences in the means and Discourses teachers invoked led to different foci in their narratives of practice. Each object-construction constrains or enables different actions, because the teachers are negotiating different combinations of goals, along with utilizing different mediational means and Discourses of Justice to sense-make and inform their actions. While comparisons allow patterns and intentions to lift out of the other narratives, the goal of this study is not to identify the "right" way to pursue justice – it's about understanding how the educators are sense-making

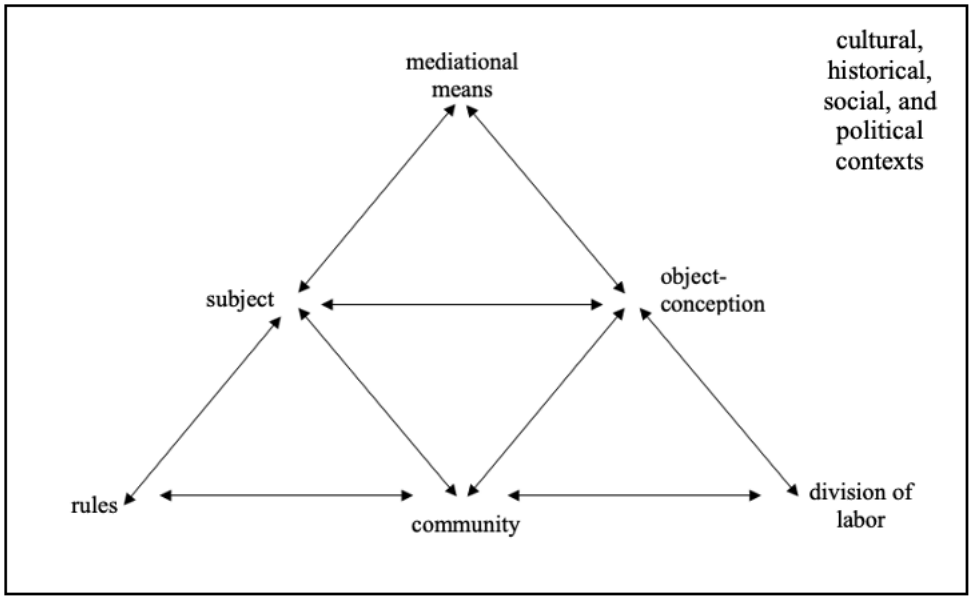
and what combinations of means and Discourses are connected. The pursuit of justice in mathematics education is multi-layered work that requires attention to different facets of the environment and system. Learning how educators immersed in this work perceive their praxis as oriented toward justice can inform next steps for research. Want O-Cs that aren't competing/conflicting because those can be generative for collaboration and productive learning.

## Discussion

This study aimed to explore the following research questions: How do educators who identify as "committed to social justice" construct their object-conceptions of justice in mathematics education? What mediational means do the educators leverage in constructing object-conceptions of justice in mathematics education? How are *Discourses of Justice* invoked as the educators construct their object-conceptions? The educators developed a variety of object-conceptions of justice that guided their mathematics teaching and leadership. The educators leveraged resources (mediational means and *Discourses of Justice*) to construct these conceptions. As the educators explained these object-conceptions, they leveraged key resources. The resources that came forward in educator conceptions of justice provide insight into what the activity system of justice entails.

An activity system consists of six nodes, all of which are situated within cultural, historical, social, and political contexts (Figure 1; Engeström, 1987). The three central nodes are that of the subject, mediational means, and object-conceptions. In this study, educators invoke mediational means to enact their object-conceptions of justice. The remaining nodes include the community of people who share an interest in the object, the rules that dialogically shape interactions between members of the community, and divisions of labor to understand how action occurs (Engeström, 1987; Foot, 2014).

Figure 1.
The Cultural-Historical Activity System (Engeström, 1987).




The resources that study participants leveraged in their conceptions of justice can be considered through these six features of activity systems. In doing so, three patterns stood out as part of the educators' process of conceptualizing and pursuing justice. First, the educators' personal experiences, histories, and beliefs (the node of the subject) came forward as they talked about justice. Second, the institutional affordances and constraints (the nodes of rules and divisions of labor) influenced what mediational means the educators took up in their narratives of teaching practice aligned with justice. Third, the community of justice-oriented mathematics education researchers and teacher educators (the node of community and the context surrounding the activity system) shaped the *Discourses of Justice* that were available for the educators in their conceptions. Understanding these three patterns provides insight into what the activity system of justice in mathematics education might entail.

**Participants' Subjectivities in their Conceptions of Justice**

The educators brought forward their own identities, histories, experiences, and beliefs as they constructed conceptions of justice in the interviews. These included their experiences as students and as teachers, such as Morgan's reflection on how involving families in his classroom in previous schools has shaped his emphasis on family involvement as a part of developing more just classrooms in his current leadership role. Melissa's experiences with three differently resourced institutions and the types of learning students had access to shaped her goal of creating an environment that prioritized joy and curiosity in learning. Eliza's identity as a white woman, which contrasts with the majority of her students' identities, contributes to her conception of justice regarding students' agency and power. Kevin and Morgan both leverage their faith – belief systems – in describing their understandings of justice and their responsibilities in taking on justice work in their teaching.

Research on socially just mathematics teaching often acknowledges the role of teacher identity. Teacher education literature notes that pre-service teacher identities and beliefs can influence the conceptions of justice they take up (Leonard & Evans, 2012; Simic-Muller et al., 2019; Thanheiser & Sugimoto, 2020). Some teacher educators work with pre-service teachers to develop their reflexivity and awareness of the subjectivities they bring to teaching (e.g., de Freitas, 2008). Concerning in-service teachers, Gonzalez (2009) claims that teachers' "identity and awareness mediate[s] both action and pedagogy" (p. 23). The study reported in this manuscript extends these claims to articulate how such subjectivities mediate object-conceptions of justice.

**Institutional Structures Affording Mediational Means**

Institutional pressures and aims can influence how educators make sense of their goals for teaching and learning (Bartell, 2013; Harrison, 2015). As the educators constructed understandings of justice, they drew upon mediational means that brought forward their roles, responsibilities, and institutional resources. These institutional features, consciously or unconsciously, mediated the educators' object-conceptions. For example, Kevin's job as a math teacher in charter schools and the Sunshine Summer Program, institutions that all prioritized college attendance as a measure of student success, influences the priorities Kevin constructs for achieving justice. He necessitated that the foundational mathematics skills be built before engaging in project-based learning, given that students need to pass standardized assessments at the end of the year, and references achievement data as a mediator for his goals. Eliza's object-conception of justice provides additional evidence for how institutional structures and responsibilities can impact mediational means. Eliza speaks to her agency in deciding which curricular resources fit within her vision of justice and math learning. She states that her responsibility as a math teacher is to help each student foster a productive relationship with mathematics. Her institutions (Sunshine and her full-time employer) provide resources to do this. Eliza's understanding of her role and agency in these systems affords her adaptation or rejection of certain curricular resources in service of that responsibility.

The literature on social justice in mathematics education mostly discusses the role of institutions as contributing to tensions teachers experience when enacting justice-oriented pedagogies. That is, when institutional features are discussed, it is to illustrate how they limit teachers' opportunities to teach mathematics for social justice authentically (Gregson, 2013; Brantlinger, 2012). Most often, this tension arises from scenarios such as Kevin's, where there is

institutional pressure for students to perform well on standardized assessments, leading to less instructional time to discuss justice and social issues. Gutiérrez (2016) offers creative insubordination as a way to co-opt institutional structures to serve one's conception of justice. On the other hand, though less discussed in the literature is Eliza's scenario, where teachers experience agency within their institutions to pursue justice (Gonzalez, 2009; Raygoza, 2019). In such studies, institutional structures afford teachers the responsibility to do what they see as necessary to support students' learning; teachers take agentic action to shift curriculum or course designs to fit their notions of justice (Gutstein, 2003; Felton-Koestler, 2019).

**Community and Contexts Through Discourses of Justice**

Finally, *Discourses of Justice* represent some frames of meaning that constitute socio-political, cultural, and historical contexts that shape activity systems. As the educators constructed their understandings of justice, they brought forward certain Discourses and awarenesses that influenced how they made connections between their actions and conceptions. For these educators, holding a *Discourse of Systemic Oppression* seemed to be pivotal in reaching an understanding of justice relying on transformation. Eliza spoke about her critical reflexivity regarding her position in society, mathematics, and as a teacher. Her explicit attention to the ways power functions through racism to shape her interactions and dialogically related goals for teaching affords her attention to system structures and practices that perpetuate injustice. On the other hand, Kevin's limited access to a *Discourse of Systemic Oppression* may be connected to the *DoJ-E* predominant in his conceptions of justice. He stopped short of explicitly naming how inequities in the educational system are created and perpetuated and did not discuss how he, himself, was implicated in power dynamics that impacted students' learning experiences. The invocation of a *Discourse of Systemic Oppression* may be a mechanism for

moving from *DoJ-Es* to *DoJ-Ts*: constructing understandings of justice and actions at the system level. Much literature acknowledges that teachers must have critical consciousness to effectively enact TMfSJ (Chubbuck & Zembylas, 2009; Davis & Martin, 2008; Harrison, 2015; Kokka, 2015, 2019; Martin, 2007). It is challenging for teachers to develop such conscientização (Bartell, 2013; Tanase & Lucey, 2017). However, focusing on teachers' critical consciousness may be crucial for accessing and expanding *Discourses of Justice* to attend to systems of inequities (Yow, 2012).

This manuscript attempted to identify how, through *Discourses of Justice*, teachers leverage conceptions of justice and practices from the community. The role of the community is rarely discussed in current research on social justice in mathematics education. Some studies discuss how collectives of teachers, often in professional development opportunities, collaborate toward justice teaching (e.g., Bartell, 2013; Gonzalez, 2009). However, no studies have focused on how communities can impact the ways educators conceive of justice. Recognizing how educators' praxis is situated within the community's landscape of research and teaching regarding justice can led to the identification of networks and new connections to sustain future progress.

**Summary: So What?**

As the educators constructed their object-conceptions of justice (including their perception of needs, solutions, and actions), they invoked a variety of mediational means and *Discourses of Justice*. Identifying these resources and how they were used by educators to construct conceptions of justice can aid the field in moving beyond questions of "what is justice?" to consider "how can we achieve justice?". Situating teachers' conceptions from an activity theory perspective can be generative for future research, including exploring how

members of the system work in tandem to achieve a shared object of systemic justice in mathematics education.

### *Implications for Research and Practice*

The lenses of Mediational Discourse Analysis and Cultural Historical Activity Theory offered in this study can provide multiple avenues for future research into the learning of teachers and collectives. First, more research is needed to combine these frameworks to understand how teachers conceptualize justice in mathematics education and how they work towards that object. The narratives presented in this manuscript provide one such example of how this may be done. Still, more experiences and patterns are needed to begin understanding the means and Discourses that mathematics educators draw upon as they pursue justice. Further, more explorations of educators' talk can start to identify if there are any combinations of Discourses of Justice and mediational means that often appear together. Are there combinations of these features that afford certain types of actions? Are there combinations constraining each other, and how do educators make sense of justice in their contexts? A natural extension of this study and these questions involves following teachers into classrooms to see how they invoke Discourses of Justice and mediational means in their instruction with students, in conversations with colleagues, and how they reflect on these moments.

The combination of MDA and CHAT connects individuals to broader frames of meaning and systems that organize behavior. CHAT, in particular, could be a valuable tool for the research community to attend to collectives and activity systems in mathematics education. Establishing activity systems, such as mathematics departments or the collective of teachers, administrators, and coaches within a district working on mathematics instruction, and exploring their individual and collective negotiation of object-conceptions to identify shared visions for

teaching and learning, may be productive in research on teacher learning. Research could consider how different features of an activity system afford or constrain teacher action to dismantle oppressive practices and policies. There is a need for research in mathematics education to leverage theories that attend to system-level change if we want to move past micro-level explorations of just mathematics education.

In addition to areas for future research, this study provides generative ideas for teacher learning and professional development. This study recenters discussions of justice in mathematics education on the current actors in K-12 classrooms and presupposes new ideas and innovations are developed out of current understandings (Vygotsky, 1978). It is crucial to work with teachers to articulate and reflect on their vision for mathematics education and justice:

> Positioning teachers' voices as central to investigating social justice education allows us to understand how their commitments and challenges collide and vary within school, district, or charter contexts and larger social and political contexts. The more we understand these intersections for teachers, the better we can prepare and support teachers to teach for social justice (Raygoza, 2020, p. 24)

Analyzing their conceptions of teaching and learning can support teachers in aligning their purposes for enacting pedagogical practices and using instructional resources with their goals. Further, teachers may be supported in developing a lens to parse the language they use when talking about teaching, students, and mathematics to understand how their talk connects to larger frames of meaning (Yow, 2012). Intentionality in their language and practice can lead to more evident perspectives on what they are trying to achieve and how they are working towards those goals.

In understanding what teachers' object-conceptions of justice are and their related means and Discourses drawn upon to act towards such goals, certain avenues for innovation and next steps will come forward. Professional development facilitators and teacher educators should work with their communities to understand what instructional means are currently in use in

teacher practice and the aims teachers see those resources fulfilling to identify opportunities to adapt or shift their use towards justice. Out of these understandings, it may also become apparent that the teachers may benefit from adopting a new resource or structure to help them stay aligned with their conceptions of justice. If teachers are invoking a particular Discourse to describe justice, it may be useful to understand how that Discourse influences the potential means and actions they may take up. Further, this lens can guide teacher educators or professional development facilitators on when and how it may be relevant to introduce other Discourses of Justice that expand how teachers conceive of and pursue justice. Working with collectives of educators to develop an awareness of how Discourses and means to structure practice and how practice can inform the Discourses and means one draws upon can lead to critical masses of educators working together to make lasting change.

## Conclusion

This study centers the voices of four educators in their evolving understandings of what it means and looks like to pursue justice in mathematics education. By privileging educators' narratives, I recenter the conversation regarding justice in mathematics education on those engaged in praxis. Examining the conceptions of justice teachers construct and the resources they invoke provides insight into how educators come to understand and work toward justice. It may also contribute to the identification of future areas for research and practice to articulate the features of an activity system of a critical mass of teachers working towards for justice in mathematics education.

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# Chapter 4 - Conclusion

Justice in mathematics education is a slippery and ill-defined ideal (North, 2006). Researchers, teacher educators, and teachers are engaged in ongoing processes of conceptualizing what a more just educational system would entail, and identifying steps they could take to achieve it. How individuals act in praxis is informed by their understandings of needs and solutions – insights into these conceptions and practices are relevant for anyone supporting the advancement of the field toward a more just education. This study reported on conceptions of justice and suggestions for achieving justice through two sources: a) a systematic review of published manuscripts that set up and guide research, teacher education, and practitioner innovations, and b) a strategic series of semi-structured interviews with educators currently engaged in justice-oriented praxis. Findings from this study offered novel insights concerning the framings of justice available within the field and the ways teachers make sense of and act toward justice. In this conclusion, I briefly summarize the study findings from each manuscript. I then discuss the study's overarching themes and present recommendations for researchers, teacher educators, and practitioners committed to cultivating a more just mathematics education system.

## Overview of Manuscripts

The first manuscript in this study recognized the growing body of literature in mathematics education regarding justice. This manuscript answered the question, *what are the Discourses of Justice in mathematics education literature*? I conducted a systematic literature review of the 77 manuscripts that explicitly describe or define justice with respect to K-12 mathematics education. This research aimed to provide an organizational framework –

Discourses of Justice – through which to understand how the literature is creating and sustaining ways of talking about justice. From my analysis came three sets of findings. First, my analysis uncovered three distinct ways of conceptualizing justice across the research: three *Discourses of Justice*. These three Discourses act as an organizational framework that focuses on the levers for justice promoted in mathematics education literature. This approach supports action-oriented discussions of justice. Secondly, findings showed that research publications often combine these Discourses across their arguments. Scholars who write published manuscripts are invoking multi-layered conceptions of justice; this is necessary to attend to the complex, nuanced issues of systemic oppression and inequity rampant in the mathematics education system. Finally, a third finding revealed discrepancies in how the Discourses were invoked in manuscripts intended for different audiences. Ultimately, practitioner-focused manuscripts do not leverage Discourses of Justice that attend to system-level features in the same ways as manuscripts for researchers and teacher educators.

The second manuscript in this study recognized the importance of practitioners' conceptions of justice and the actions they saw aligning with those conceptions. This manuscript answered the research question, *how do educators construct conceptions of justice in mathematics education?* This manuscript reported on the analysis of interviews with four educators who are committed to justice work in mathematics education. I explored the educators' conceptions of justice and the resources they used in constructing those conceptions, resulting in two main findings. First, the educators shared some facets of their conceptions of justice, including a focus on student learning of rigorous, critical mathematical skills and an emphasis on authentic, caring relationships with students. Yet they also constructed different conceptions of justice, especially regarding the capacity to articulate justice as related to institutional and

systemic change. The educators that invoked an awareness of systemic oppression discussed how injustices existed within the educational institutions and normalized practices of mathematics; this awareness seemed to be a resource that constrained or afforded educators' conceptions of and praxis toward justice as a systemic issue. Secondly, findings showed that the educators regularly drew upon their personal experiences and institutional responsibilities to inform actions toward their conceptions of justice. Connections between these influences, resources, and actions present opportunities for identifying key mechanisms to advance praxis toward justice.

**Contributions to the Field**

This study contributes to the field's understanding of the work of justice by identifying and connecting systems of meaning with individual actions and talk. Collectively, these manuscripts explore how members of the mathematics education community (those who publish and educators) conceptualize justice. I argue that there is a need to better understand how various stakeholders in mathematics education conceptualize justice, as these conceptions guide actions – which drive the field's future foci for research and practice.

Justice is a complex issue that spans interlocking systems (e.g., education, public health, criminal justice) and levels (individual interactions, institutional structures, and ideological belief systems) (Freire, 1970/2000). The theoretical foundations of the work on justice in mathematics education take up this systems perspective (Frankenstein, 1983; Gutstein, 2003; Ladson-Billings, 1995). However, this study's findings suggest that it was challenging for manuscript authors and educators to consistently attend to systemic sources of injustice and discuss actionable practices they saw as disrupting and reconstructing more just structures and institutions.

The first manuscript revealed that authors invoked *Discourses of Justice as Transformation* or *Democracy* less often than expected in the sections of manuscripts where they

interpreted results or presented implications for practice. Further, these *Discourses of Justice* (which represent systems perspectives) were invoked at a disproportionate rate in manuscripts with practitioner audiences. Manuscript authors did not explicitly and consistently discuss justice at, or with connection to, system-level Discourses; this is especially true when considering the connection between research and practice.

The second manuscript presented educators' conceptions of justice, including the resources they invoked across their narratives. Again, there was not consistent attention to the system-level *Discourses of Justice as Transformation* and *Democracy* across participants' and their conceptions. In instances when educators did attend to disrupting institutional structures and cultural understandings in their conceptions of justice, they invoked additional mediational means. More specifically, the educators utilized system-level *Discourses* in combination with explicitly naming the ways they saw racism and other systems of oppression structuring students' experiences in the mathematics classroom and in society. This awareness of systemic oppression represents a mechanism through which educators can articulate and act toward a systemic conception of justice.

The challenge for educators and manuscript authors to take a system perspective is important, given that justice is acknowledged as an issue of intersecting power systems. My dissertation provides a lens to understand if and how scholars attend to institutional and ideological features of justice as opposed to only describing and promoting interpersonal justice solutions. This study contributes a perspective on conceptions of justice and how those conceptions provide implications for action. Next, I briefly review limitations of this study before explicating opportunities for further research and recommendations for members of the mathematics education community working toward justice.

### *Limitations*

This study presents one perspective on conceptions of justice in K-12 mathematics education and the implications of these conceptions for action. Yet, the scope of this dissertation study implies that only some of the ideas related to justice are represented in this evidence and claims. In the first manuscript, I conducted a systematic review of the literature on K-12 mathematics education that explicitly discussed "justice." Identifying "justice" as the keyword was necessary to narrow the focus of the analysis and unpack the conceptions associated with the term "justice." However, this led to the exclusion of literature that relates to ideas of justice, such as manuscripts discussing "liberation," "anti-blackness," or "thriving" in mathematics education (e.g., Davis, 2018; Martin, 2019). Within the analyzed literature, the focus on "justice" resulted in coding only sections of text that used this term. This allowed for the themes to stay close to the conceptions of justice as articulated in the literature, but blurs the potential connections between Discourses of Justice and other related Discourses or ideas regarding teaching and learning that manuscript authors invoked.

The second manuscript presents K-12 math educators' conceptions of justice; the scope of the study creates boundaries for the generativity of the findings. Recruitment of participants for the series of interviews led to four volunteers. The participants did not demographically represent those of the recruitment population. Further, the small participant size led this study to focus on individual conceptions of justice and resources, as opposed to exploring a collective of teachers engaged in justice work. In addition, interview transcripts were analyzed with respect to "justice," which were naturally entangled with the participants' understandings of the nature of mathematics, teaching, and learning. Due to the focus of the study, these understandings were

not explicitly analyzed. There are rich opportunities for future research that explores these connections.

**Future Research and Recommendations**

This study focused on the identification of conceptions of justice and the exploration of how practitioners construct and pursue these conceptions in practice. We must recognize that our everyday actions – including the language we use and the goals we set – have the chance to perpetuate or disrupt injustice in mathematics education. These actions are situated within social, cultural, historical, and political contexts, as well as the power dynamics of in-the-moment interactions. As such, the ways one articulates their conceptions of justice (the needs and the solutions) are constantly negotiated and adapted to fit within environmental constraints, yet to still afford attention and action toward justice. Developing the capacity to analyze and innovate existing structures and systems of inequity in mathematics education requires time, collaboration, and resources to support progress for researchers, teacher educators, and teachers.

The constructs identified in this study motivate future research regarding the relationships between *Discourses of Justice* and educators' conceptions and practice. First, future research may aim to expand on the *Discourses of Justice* I have identified in this study. This may involve looking to other literature, such as general education research, or broadening terminology to include the manuscripts related to emancipatory, liberatory and transformative teaching and learning in mathematics education. Research questions might include, *what additional Discourses exist regarding justice? Where do these Discourses show up across the field?* Research could also look to unpack the relationships between the *Discourses of Justice* and other *Discourses* regarding mathematics teaching and learning, such as deficit Discourses (Adiredja &

Louie, 2020) or race-gender Discourses (Reinholz & Wilhelm, 2022): *How and why do these intersections occur?*

Further, future research trajectories may attend to the entanglement of conceptions of justice and practice outlined in this study. This study focused on how educators constructed these conceptions throughout a series of interviews; however, conceptions of justice are actively constructed and enacted in interactions. This study leads to a natural inquiry into *how educators develop their conceptions of justice in interactions with students and with other educators*. Through observations of educators' practice, research can also identify if there are additional resources they draw upon to pursue justice compared to those articulated across interviews. Additionally, research may explore *how contextual features constrain and afford educators' actions toward justice*.

Finally, this study motivates future research that attends to the collective actions of systems that are oriented toward justice. The theoretical perspective of Cultural-Historical Activity Theory (Engeström, 1987) describes how activity systems collectively work towards shared objects. This study serves as a foundation for research on how departments, districts, or other organizations of educators construct and move towards conceptions of justice. Such research could establish the resources, responsibilities, and *Discourses* that shape and are shaped by collective action of institutions. Research questions could also include, *what tensions arise as two systems interact in pursuing justice? How do productive collaborations arise in the pursuit of justice in mathematics education?*

### *Recommendations*

Along with these potential avenues for future research, I advocate for continued exploration of tangible actions that can support researchers, teacher educators, and practitioners

in conceptualizing and pursuing systemic justice in mathematics education. I briefly present recommendations for each group of actors than can ignite progress toward this aim.

I propose that mathematics education researchers should aim to explicitly articulate systems perspectives of justice within study frameworks. Incorporating critical theoretical frameworks and methodologies that address power and justice at institutional and ideological levels, can support attention to the ways individual actions implicate systems of power and meaning. The problems that researchers propose for study and the tools they use to explore those problems have implications for the direction of future research and practice. To guide the field to more explicitly center systemic perspectives of justice, researchers should intentionally weave system-level Discourses of Justice throughout their interpretations of analysis and implications for practice. These frameworks and methodologies may also originate in other disciplinary traditions, such as sociology and ethnic studies, and leverage critical perspectives on racism, classism, and sexism, among other systems of power.

Additionally, teacher educators should develop the capacity to recognize and articulate how teaching practices can serve different goals, as detailed in this dissertation. Teacher educators have a responsibility to explicitly connect principles of practice to teaching moves oriented toward justice. This may support pre-service teachers (PSTs) in building their own conceptions of justice, identifying mediational means that can advance their goals, and understanding how teaching practices may be enacted and adapted to serve their conceptions of justice. Teacher educators can foster this capacity through reflective analysis of their own and others' teaching. Organizing methods courses around features of just mathematics education, with opportunities for PSTs to explore, analyze, and experiment with different teaching moves or instructional resources, is one strategy teacher educators can implement.

I suggest that educators work to incorporate reflexive practices into their routine practice through which they can cultivate their own critical consciousness. Educators need regular opportunities to reflect on their biases and subjectivities that shape how they conceptualize justice in teaching and learning mathematics. Further, reflexivity can support educators in recognizing their spheres of influence and agency in advocating for and creating change. Research shows that this is challenging for teachers to do (Bartell, 2013; Harper, 2019). The literature – and this study – also supports the idea that teachers' critical consciousness may be a lever for being able to effectively attend to systemic features of justice (Chubbuck & Zembylas, 2009; Kokka, 2019; Martin, 2007; Davis & Martin, 2008). Teachers could engage in structured opportunities to analyze teaching practice and conceptions of justice, such as those articulated by Yow (2012), de Freitas (2008), or Bartell (2013). Professional learning opportunities can also support the creation of communities holding each other accountable for developing critical consciousness.

Finally, I recommend that all three groups of actors partner with local activist organizations to understand community-based frameworks for creating just spaces and advocacy across system levels. The mathematics education community does not need to re-invent processes and strategies for pursuing justice in teaching and learning. Grassroots organizers and activists can provide insight into community needs, prioritize the voices of marginalized community members, and allow mathematics education actors to learn from those with expertise in this area. Some scholars in mathematics education are already pursuing the relationship between teachers and activism (i.e., Kokka, 2018; Picower, 2018; Pour-Khorshid, 2018; Sabati et al., 2022). I echo their call to develop networks across organizations and expertise to dismantle the unjust system of mathematics education and reconstruct a more just system.

**Closing Comment**

The work outlined in this dissertation has evolved alongside my own personal and professional development as a mathematics education scholar pursuing justice. This dissertation responds to the overarching question, *"what does justice mean and look like in (mathematics) education?"* I acknowledge that my previous experiences as a teacher candidate and teacher, as well as my doctoral learning experiences, have guided my various responses to this question; this dissertation represents one such way to answer this question at this point in time. I recognize that there are more remaining questions than answers, and I look forward to contributing to the various answers to this question throughout my research and practice.

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# Appendices

## Appendix A: Code Application for All Reviewed Literature

| | Citation | Type (E, T, P) | Problem Setting | Theoretical Framing | Results/ Implications |
|---|---|---|---|---|---|
| 1. | Aguirre, et al. (2019) | P | Empowerment | Empowerment Transformation | Empowerment Transformation Democracy |
| 2. | Aguirre, et al. (2013) | E | Empowerment | Empowerment Transformation | Empowerment |
| 3. | Alexander & Munk (2010) | P | Empowerment | | Empowerment |
| 4. | Amidon (2013) | T | Empowerment | Empowerment | Empowerment |
| 5. | Aslan Tutak, et al. (2011) | T | Empowerment Transformation Democracy | Empowerment Democracy | Empowerment Democracy |
| 6. | Atweh & Brady (2009) | T | Empowerment | Empowerment | Empowerment Transformation Democracy |
| 7. | Bartell (2013) | E | Empowerment Transformation | Empowerment Transformation | Empowerment Transformation |
| 8. | Bond & Chernoff (2015) | T | Empowerment Transformation Democracy | | |
| 9. | Boylan (2009) | E | Empowerment | Empowerment | Empowerment |
| 10. | Brelias (2015) | E | Democracy | Transformation | Empowerment Democracy |
| 11. | Colombo et al (2019) | P | Empowerment Transformation | Empowerment | |
| 12. | D'Ambrosio & D'Ambrosio (2013) | T | Empowerment Democracy | Empowerment Democracy | Empowerment |
| 13. | de Freitas (2008) | E | Empowerment | Empowerment | Empowerment |
| 14. | DeBay (20107) | E | Empowerment | Empowerment | Empowerment Transformation |

| | Citation | Type (E, T, P) | Problem Setting | Theoretical Framing | Results/ Implications |
|---|---|---|---|---|---|
| 15. | Esmonde (2014) | E | Empowerment Transformation | Empowerment | Empowerment |
| 16. | Felton-Koestler (2017) | E | | | Empowerment |
| 17. | Felton-Koestler (2019) | E | Transformation | | Empowerment Transformation |
| 18. | Garii & Appova (2013) | E | Empowerment | Empowerment Transformation | |
| 19. | Garii & Rule (2009) | E | Empowerment | Empowerment | |
| 20. | Gates & Jorgensen (2009) | T | | Empowerment Transformation | |
| 21. | Gregson (2013) | E | Transformation | Transformation | Empowerment Transformation |
| 22. | Gutierrez (2013) | T | Transformation | Empowerment Transformation | Empowerment Transformation |
| 23. | Gutstein (2013) | P | Transformation | Empowerment | |
| 24. | Gutstein (2016) | E | Empowerment | Empowerment Transformation | Empowerment Transformation |
| 25. | Harper (2019) | E | Transformation | Empowerment Transformation | Empowerment Transformation |
| 26. | Harrison (2015) | E | | Empowerment Transformation | Empowerment Transformation |
| 27. | Hendrickson (2015) | P | Empowerment | Empowerment | Empowerment |
| 28. | Hernandez et al. (2013) | E | | Empowerment Transformation | Empowerment Transformation |
| 29. | Hughes & Laura (2018) | T | | Transformation | Empowerment Transformation |
| 30. | Hung (2015) | P | Empowerment | Empowerment | Empowerment |
| 31. | Johnson (2011) | P | Empowerment | Empowerment | |

| | Citation | Type (E, T, P) | Problem Setting | Theoretical Framing | Results/ Implications |
|---|---|---|---|---|---|
| 32. | Jong & Jackson (2016) | E | Empowerment Transformation | Empowerment Transformation | Empowerment Transformation |
| 33. | Kokka (2015) | T | Empowerment | Empowerment Transformation | Empowerment Transformation |
| 34. | Kokka (2019) | E | Empowerment Transformation Democracy | Empowerment Transformation Democracy | Empowerment Transformation Democracy |
| 35. | Kokka (2020) | E | Empowerment Transformation | Empowerment Transformation | Empowerment Transformation |
| 36. | Larnell et al. (2016) | T | | Empowerment Transformation | Empowerment Transformation |
| 37. | Leonard et al. (2010) | T | Empowerment | Empowerment Transformation Democracy | Empowerment |
| 38. | Leonard & Moore (2014) | E | Empowerment Democracy | Empowerment Transformation Democracy | Empowerment Democracy |
| 39. | Lesser & Blake (2007) | T | Empowerment Transformation | Empowerment Transformation | Empowerment |
| 40. | McCoy (2008) | P | Empowerment Transformation | Empowerment | Empowerment |
| 41. | McGee & Hostetler (2014) | T | Empowerment | Empowerment Transformation Democracy | Empowerment Transformation |
| 42. | Nava et al. (2019) | E | Empowerment Democracy | Empowerment | Empowerment Democracy |
| 43. | Ndlovu (2011) | E | Empowerment Transformation Democracy | Empowerment Transformation | |
| 44. | Nicol et al. (2019) | E | Empowerment Transformation | Empowerment Transformation | Empowerment |
| 45. | Nolan (2009) | T | Empowerment | Empowerment Transformation Democracy | |

| | Citation | Type (E, T, P) | Problem Setting | Theoretical Framing | Results/ Implications |
|---|---|---|---|---|---|
| 46. | Panthi et al. (2018) | E | Empowerment | Empowerment | Empowerment |
| 47. | Penteado & Skovsmose (2009) | T | Empowerment Transformation | Empowerment | Empowerment |
| 48. | Planas & Civil (2009) | E | Empowerment | Empowerment | Empowerment |
| 49. | Povey (2002) | E | Empowerment Democracy | Empowerment | |
| 50. | Rands (2013) | T | Empowerment Transformation | Empowerment | Empowerment Transformation |
| 51. | Raygoza (2016) | E | Empowerment Transformation | Empowerment Transformation | Empowerment Transformation Democracy |
| 52. | Raygoza (2019) | T | Empowerment Transformation Democracy | Empowerment Transformation Democracy | |
| 53. | Raygoza (2020) | E | Empowerment Transformation | Empowerment Transformation | Empowerment Transformation |
| 54. | Reagan et al. (2011) | E | Empowerment | Empowerment Transformation Democracy | Empowerment |
| 55. | Register et al. (2020) | E | Empowerment Democracy | Empowerment | Empowerment Democracy |
| 56. | Simic-Muller (2015) | P | Empowerment Democracy | Empowerment | |
| 57. | Simic-Muller et al. (2015) | E | Empowerment Transformation Democracy | Empowerment Transformation | Empowerment Transformation |
| 58. | Skovsmose (2018) | T | Empowerment | Empowerment | |
| 59. | Stavrou & Miller (2017) | T | Empowerment Transformation | Empowerment Transformation | Empowerment Transformation |

| | Citation | Type (E, T, P) | Problem Setting | Theoretical Framing | Results/ Implications |
|---|---|---|---|---|---|
| 60. | Stinson et al. (2012) | T | Empowerment Transformation Democracy | Empowerment Democracy | |
| 61. | Stinson (2004) | T | Empowerment Transformation Democracy | Empowerment Transformation | Empowerment Transformation |
| 62. | Tanase & Lucey (2017) | E | Empowerment Transformation Democracy | Empowerment Transformation | Empowerment Transformation Democracy |
| 63. | Thanheiser & Sugimoto (2020) | E | Empowerment Transformation Democracy | Empowerment Transformation | Empowerment |
| 64. | Turhan Turkkan & Karakus (2018) | E | Empowerment Transformation Democracy | Empowerment Democracy | |
| 65. | Voss & Rickards (2016) | E | Empowerment | Empowerment Transformation | Empowerment Democracy |
| 66. | Warburton (2016) | E | | Empowerment Transformation | Transformation |
| 67. | Ward (2020) | P | Empowerment | Empowerment | |
| 68. | Wright (2017) | E | Empowerment | Empowerment | Empowerment |
| 69. | Yaro et al. (2020) | T | Transformation Democracy | Empowerment Transformation | Empowerment |
| 70. | Yolcu (2019) | E | Empowerment Transformation | Empowerment Transformation Democracy | |

## Appendix B: References of Reviewed Literature


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## Appendix C: Interview 1 Protocol

**Reference Key:**
(L) – question adapted from Louie (2015)
(G) – question adapted from Gregson (2012)
(K) - question adapted from Kokka (2018)
(MIST) – question adapted from MIST case study teacher interview protocol

**Domains Covered in Interview:**
Biographical
Commitment to Equity
Definition of Equity/SJ
Instruction
Resources
Goals & Intentions
Expectations
Community

**Biographical:**

1. How long have you been teaching secondary mathematics?
    a. Clarify necessary details from questionnaire responses - how long have you been teaching secondary mathematics at Sunshine? more detail on multiple positions held at Sunshine or multiple sites worked at…
    b. Is there anything else you need me to know about your work history/timeline?
2. Can you talk about how you ended up teaching (working at) at Sunshine?
    a. Why did you stay?
    b. If applicable, what brought you back after your break?
3. How do you feel about your decision to join Sunshine? (G)
    a. What was your intention in joining Sunshine?
        i. Probe for connection to place, community, school, students; philosophy of education and goals; reasons for content/grade level
        ii. Why this job/program instead of others if there were options?
    b. Has that intention changed at all? If so, how?
        i. Why?

**Commitment to Equity/SJ:**

4. How would you describe your educational journey thus far? (K)
    a. Probe on general trajectory zooming out, relationship with math, wanting to be a math teacher (why?)
    b. How do you see those experiences related to your current interest in equity/social justice work?
5. How did you get into equity/social justice work? (K)
    a. What factors influenced this journey? [Probe on the general trajectory, relationship with math, wanting to be a math teacher, etc.; social awareness and attention to systems outside of education?]
    b. What has impacted your continued work towards equity and social justice?
    c. *(If a participant mentions non-teaching related work)* How does this connect to your work within the classroom?

If the interviewee talks about the structure of discourse (who's talking to whom and when) probe on content (and vice versa). If the interviewee says, "Teachers (or students) should be asking questions," probe to find out the kinds of questions the teacher (or students) should ask and for what purpose, as well as whether they conceive of discussion as happening in whole-class settings and/or in small groups alone. (Probes from MIST tool)

**Definitions of Equity/SJ:**

6. In your written response, you defined equity as [insert participant response] Can you tell me more about what you mean by _____?
    a. What is [fill in the blank with construct]?
    b. Why is it important?

c. Can you tell me what you mean by giving students permission?

d. Repeat for [fill in the blank with construct]

7. In your written response, you defined social justice as [insert participant response]. Can you tell me more about what you mean by _____?

    a. What is [fill in the blank with construct]?

    b. Why is it important?

    c. What sort of social issues are you thinking about here? An example of a social question?

    d. Repeat for [fill in the blank with construct]

8. It sounds as if you think social justice and equity are a little different because social justice takes on those social issues and connects them to math. Is that correct? Can you expand on this? *(Only ask if it is not clear from the questionnaire and responses to 6/7)* Do you differentiate between equity and social justice?

    a. Are these the same or different for you? Why or why not?

    b. Can you describe an example of equity in math education that is not an example of social justice in mathematics education?

**Instruction:**

9. In your written response, you described a typical day in your Sunshine classroom. Could you tell me more about what you mean by _____?

    a. What is [fill in the blank with construct]?

    b. Why is it important?

    c. Do you feel you need to adjust your instruction for different groups/classes? (MIST)

i. If not, why not?

ii. If so, for which classes?

iii. Why do you find you have to adjust your instruction?

1. You mention that you see different groups of students engaged and motivated or not?

a. What do you think forms these groupings?

b. Why do you think students are or aren't engaged?

iv. How do you adjust your instruction?

1. How about with pacing?

2. Do you use different tasks? (Please ask for examples).

3. Do you group students? If so, how?

4. Other ways?

10. In your written response, you described the characteristics of equitable math instruction you would look for in observing another teacher's Sunshine classroom. Could you tell me more about _____?

a. What is [fill in the blank with construct]? What does that look like? What should teachers be doing, in your mind, to _____?

b. Why is it important?

c. Who is accountable, and to whom in the classroom?

11. How do you see your teaching in relation to this description of equitable math instruction?

a. What similarities are there?

b. What differences are there?

**Resources:**

12. As you think about a regular day in your Sunshine classroom, what resources do you typically use?
    a. Curriculum?
    b. Participation structures?
    c. Mathematical tools?
    d. Non-mathematical tools?
13. For each of the above-mentioned resources, how do you decide what resources to use?
    a. How do these resources impact your teaching? What do they help you do?

**Goals and Intentions:**

14. How would you describe your goals as a Sunshine teacher? At the end of the day, what makes you feel, or would make you feel, like you've been successful? (L)
15. What are your goals for equitable and just mathematics teaching? (K)

**Expectations:**

16. What are your expectations for student learning at Sunshine?
    a. In the classroom? Outside of the classroom?
17. What evidence is used to see if you meet these goals at Sunshine?
    a. On a daily basis? Over the course of the program?
    b. Why do you have these goals? Why do you think these expectations are important for you? For your students?

**Community:**

18. Can you describe the relationships you have with students? With students' families?

   a. How do these relationships impact your role at Sunshine?
   b. Your teaching practice?

19. Can you describe the relationships you have with your colleagues? Other teachers? Site directors? Central Office team members?
   a. How do these relationships impact your role at Sunshine?
   b. Your teaching?
20. Are there any experiences or people who you would point to as being especially important in your development as a math teacher (and a math teacher committed to equity/SJ)? (L)
   a. Who? How did they impact you?
21. Where do you go to talk about your teaching practice? Equity? Do you have a chance to engage in the issues, discussions, trends that circulate in the mathematics education community? (G)
   a. Who are the people you communicate with?
   b. When do you do this work?
   c. What do these conversations help you do or think about?
22. Is there anything else you'd like to add that I didn't ask you about or that we didn't get to talk about?

## References

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## Appendix D: Interview 2 Protocol

**Reference Key:**

(L) – question adapted from Louie (2015)
(G) – question adapted from Gregson (2012)
(K) - question adapted from Kokka (2018)
(MIST) – question adapted from MIST case study teacher interview protocol

**Domains Covered in Interview:**

Biographical
Commitment to Equity
Definition of Equity/SJ
Instruction
    Resources
    Goals & Intentions
    Expectations
    Community

**Biographical/Commitment to Equity/SJ:**

*Clarifications from Interviews 1 or 2.* Can you say more about…

**Definitions of Equity/SJ:**

1. Sunshine described the program's work toward equity and social justice as [omitted for anonymity] How do you see your site/team taking up this description?
    a. how does this description fit among your organization?
2. Is there other language or terminology that you would use to describe your teaching/Sunshine instead of equity or justice-focused?

**Connecting Definitions to Practice:**

[Play Clip 1 all the way through for participants. https://www.nctm.org/Conferences-and-Professional-Development/Principles-to-Actions-Toolkit/The-Case-of-Shalunda-Shackelford-and-the-Bike-and-Truck-Task/ ]

**Analyzing Video Clip:**

3. Describe what you noticed about the instruction in the video you just watched.

i. *Probe around specific language or ideas that are raised*. Can you tell me more about _____? What do you mean when you say _____?

ii. Why is that interesting to you?

3. Would this be a sort of classroom interaction you would see at Sunshine/your site?

    i. What similarities are there? How does this fit? Why?

    ii. What differences do you notice? How does it not fit? Why?

Resources:

4. In the video, the teacher used/mentioned [resource from video] in their classroom instruction. [*Or bring something back up that teachers have mentioned in response to prompt 5.*] Do you use a similar resource at your site/in your team? How would you use this resource in your work at your site/in your team?

    i. What would using this resource help you do?

    ii. What might using this resource make more challenging?

    iii. How would you decide when and how to use it at your site/in your team?

    b. Would you have wanted the teacher in the video to use any other resources/tools in their teaching?

        i. How would you have wanted those resources used?

        ii. Why would you want the teacher to use that resource (instead or in addition)?

Adjustments and Alignments:

5. How would you change the instruction in the video to make it more in line with your site's/Sunshine's vision of equity/justice in mathematics education?

    a. How would you know that those changes are making things more equitable/just?

6. To what extent do others at your site or in the program (math teachers, academic coaches/support staff, site directors, central office team members) differ in their view of equitable math instruction from what you just described? (MIST)
    a. How do you know?
7. How would you support a teacher new to Sunshine to do this type of instruction? [Prog Staff Q]
    a. What would be your first priority to support them in integrating into their work?

Expectations:

Questions 8 – 11 involved reading specific values for Sunshine Summer Program to participants from the program website and asking the educators to provide examples of the described features. Question details are omitted to protect anonymity of the program and city.

Aims & Motives:

12. What do you think the aim of Sunshine is, as a program? In terms of mathematics teaching and learning?
    a. What is the intended outcome for students?
    b. For teachers?
13. How does this aim impact your teaching over the summer?
    a. How does it support you in achieving your goals?
    b. How does it make your goals more challenging to achieve?
    c. Why?
14. What do you think the future of Sunshine is, as a program? In terms of mathematics teaching and learning? What is next?

a. For students?
    i. Why?
b. For teachers?
    i. Why?

Community:

15. With whom at Sunshine (who you have not already mentioned) do you engage with around ideas of equity? Equitable mathematics teaching?
    a. How do these conversations impact your teaching?
16. What supports are at Sunshine to help you engage with ideas of equity? Equitable mathematics teaching?
    a. Professional learning opportunities? Norms for engaging with other staff?
    b. How do those supports help you think about equity and equitable mathematics teaching?
17. Are there things at Sunshine that you feel like make it challenging to engage with ideas of equity?
    a. How do these things make it challenging for you to think about/move towards equity and equitable mathematics teaching?
18. Are there supports outside of the Sunshine program that you draw upon to think about equity? Equitable mathematics teaching?
    a. What are they?
    b. How do these supports impact your teaching?
    c. Why do you need these supports outside of Sunshine?

19. Is there anything else you'd like to add that I didn't ask you about or that we didn't get to talk about?

## References

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