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Justice and the Mathematics Classroom: Realizing the Goals of the AMTE Standards for Preparing Teachers of Mathematics

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Realizing the Goals of the AMTE Standards for Preparing Teachers of Mathematics

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Abstract

This chapter is an introduction to justice in the post-secondary context of mathematics courses for prospective teachers. The chapter is a research-to-practice report (i.e., it describes an aspect of instruction and discusses how it is informed by, connects to, or is illustrative of findings from research). While the reader might be any type of mathematics teacher educator, the focus here is supporting those who teach mathematics content courses for elementary school teacher candidates. In addition to having an effect on discipline-specific knowledge, college mathematics classes contribute to the ways candidates communicate in/with/through mathematics in working with children. The chapter includes discussion of the keys of mathematical literacy: mathematics *for* and *of* justice and examples of what the ideas look like in practice. The examples include information from research and a reference case presented as the accumulation of experiences for Kara Thomas and Dr. Rhodes. The case is a means for exemplifying issues such as equity, agency, and identity in the mathematics classroom.

> Mathematical literacy is a civil right…the idea of citizenship now requires not only literacy in reading and writing but literacy in math and science. (Moses, 2001, p. 11)

> It is impossible to struggle for civil rights, equal rights for blacks, without including whites. Because equal rights, fair play, justice, are all like the air: we all have it, or none of us has it. (Angelou, 1990)

> The function of education, therefore, is to teach one to think intensively and to think critically. But education which stops with efficiency may prove the greatest menace to society. (King, 1947)

Put simply, teaching for justice means instruction that is "lively, accessible, and personally meaningful for students" (Gutstein & Peterson, 2013, p. 1). This is true for learners across the grades, up to and including university. The driving question then, is: How do people with advanced degrees in mathematics contribute to the preparation of prospective school teachers so that children will learn to be mathematically literate citizens?

> There is nothing in the training of mathematicians that prepares them to lead such a literacy effort. Yet the literacy effort really cannot succeed unless it enlists the active participation of some critical mass of the mathematical community. The question of how we all learn to work across several arenas is unsolved. Those arenas are large and complicated. (Moses, 2001, p. 16)

Starting from the foundation that systems of meaning (discourses) infuse the work in every arena of teaching, the chapter:

(1) explores teaching mathematics for justice through the educational journeys of an elementary teacher candidate and a university mathematics faculty member.

(2) unpacks the phrases "mathematics *for justice*" and "mathematics *of social justice*,"

(3) provides guidance for teaching mathematics for justice,

(4) offers readers some suggestions for next steps in professional learning.

When mathematics is lively, accessible, and connected to meaningful contexts, learners develop positive mathematics identity and sense of mathematical agency (see Table 1, Aguirre, Mayfield-Ingram, & Martin, 2013). This chapter highlights specific instructor/teacher actions

that impact teacher candidates' conceptions of mathematics and of themselves as learners. We use Kara's educational journey from middle school through teacher preparation to illustrate these ideas. The case story for Kara is an intentional combination of multiple research studies and experiences of the authors to illuminate mathematics for and of justice (Hauk, 2019; Jackson, 2022; Strutchens, 1993; White et al., 2016).

To begin, read the first excerpt from the case of Kara and reflect on how the story demonstrates just (and unjust) mathematics teaching.

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Kara Thomas in Middle School – Grade 6

Dr. Brown met Kara Thomas while conducting a research study among students in the middle grades (grade 6, 7, and 8). Kara was in the gifted program at school. Kara said she liked reading and "really liked mathematics." When asked how she would rate herself as a mathematics student, Kara said "9, because like mathematics comes pretty easy to me." Kara attributed her success to a natural ability to do mathematics and to her mother and grandmother -- both were very supportive and encouraging about Kara's mathematical ability. Kara did well in elementary school. She swiftly memorized and recalled many mathematics facts and skills. However, Kara did not have opportunities to apply these facts and skills in new or unique situations. Though Kara said she believed mathematics was "useful in the real world," when asked for examples, the only illustrations that came to mind for her were of using mathematics at a grocery store.

When Kara entered middle school, she was placed in an accelerated pre-algebra class for sixth graders. Kara struggled to make her usual As and Bs in the class. By the end of the first quarter, her grade was a high C. Kara's view of mathematics and herself as a doer of mathematics was challenged. She had never before had to articulate her thinking or "make an
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argument to explain an answer" in mathematics. She saw her high C as a bad grade. Kara wanted to withdraw from the class and convinced her mother to have her moved to a different sixth grade mathematics class. Kara's mother agreed to withdraw Kara from the accelerated class because she wanted Kara to continue liking mathematics. The new class was using a grade 7 textbook and her mother felt Kara was still ahead of grade level.

In her new class, Kara was quiet and completed tasks. She did not have a particular group of students that she liked to sit with in class and negative peer pressure did not seem to be a problem for Kara. Kara was doing well in the class without studying. She usually did her homework during class time. Kara said that she hardly ever studied at home and that she did not really have to pay attention to understand what was going on in the class. In fact, an avid reader, she often read or worked on writing assignments in her mathematics class. During one interview, Dr. Brown asked Kara about how often she asked questions in class:

Kara: Never.
Dr. Brown: Never, okay. Why do you not ask questions?
Kara: Most of the time I understand what we are doing.

Kara's comments were confirmed by her teacher. He said, "She doesn't interrupt and ask questions. That's because she usually understands already." This teacher was the same teacher Kara had for the pre-algebra class from which she had withdrawn. In fact, the teacher said, "there may have been a gap that Kara needed filling to survive the pre-algebra class, it's better that she moved down to a more appropriate class." When Dr. Brown asked Kara if her teacher encouraged her to do higher level mathematics, she replied:

Kara: Yes, he had me studying pre-algebra in the first quarter.
Dr. Brown: Okay, and then what happened?
Kara: I quit.
Dr. Brown: Why?
Kara: Because it was too hard. I was making bad grades.

~~~~~~~~~~~~~~~~~~~~ END BOX 1 ~~~~~~
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There are several things to notice in this glimpse into Kara's middle school mathematics learning. First, Kara was identified early as a gifted student yet her experiences with mathematics had promoted the views that (a) mathematics is algorithmic where memorizing procedures is the key to success, (b) high grades are the measure of success (e.g., not sense-making or a feeling of understanding), and (c) struggling when mathematics is "hard" is a reason to quit. Second, consider Kara's teacher, for whom silence was evidence of competence. Kara *not* asking questions (which would "interrupt" class) was evidence for the teacher that Kara understood mathematics and an indication of Kara being in an "appropriate" class. Kara enjoyed reading and writing, but had few opportunities to learn how to communicate with and about mathematics beyond drill and recall.

There was a miscarriage of justice for Kara: she was not challenged to meet high expectations nor supported to reach them. The teachers were complicit in it. Her caregivers were complicit in it. Kara did not have the opportunity to learn mathematics in a way that would allow her to see it as a tool to use to read the world, to see mathematics as more than something that one memorizes in order to do well in school (Gutstein, 2006a). The injustice of low expectations was demanded by, and built upon, conflicting status quo mandates such as "mathematics is supposed to be hard" and "good teaching should make students like and be comfortable with mathematics." Whether or not a student is gifted, worthwhile learning -- knowledge growth that is flexible, extensible, persistent -- involves struggle. It includes missteps and stumbles to generate complex cognitive and socio-emotional connections among existing mental structures.

Dr. Brown's particular research arena was factors impacting sixth grade African American students' mathematics performance. As a reader, this statement may influence the interpretation of the previous pages. Pause for a moment and ask yourself why this might be the

case. While the details of Kara's story are unique to Kara, the school environment she experienced as well as the caregiver decisions and the teacher perspectives that shaped her early opportunities to learn occur in various combinations for many students across the United States (Abedi & Herman, 2010; Carter & Welner, 2013).

As noted in the *Standards for Preparing Teachers of Mathematics* (Association of Mathematics Teacher Educators [AMTE], 2017), it is essential to prepare teachers to support children in building skills for learning, for handling frustration and engaging in productive interactions with other people while making sense of mathematical ideas. We began with Kara's middle school experience as a way to bring up the question: What does justice look like in mathematics classrooms? Addressing that question is the foundation for understanding the need for attention to justice in mathematics content courses for future school teachers.

What is Justice in the Context of a Mathematics Classroom?

Equity is a significant component of justice (although certainly not the only one). For the authors, equity is a verb and not a noun. Justice and equity work together to form a kind of calculus of accumulating moments with and among people, curricula, and policies, in the pursuit of liberation. A joint position statement by TODOS: Mathematics for All and the National Council of Supervisors of Mathematics (2016), describes justice in mathematics learning in K-12 and the importance of acknowledging, acting, and being accountable for next steps in seeking a just mathematics education for learners. Based on this position statement, and related research (e.g., Aguirre, Turner, et al., 2013, Gutstein & Peterson, 2013; Celedón-Pattichis, et al., 2018), Table 1 offers examples of components in a just mathematics classroom, along with a brief description of each. As you review the list, reflect on Kara's pre-algebra experience and the extent to which these components were a part of her mathematics learning.

[Table 1 goes here]

In the pre-algebra class, Kara had encountered for the first time an expectation that she justify her reasoning out loud and in writing. She had not had an opportunity to learn to do so in her previous schooling. Nonetheless, the school, program, and teacher all expected the gifted Kara to be skillful at it. She experienced the demands of status quo authority that include high status accorded to individual work, that student work can (or should be) perfect (and fast), that there is one right way (and a right to comfort in getting there), and that to make a mistake is to be a mistake (Okun, 2021). There was no scaffold planned into the pre-algebra class that included initiating and rapidly developing proficiency in mathematical discourse. Kara's only apparent option was to withdraw.

How are Teaching Mathematics *for* Justice and Teaching Mathematics *of* Social Justice Different?

Larnell, Bullock, and Jett (2016) discussed two paradigms in the teaching and learning of mathematics with a social justice lens. One paradigm is based in Freire (1970/1993): mathematics is a tool to critically investigate, critique, and address social/societal issues. The other is based in Moses (1994): mathematical teaching and learning are the foundation for participation in, and transformation of, the majority society status quo. The Freirean perspective looks at the mathematics *of social justice* while Moses' is concerned with mathematics for social justice, and more broadly, *for justice* in many arenas (political, economic, environmental; Moses, 2001). Thus, the distinction between "of social justice" and "for justice" is an important nuance in communicating about meaning. Natural questions arise: What are the mathematical content and pedagogical foci in a just and effective learning experience? What does it mean to teach the mathematics of social justice?

The answers have significant implications for instructional practice. As noted previously, the focus of this chapter is the first question and what is already known about good teaching that is also just (e.g., Table 1). For the second question, college instructors (like many teacher candidates) may confound the mathematics of social justice with mathematics for justice. Research- and practice-based evidence points to the importance of scaffolds for teachers at all levels who seek to include highly charged events of the day in teaching the application of mathematics to questions of social justice (Downing & Black, 2020, Gewertz, 2020).

Mathematics for and of social justice is not only possible, it is realized daily in some classrooms. The nature of that realization has been described in several ways, including through a contrast between social justice goals and mathematics goals (Gutstein, 2006a; see Figure 1).

[Figure 1 goes here]

For instance, in reading the world with mathematics, context matters. How would a problem given to first graders asking them to count the number of feet in a collection of animals interact with the funds of knowledge brought to the classroom by children in urban versus rural contexts? To cast the problem in terms of cows and chickens for rural students could be appropriate, but many children who have grown up in a city may have everyday experiences of other animals. If the problem is changed to count the number of legs of the dogs and pigeons on a particular street, then the urban children can relate but the rural children may not have seen a pigeon before. Consideration of reading the world with mathematics such as this is available in the book *What Is It About Me You Can't Teach? Culturally Responsive Instruction in Deeper Learning Classrooms* (Rodriguez, Bellanca, & Esparza, 2016).

Indeed, the mathematics of social justice can be taught in unjust ways. Counter to the belief among some in the mathematics education community, teaching the mathematics of social

justice does not guarantee, de facto, the humanizing of students or instructional responsiveness to the people in the room. Teaching mathematics for justice demands responsiveness by its very definition, as the transformation of the status quo requires decentering the instructor as authority (i.e., defies the status quo). In increasing complexity and weight towards social justice, teaching mathematics of social justice, taught for justice, includes goals that (Gutstein, 2006b, 2012):

1. Engage students in critical mathematics through a pedagogy of questioning.
2. Facilitate student's development of mathematical power (as defined by NCTM (2000).
3. Use problems that motivate students to study and use mathematics.
4. Cultivate students' development of a sense of agency.
5. Incorporate students' life experiences directly into the curriculum.
6. See and encourage students to see mathematics in life daily.
7. Help students to develop sociopolitical consciousness.

One example of the outcomes of such instruction that is both for justice and of social justice is the following report from a 9th grade student (Gutstein & Peterson, 2013)

> I thought math was just a subject they implanted on us just because they felt like it, but now I realize that you could use math to defend your rights and realize the injustices around you. Now I think math is truly necessary and, I have to admit, kinda cool. It's sort of like a pass you could use to try to make the world a better place. (p. 1).

Kara's report on her continued learning of mathematics in high school was not aligned with either teaching mathematics for or of justice. All the same, it influenced her understanding of the content and what it means to do mathematics.

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Kara Thomas in High School

Through the rest of middle school and her first three years of high school, Kara continued to learn mathematics by memorizing algorithms and formulas, focusing on which procedure to use
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to solve particular types of word problems "I know that when I see 'times more' you have to multiply and for `less than' you have to take away." She used mnemonic devices without understanding where they broke down or the underlying concepts. For example, she quickly used "the FOIL trick" (first-outer-inner-last) to find the product of two binomials

$$(x + 1)(x + 2) = x^2 + 2x + x + 2 = x^2 + 3x + 2$$

but did not connect the "trick" with the distributive property. In her senior year of high school, Kara took a course for Advanced Placement Statistics. Here is what she had to say about this experience:

Kara: Our "textbook" for the class was a packet of problems for each section that we worked on in class. This teacher's teaching style was for us to come to class with the packet and work on the problems with other students in the classroom. He asked us questions about the problems and asked us what we thought about how to solve the problems. When we asked a question, he asked us things like "what do you think" and "what do you know about this topic." There were no other textbooks and he did not lecture or show us things to help us with the concepts. He just said to ask our peers for help or told us to think about our thinking. This resulted in learning a lot of the math completely on my own with the help of some YouTube videos and my peers who were just as lost as I was. I think learning from peers and listening to their strategies are important when learning math, but because no one was taught the information, this interaction with my peers was not very useful.

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Kara's reflection on her AP Stats experience is in alignment with how she had been acculturated into learning mathematics throughout her K-12 education. Kara was successful in high school most of the time because she could memorize what she needed for tests. As in sixth
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grade, Kara's high school AP Stats experience was a rare disruption to the way she had always succeeded in doing mathematics. Unlike sixth grade, she stayed in the course. For Kara, the experience of AP Stats was not positive because the teacher relied heavily on students' reasoning and making sense of mathematics and expected them to *already* be effective at communicating about it with each other. Like grade 6, the experience Kara reported did not include support from the teacher for how to succeed in meeting the mathematics discourse expectations.

In high school, Kara loved her English classes and felt successful in most of the mathematics and science classes she took. She also liked working with the young children at her church. For college, Kara decided to pursue becoming an elementary school teacher.

Why Justice in Content Courses for Preservice Teachers?

Teaching mathematics for justice is actually an expectation in standards and related accreditation requirements in teacher education. National policy documents include touchstone standards about the contexts of mathematics teaching and learning (see Figure 2).

[Figure 2 goes here]

Recent major standards documents, like those cited, have attended to justice more so than previous standards. In U.S. education, and more broadly, the last decade has seen increasing awareness that mathematics curriculum and instruction, from kindergarten through graduate school, have been shaped by and perpetuate economic-, linguistic-, and race-based systemic inequities (NCTM, 2020; Sensoy & DiAngelo, 2017). Concurrently, education at all levels is moving towards an orientation that is both responsive and sustaining to the variety of learner cultures and funds of knowledge (Gay, 2018; González, Moll, & Amanti, 2005; Ladson-Billings, 1995; Paris, 2012; Turner et al., 2019). For the expectations in Figure 1 to become reality in teacher preparation, justice must be addressed in both methods and mathematics courses. It is

impractical to expect to achieve the standards if teacher candidates have never seen such practices implemented in their own mathematical learning experiences. The content courses for prospective teachers provide a natural setting in which to model just mathematics classrooms.

An additional reason to attend to justice is that the way in which students learn content can reflect the norms of the discipline itself without being constrained by them. Mathematicians do not replicate memorized procedures. Mathematicians do not stay silent when they understand an idea. And, as Danny Martin has noted (2012):

> Despite the tensions, I am convinced that a focus on mathematics content knowledge alone is not in the best interest of the students or of the children they will teach. "We'll focus on the math, you'll get that other stuff in education" is insufficient. Such a compartmentalized approach to educating and developing elementary school teachers whose responsibility it will be to educate the whole child seems contradictory. Moreover, there exist very few examples of highly skilled, human services, professional work where knowledge of those who are served and the knowledge needed to serve them are artificially separated. To the degree that math departments perpetuate such separation, they reinforce that teaching mathematics to children is mostly about teaching mathematics and less about teaching children. (p. 19)

Recall Gutstein and Peterson's (2013) description of mathematics for justice involves rethinking teaching to "make mathematics more lively, accessible, and personally meaningful for students" (p. 1). Transitioning from having quiet students do what is shown to them to a lively classroom engaging students in accessible and challenging content is a process. It begins with a commitment and grows through cycles of change as an instructor learns from how lessons play out. To illustrate the professional learning process for a mathematics teacher educator, we turn to the experiences of Kara when she was a college student in Dr. Rhodes Geometry for Teachers course. A PhD mathematician, Rhodes had taught mathematics content courses for prospective teachers for about 10 years before Kara enrolled in his course.

Dr. Rhodes' story offers insights for those who might be new to thinking about justice in their own classrooms. His journey demonstrates how learning to teach for justice is a process,

with pitfalls and joys along the way. It also shows how instructors can use regular reflection about their own practice to grow as a just teacher educator.

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Dr. Rhodes: Start by decentering

When asked about his early days in teaching future elementary school teachers, Dr. Rhodes reflected on developing his "decentering" of himself:

Dr. Rhodes: I have, over the years, changed how I see student questions like: "when am I ever going to use this?" and "is this mandatory" or "is this going to be on the test?" Years ago, I was annoyed and then insulted by such questions. They seemed confrontational to me. I saw myself and my discipline as US and students as THEM. Then, I shifted to a perspective that meant my job was to enculturate students -- get them to see and value the academic way, to find commonality in what they valued and what the academy or the department or, well mathematicians (US) valued and leverage that. I listened for universals in the questions about "when am I ever going to use this" and "is it on the test" and then I said yes (or no) it was on the test or that I wasn't sure when they were going to use it, but that the point of mathematics learning was to give them tools they could reach for when needed and I could not predict precisely which tool they would need. After all, they were all attending college, there was a common goal there, in the "success in college" realm, to acquire tools for later success.

Then, some time and experiences happened and I started paying attention to more subtle similarities and differences in the questions, restating the questions a bit and asking for confirmation or refinement from students. I accepted the fact that there were some commonalities, but that my tool box analogy might not be enough.

At some point, I decided that the next time I got the "Is this on the test?" question, I
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would say "Thank you for asking! I am wondering about what the answer means *for you*. I really am wondering. Everyone, take out a piece of paper, don't put your name on it. Please think for a moment and write a bit about what it means if I say "yes, this is on the test", what does that mean for you? What are the consequences for your next actions, decisions, thoughts, feelings? That's number one. Number two, If I say "no", what does that mean for you?"

Well, of course, someone asked. I did what I planned and I collected the answers. I don't know if other people's students will say the kinds of things mine did, but they were certainly interesting. Some said "yes" would help them decide what to study, because they had limited time for studying, prioritizing what was useful, and that I (the instructor) was the expert and they wanted expert advice on how to prioritize. Some said a "no" would help them know how stressed to feel about what was about to happen regarding the topic. This is all to say, when I stopped minimizing differences and started unpacking the details, I learned about student experiences in ways that felt useful to me. Notice, I had to PLAN for that moment, ahead of time. Many times, I have left a classroom and three hours later, go: Oh, now I know what I should have said!

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What Does Mathematics for Justice Look like in a Course for Future Teachers?

Whoever the learner is, learning includes work to create, connect, and revise old and new knowing, thinking, and interacting with mathematics. To do so requires opportunities to learn. Offering opportunities to learn that are *seen by the learner* as opportunities is part of justice. Thus, the first part of Kara's story, up through high school, has immediate parallels in post-secondary settings. When prospective teachers reach college and begin their mathematics coursework, what are the expectations regarding what they already know and will gain in
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knowledge? What are the scaffolds and associated opportunities to learn in the courses for prospective teachers to support meeting those expectations?

As many have noted, the social, cultural, and anthropological aspects of teaching are frequently ignored in content courses (see, e.g., Jett, 2013; Ramirez and McCollough, 2012). Mathematics is often treated as devoid of the human experience and condition, which does more than simply ignore the individual mathematical identities of students, it steals them (Jett, 2013).

For Dr. Rhodes it was important to encourage and make explicit the self-perceptions of the prospective teachers he taught. Course activities were created to support future teachers to develop a deep understanding of mathematics through problem solving, making and testing conjectures, and pausing to unpack and discuss how to identify and talk about the exploration of mathematical ideas they and others had. Anticipating that students might enter with a belief that mathematics was about getting right answers, fast, the course was designed to support students in challenging that belief. During the first few weeks of the course, Kara hit some roadblocks like she had experienced in the AP Stats course. But, as the semester progressed, Kara began to assert herself and her abilities through in-class talk and written assignments. Kara's experience in the Geometry for Teachers course would be transformative for her because Dr. Rhodes had already begun his own professional transformation.

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Kara: "I want to figure it out for myself!"

Students work in groups at tables. Each group has a course packet (on paper), blank paper, and a set of AngLegs (plastic pieces that snap together to form two dimensional geometric shapes) to construct different right triangles (see Appendix A for the course packet task)

Each group builds squares on each side of the triangles in the task and then records the
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area of each square in a table provided in their course packets. Several students notice that the area of the square on the hypotenuse is the sum of the areas of the squares on each of the legs. Three people, each in a different group, say out loud some version of: "Oh, that's where $c^2 = a^2 + b^2$ comes from! They never told us that before."

As Dr. Rhodes is talking with a group near the board at the front of the room about their ideas, he turns to draw a triangle on the board and discovers that all of the markers for the whiteboard are dry. Dr. Rhodes leaves the room to get more markers. When he returns five minutes later, Riley explains that the whole class had started discussing whether or not the Pythagorean Theorem was true for triangles that are **not** right triangles. Before Dr. Rhodes has a chance to respond, Kara says, "No, no, no! Don't ask him, I want to figure it out for myself!" Dr. Rhodes asks the class to explore this question and see what they discover.

About ten minutes later, Dr. Rhodes asks the class to stop exploring so they can discuss. He begins with Kara. She tells the other students that "it's not true--it doesn't work for other triangles." Dr. Rhodes asks her how she knows that it's not true, and she responds that she created other triangles that were not right triangles and then computed the areas of the squares on each side. When she added the areas, they were not the same as the area of the square on the longest side. Dr. Rhodes then asks Kara if she found any patterns or relationships among the triangles she tried. For example, did acute, right, or obtuse have squares with larger areas on certain sides? Kara replies that she had not really paid any attention to that aspect so she could not say. Dr. Rhodes then asks the groups to pay attention to acute and obtuse triangles to compare c^2 with $a^2 + b^2$ in each of these cases (see Appendix B).

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Where is justice in this classroom vignette?
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(1) Mathematical Content: Notice that the preservice elementary teachers are engaging in content at a deep and meaningful conceptual level. Yes, they are struggling. One knows that the struggle is productive because students ask questions and connect ideas "Oh, that's where…"

(2) Challenge of Cognitive Demand: It is apparent that students are in an environment that supports them in building their own mathematical identities and a sense of agency: Kara clearly believes that she has the ability and the necessary tools to answer the question at hand and that she can be efficacious at finding a solution, in communicating with classmates about it, and will be supported to do so in this particular class.

(3) Mathematical Identity and Agency: It is the teacher candidates who initially propose the question about other triangles and they who choose to explore different cases with the AngLegs.

(4) Equitable Access to Ideas: The vignette demonstrates some signs of what is sometimes termed in the literature as *equity of voice*, different students voicing their ideas, questions, and reasoning.

(5) Formative Assessment: The prospective teachers engage in self-assessment during this segment as they try to make sense of what they already know, test the bounds of what they already know, and then consider how to apply what they know to other contexts.

The five categories noticed above come from the Teaching for Robust Understanding (TRU) framework (Schoenfeld et al., 2016). The framework is a minimal set for noticing and weighing justice in instructional decisions. Also present in the snippet from Kara's college experience are some of Dr. Rhodes early efforts at:

(6) Responsive Instruction: The teacher adapts instruction to support mathematical thinking, having students explore a question that emerges in the classroom (rather than ignoring the question or asserting an answer).

After ten years, Dr. Rhodes was reflective and beginning to be responsive in his teaching. This was part of a professional process for him.

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Dr. Rhodes: Process rather than destination

In my earlier teaching career, the mathematical tasks I used or designed to engage future teachers did not have a rich and textured context, did not include school children's cognitions and experience. And they did not have specific connection to school curriculum or standards or teacher preparation standards (like the MET II, which I read later, and the AMTE standards). When I had learned more from AMTE and was using tasks with rich and textured context, I found the tasks might overwhelm preservice teachers. Most of my future teachers saw good teaching as being the reduction of complexities of mathematics. They appreciated using mnemonics (e.g., PEMDAS and "the alligator eats the bigger number") for their own math learning. I rarely heard things like, "I want to figure it out for myself!" I think my future teachers had a hard time distinguishing between themselves as mathematics learners and themselves as professionals learning mathematics to teach it to children. When I started getting specific about switching between their role as learners and as teachers by linking the perspective shift with watching videos of CHILDREN learning, then things started to change.

For a teacher candidate to go through several mathematics content and methods courses and not be able to distinguish between their own lens of mathematical thoughts as adults and the lens of a child learning the material for the first time demonstrates a failure by the system. Part of our job is to help the teacher candidate move away from self-focus, to attend to noticing and being responsive to differences and similarities across (young) people. Basically, this is the same thing I was talking about in what I had to learn to notice and respond to when students asked the
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"is this on the test" questions.

My own lessons learned from this are that teacher candidates need opportunities to interact with people (especially children) who are different from them. Different from who they are now and from who they were as children. That "interaction" can be real or virtual (e.g., through video). They should be able to see classrooms full of children like the 6th grade classrooms I visited a few years ago, where every child was excited to do mathematics and was willing to share their ideas with each other, even when they knew their solutions were not correct. It would be a major step in helping the teacher candidates see teachers in such classrooms, in action. Now, I bombard my prospective teachers with evidence that the vision AMTE has set forth is possible in K-12 classrooms. Teacher education -- as a field -- struggles with how to do this effectively. This struggle serves to show that helping teacher candidates to construct and use a mathematical knowledge for teaching that is equitable is a continuing *process* rather than a *destination* that we arrive at with each of the candidates.

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The final vignette provides a pair of snapshots of Kara's experience in Geometry for Teachers. One of the first assignments for Kara was to write about her future classroom. One of the last assignments was to repeat the task and then compare her initial and end-of-semester thoughts to her own initial responses and reflect on what might have happened during the course to have changed her perspective or reinforced her initial views and beliefs.

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Kara's Vision of her Future Teacher Self

Initial

In my ideal classroom, I, the teacher, am teaching the meaning of place values. I am

asking my 2nd grade students what each place value is. The students are attempting to understand the newly taught material. Within learning about place value the students are absorbing the material through different color-coded blocks. Each color represents a different place value. A central theme would be to keep trying and to keep growing in patience, which both students and the teacher need.

End-of-Semester

As the teacher, I am encouraging students to think critically without DIRECTLY telling them. The students are using the knowledge they have retained to create problems and answer solutions. The students are learning to work with manipulatives and the MANY possibilities they can conjure to better understand something that they don't know or struggle on. A central theme could be critical thinking for both students and teachers, because as teachers we try our best to allow our students the opportunity to think without telling them exactly what to do. Show guidance. The students are also learning how to explain the knowledge they have and how they get from one point to another: the why is important.

Comparison

Personally, I think [what changed is] the generalization of math and what it can be. At first, I assumed just knowing [the "how"] was enough. But through the semester, I saw that knowing "why" is crucial to expansion of a child's mind. I've definitely learned that adults don't give students the correct credit they deserve. It's interesting to watch videos on the way one student can figure something out versus what I would do. Kids hold more than anyone could imagine, it's just the chance of allowing them to speak or explain to better understand.

~~~~~~~~~~~~~~~~~~~~~~~~~ END BOX 6 ~~~~~~~~~~~~~~~~~

The Future of Mathematics Teacher Education and Resources for Getting There

As noted in Kara's reflection, being self-aware and facilitating self-aware learning are valuable (instead of attention and authority being vested largely or solely in the instructor; Authors, 2021; Teuscher et al., 2016). In the process of differentiating learners from one's teacher-self, *decentering* becomes essential. This kind of instructional decentering is, at its most basic, the act of seeing from someone else's point of view and has historical roots in the work of Piaget (1955). It means engaging with other people as a *participant* in interaction, rather than as the center of interaction. In decentering, instructional attention is on uncovering, understanding, and expanding on what students know and do to include novel, non-standard, and standard mathematical ideas and methods.

Indeed, to consider the perspectives of preservice teachers who may be learning, for the first time, how to learn and think about mathematics in order to teach it, college instructors must move away from their own expert perspectives and mathematical knowledge. That is, mathematics faculty who teach future teachers are faced with a need for professional refocusing, one that leverages but is not limited to their skill in advanced mathematics. They must expand and connect that knowledge to a multi-layered mathematical knowledge for teaching (MKT; Ball, et al., 2008). Moreover, as illustrated in Dr. Rhodes' journey, to teach mathematics for justice, a college instructor will also need to take on the view of future teachers who are in the beginning stages of constructing their own MKT (for their eventual work with children).

Dr. Rhodes is on the cusp of what is commonly referred to in the literature as culturally responsive pedagogy (Gay, 2018). The absence of cultural responsiveness in the courses for future teachers can have detrimental consequences on both teachers candidates' own learning
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and that of their future students (Jett, 2013; Ladson-Billings, 2001). The next stage of evolution in the professional growth for those teaching content courses for prospective teachers includes attention to cultural responsiveness. This means that the instruction itself is responsive to the adult students as learners of mathematics, and that the instruction allows opportunities for the prospective teachers to attend to their own (future) responsiveness to learners who are children. This can be achieved by supporting teacher candidates in critical reflection on their future selves and classrooms. A further step, extending culturally responsive pedagogy, is culturally sustaining pedagogy which "seeks to foster-to sustain-linguistic, literate, and cultural pluralism as part of schooling for positive social transformation" (Paris & Alim, 2017, p.1). A future version of Dr. Rhodes will be ready to engage in instruction that would prepare teacher candidates to enact tasks such as those mentioned in Rodriguez, Bellanca, and Esparza (2016) or the "La Lotería" task described by Ramirez and McCollough (2012).

Conclusion

In the AMTE *Standards for the Preparation of Teachers of Mathematics*, attention to justice is not just in Standard 4, it is infused in all the standards. Consider the following content-focused indicators and how a justice-oriented classroom, one in which students are engaged in lively, accessible, and relevant mathematics, can support the journey of becoming well-prepared and effective teachers:

> **Indicator C.1.2. Demonstrate Mathematical Practices and Processes:** Well-prepared beginning teachers of mathematics have solid and flexible knowledge of mathematical processes and practices, recognizing that these are tools used to solve problems and communicate ideas.
>
> **Indicator C.1.3. Exhibit Productive Mathematical Dispositions:** Well-prepared beginning teachers of mathematics expect mathematics to be sensible, useful, and worthwhile for themselves and others, and they believe that all people are capable of thinking mathematically and are able to solve sophisticated mathematical problems with effort.

Indicator C.1.5. Analyze Mathematical Thinking: Well-prepared beginning teachers of mathematics analyze different approaches to mathematical work and respond appropriately.

Rochelle Gutiérrez (2013) has noted about teaching mathematics, that "all mathematics teachers are identity workers" (p. 16). As you can discern from Kara's experiences, the mathematics she learned influenced what she thought mathematics was. How she learned that mathematics influenced what she thought was important in the discipline. Collectively, what and how mathematics was taught shaped her view of mathematics and mathematical identity. Thus, while the ideas in this chapter are important take-aways for the teaching of *all* mathematics, with preservice teachers the stakes are higher. It may be particularly critical for future teachers who did not have a justice approach to learning mathematics in middle or high school. Prospective teachers taking content courses are beginning to develop their professional identities as teachers of mathematics. The way in which they are learning mathematics at college is critical to helping them strengthen their own mathematical knowledge as well as conceptualize their own future classroom.

A potentially useful first step for college faculty who teach preservice elementary teachers is to understand the differences between teaching *of* and *for* justice. A good next step is to examine and enhance their current practices. Tools include readings, such as the Benjamin Banneker Association (2017) position statement regarding mathematics *about*, *for*, and *with* social justice, resources like Berry III et al. (2020), and the application of the TRU framework (Schoenfeld et al., 2016). In the process of reflecting on and enhancing his instruction, Dr. Rhodes reported what research has indicated: differentiating and decentering are crucial steps in building flexible knowledge for just mathematics instruction of adult learners who are prospective teachers (Hauk et al., 2014). In a similar vein, Dr. Rhodes demonstrated that skill in multiple discourses (e.g., mathematics, school, teaching) is central to a college instructor's

mathematical knowledge for teaching future teachers (Jackson et al., 2020). Such knowledge of discourses is far reaching and is "knowledge about the nature of communication, including context and valued forms of inquiry, socio-mathematical norms, and language in, for, and through mathematics in post-secondary educational settings" (Hauk et al., 2017, p. 429).

The goals of this chapter were to offer mathematics faculty who are new to situating mathematics for justice in their professional work the opportunity for intensive, critical, thinking. An opportunity to reach beyond effectiveness or efficiency of instruction to the quality of the human interactions in teaching mathematics. To help accomplish this, the chapter included discussion of the keys of mathematical literacy: mathematics *for* and *of* justice and examples of what the ideas look like in practice. The examples included information from research and a reference case presented as the accumulation of experiences for Kara Thomas and Dr. Rhodes. The case was a means for exemplifying issues such as equity, agency, and identity in the mathematics classroom.

In furthering the advocacy called for in AMTE Standard C.4.5, we suggest that culturally responsive and sustaining pedagogies can set the stage for future justice development within mathematics teacher education. Why pursue it? Because justice is like the air, we all have it or none of us has it (Angelou, 1990).

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Table 1. Examples of Components of Justice in Curriculum and Instruction

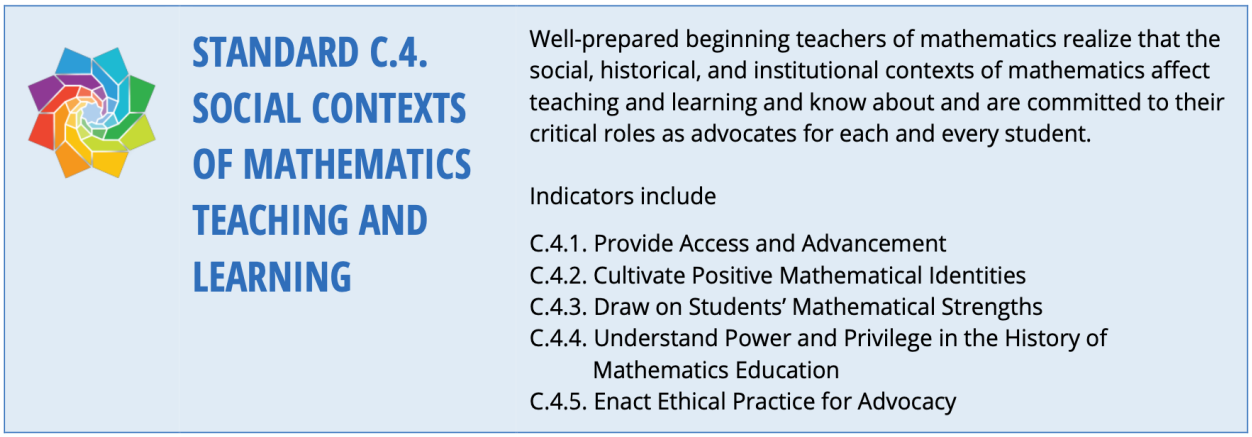
Component	Description
Variety in Cognitive Challenges	A just classroom includes challenging tasks with multiple possible points of initial engagement, variety in forms of interaction with ideas (e.g., asking students to make and test conjectures, compare, generalize, explain, or critique the reasoning of others). Variety also means students have regular opportunities to tackle novel problems as well as some practice with basics (e.g., algorithms, procedures).
Relevant Contexts	By definition, story problems have contexts. But many story problems are set in contexts that are shallow or completely removed from students' experiences. For example, authentic societal contexts can leverage mathematics to understand a social justice issue (e.g., exploring living wages algebraically, Dean, 2013). In addition to social justice contexts, mathematical applications or models for what is familiar and interesting to students provide opportunities to read the world with mathematics.
Mathematical Discourse	Mathematical discourse involves students discussing important mathematical ideas. This may include justifying a method or whether or not something is always or never true, or contrasting two problems/methods. When students dialogue about mathematics, they make sense of ideas and their own agency advances in positive ways. Note that for this to occur, tasks must be adequately challenging and relevant.
Mathematics Identity	The way a person engages in a mathematics classroom ends up shaping their identity across a continuum from a strong negative identity (I have anxiety) to a strong positive identity (I am really good at this subject).
Mathematical Agency	This is a person's sense of being able to figure out mathematics. Aguirre, et al. (2013) refer to it as "Identity in Action". When people solve challenging problems, they feel good about it and this has a positive impact on perceptions of their voice and choice in what is being learned.
Responsive Instruction	This means that the teacher adapts instruction to support mathematical thinking, connecting to what students know or following up on a question posed in a classroom setting (sometimes called a teachable moment). Sometimes, the phrase culturally responsive is used, meaning that instruction attends to students' cultural, linguistic, and community-based knowledge.

Figure 1. Goals in teaching mathematics *for and of* social justice (Gutstein, 2006a).

Mathematics Pedagogical Goals	**Social Justice Pedagogical Goals**
Reading the mathematical world	Reading the world with mathematics
Succeeding academically	Writing the world with mathematics
Developing agentic mathematical identities	Developing agentic cultural and social identities

Figure 2. AMTE (2017) and NCTM (2020) standards are explicit about context and justice in mathematics teaching.

Candidate Knowledge Skills, and Dispositions, Standard C.4 (AMTE, 2017).



Standards for the Preparation of Middle Level Mathematics Teachers (NCTM, 2020).

Standard 3: Knowing Students and Planning for Mathematical Learning Candidates use knowledge of students and mathematics to plan rigorous and engaging mathematics instruction supporting students' access and learning. The mathematics instruction that is developed provides equitable, culturally responsive opportunities for all students to learn and apply mathematics concepts, skills, and practices.		
3a) **Student Diversity** Candidates identify and use students' individual and group differences to plan rigorous and engaging mathematics instruction that supports students' meaningful participation and learning	3b) **Students' Mathematical Strengths** Candidates identify and use students' mathematical strengths to plan rigorous and engaging mathematics instruction that supports students' meaningful participation and learning.	3c) **Students' Mathematical Identities** Candidates understand that teachers' interactions impact individual students by influencing and reinforcing students' mathematical identities, positive or negative, and plan experiences and instruction to develop and foster positive mathematical identities.