

Invited Lecture

Developing Caring and Socio-politically Aware Beginning Teachers of Mathematics

Marilyn E. Strutchens¹ and B. Ratliff²

ABSTRACT In this article, we elaborate on the following goals that we have for developing caring and socio-politically aware beginning teachers of mathematics and the strategies that we use to reach them: 1) Understand what it means to achieve equity, access, and empowerment in a mathematics classroom; 2) Develop equitable pedagogical strategies, 3) Examine and overcome barriers related to student engagement and achievement, 4) Confront negative beliefs about students from different race/ethnicity, socio-economic status, gender, ability; and sociolinguistics groups and move forward in a positive manner, 5) Develop an advocacy stance.

Keywords: Equity; Secondary mathematics Prospective teachers; Introduction.

The following quote from a recent graduate of our program depicts attitudes and beliefs that we hope all the graduates of our program hold:

You both [Marilyn Strutchens and W. Gary Martin; program faculty] have broadened my perspective on life and mathematics in numerous ways. Mathematics is now so much more exciting and fun for me, and I want my future students to see the joy and beauty in it that I have found in your program. I have a better understanding and perspective on what challenges my students face, and I walk through life more aware of struggles and obstacles that others face. I want to help my students overcome anything that tries to prevent them from reaching their fullest potential. In the world we live in, students need teachers that will create a safe and supportive place where they can thrive and grow to be whatever they want to be. If I can do that for my students, I will have fulfilled my purpose.

As mathematics teacher educators prepare teacher candidates it is important that we help them to think about the social justice issues existing in the world and how these issues impact their lives and their students'. Some of the major social justice issues impacting the United States and other countries in recent years include voter suppression and manipulation, effects of climate change, health care disparities which

¹ Department of Curriculum and Teaching, Auburn University, Auburn, AL 36849, USA.
E-mail: strutme@auburn.edu

² Department of Curriculum and Teaching, Auburn University, Auburn, AL 36849, USA.
E-mail: bcr0028@auburn.edu

have been made more evident with COVID-19, refugee crisis and immigration, racial injustice, gun violence, and inequitable treatment of the LGBTQ + community (Hamilton, 2020).

Some of the issues mentioned above led several mathematics education organizations to call for change. The Association of Mathematics Teacher Educators (AMTE) issued the following statement:

The Association of Mathematics Teacher Educators (AMTE) stands in solidarity with Black Americans in the face of racial injustice. We are dismayed by the inhuman and unjust treatment of Black Americans by law enforcement personnel in recent months with the deaths of George Floyd, Breonna Taylor, and Ahmaud Arbery. We acknowledge the inequities that the pandemic has illuminated related to health care, economic standing, and education. As an organization, AMTE believes that racism must be interrogated in this country. We cannot look at what is happening to Black Americans and other oppressed groups as problems that they alone need to solve. (AMTE, 2019)

TODOS: Mathematics for All also stated:

Our position is to prioritize antiracist mathematics education for all students as we prepare to return to school this fall and the years to come. An antiracist position in mathematics education is a pledge to dismantle systems and structures that maintain racism within teaching and learning mathematics from challenging belief systems that perpetuate microaggressions to disrupting the role mathematics classes play in pushing students out of schooling. We pledge to more thoroughly develop and lead the way with frameworks for antiracist mathematics classrooms. (TODOS: Mathematics for All, 2020)

It is important for mathematics teacher educators to prepare themselves to facilitate the growth of caring and socio-politically aware beginning teachers of mathematics. How do we as mathematics teacher educators prepare ourselves to foster the growth of prospective teachers? As mathematics teacher educators, each of us must become cognizant of the lived experiences of Black, Indigenous, and People of Color (BIPOC) by reading the history of the United States through a social justice lens. We must learn ways to empower and provide access to students who often are judged by the color of their skin and not by their knowledge and abilities. We must develop the knowledge and skills that we want our teacher candidates to develop, such as those listed in AMTE's (2017) *Standard for Preparing Teachers of Mathematics* related to social contexts of mathematics teaching and learning:

Standard C.4. Social Contexts of Mathematics Teaching and Learning

Well-prepared beginning teachers of mathematics realize that the social, historical, and institutional contexts of mathematics affect teaching and learning and know about and are committed to their critical roles as advocates for each and every student. Indicators include:

- C.4.1. Provide Access and Advancement;
- C.4.2. Cultivate Positive Mathematical Identities;
- C.4.3. Draw on Students' Mathematical Strengths;
- C.4.4. Understand Power and Privilege in the History of Mathematics Education;
- C.4.5. Enact Ethical Practice for Advocacy (AMTE, 2017, p. 21).

In addition to developing the dispositions and skills ascribed by AMTE (2017) for prospective teachers, mathematics teacher educators must take the following actions according to Aguirre et al. (2017):

- (1) Stop using deficit-oriented language in mathematics education work and help educate others about how such language perpetuates negative framings of children and communities.
- (2) Deepen one's professional knowledge base and mentoring practices with mathematics and social justice as a dual focus.
- (3) Acknowledge and learn about the systems from which you benefit from unearned privilege.
- (4) Read outside of mathematics education literature to better understand target and non-target identities and how they are related to various systems of privilege and oppression.
- (5) Cite mathematics education researchers from around the world who do equity-focused work, especially scholars of color.
- (6) Engage colleagues and friends in explicitly talking about race, class, gender, and other systems of privilege and oppression.

These action steps may also be taken by teacher candidates along with the mathematics teacher educators.

1. Goals and Strategies to Enable Prospective Teachers to Become Caring and Socio-politically Aware Beginning Teachers of Mathematics

After mathematics teacher educators have begun taking the preceding action steps, they must set goals for their teacher candidates to enable prospective teachers to become caring and socio-politically aware beginning teachers of mathematics. Below is a list of goals that we have for our secondary mathematics preservice teachers at Auburn University and in the following sections, we elaborate on each of the goals and how we help our prospective teachers to obtain them: 1) Understand what it means to achieve equity, access, and empowerment in a mathematics classroom; 2) Develop equitable pedagogical strategies, 3) Examine and overcome barriers related to student engagement and achievement, 4) Confront negative beliefs about students from different race/ethnicity, socio-economic status, gender, ability; and sociolinguistics groups and move forward in a positive manner, 5) Develop an advocacy stance.

1.1. Prospective teachers need to understand what it means to achieve equity, access, and empowerment in a mathematics classroom

In order for prospective teachers to understand what it means to achieve equity, access, and empowerment in mathematics classrooms they must understand what these constructs mean. We use multiple definitions of equity to help prospective teachers to understand how difficult it is to achieve equity in the mathematics classroom. The Aspen Education and Society Program and the Council of Chief State School Officers (2017, p. 3) states that educational equity means that every student has access to the educational resources and rigor they need at the right moment in their education across race, gender, ethnicity, language, disability, sexual orientation, family background and/or family income. This definition is used to help teacher candidates see the importance of all students having access to meaningful instruction and resources needed for success. Another definition shared with students indicates the bidirectional mutual respect of equity: Equity is extended from a unidirectional exchange — as primarily benefitting growth of students and student groups that have historically been denied equal access, opportunity, and outcomes in mathematics to a reciprocal approach (Civil, 2008). A meme is also shared that has three scenarios to help students to visualize what equity means. One picture has students standing on the same number of crates regardless of their heights as they are staring over a wall to see a game. One student can clearly see the game, another student can barely see the game, and the third student is not tall enough to see the game at all. This picture represents equality, each student gets the same amount of help independent of their needs. In the second picture each student gets what he needs to see the game which represents equity. In the third picture there is not a wall, representing no barriers for any of the children which is liberty.

After discussing the definitions, students are asked to read articles and book chapters that help them to recognize equitable or inequitable situations. We examine the Mathematics Teaching Practices (National Council of Teachers of Mathematics, 2014), the five equity-based teaching practices (Aguirre et al., 2013), and This We Believe: Keys to Educating Young Adolescents (Association for Middle Level Education, 2010). After discussing these practices, students are asked to view videos that feature equitable pedagogy to see how well they identify equitable teaching strategies. One video used is Looking for Squares by Connected Mathematics. The goal of this lesson is for students to develop an early understanding of the concept of square root as the length of a side of a square. Some students drew squares that were “upright” or drawn with sides that were parallel horizontal and vertical lines, while others constructed “tilted” squares that were rotated at 45-degree angles. The teacher facilitated mathematical discourse among the students as they shared their findings with the class. Teacher candidates use checklist versions of the mathematics teaching practices and the five equity-based practices to view the video. They also answer the

following questions developed by Rousseau-Anderson (2007) to discuss what they observe: Who has access to the learning that is occurring? Are all students able to participate in the learning process? Who has access to the resources that support learning?

1.2. Prospective teachers need to develop equitable pedagogical strategies

Before prospective teachers view and examine videos for equitable practices, they experience the tasks as learners and then discuss the affordances of the tasks as teachers. These discussions help the prospective teachers to view the videos through learning, equity, and access lenses. Prospective teachers are also observed during their field placements and clinical residency experiences by their university supervisors, mentor teachers, and peers through the same lenses. Below is a note from a peer observation that took place during a paired placement clinical residency experience:

Today in 7th grade I observed my co-intern teach a lesson on addition and subtractions of integers and rationals! Students practiced addition & subtraction problems and came up with their own rules for adding and subtracting negative and positive numbers. These are the rules the classes came up with: 1) If you add two positive numbers, you will get a positive number. 2) If you add two negative numbers, you will get a negative number. 3) When you add a negative number and a positive number, your answer will have the same sign as the number with the highest absolute value. I was really impressed with student responses as they noticed the patterns and came up with the rules! We all got really excited when students came up with the absolute value rule! I thought my co-intern did a really great job engaging students and making them explain each problem. There were times that students got a little rowdy when they stated their claims on the rules, but the conversation was so great that we didn't get angry with the students. Not all of the classes got a lot of practice with adding decimals and fractions, but the lessons and student engagement today were great.

In addition to discussing the different checklists for equity-based teaching strategies teacher candidates learn about culturally inclusive mathematics lessons which fit into the following categories:

- (1) Use students' culture to help students learn mathematics. (Ford, 2005; Ladson-Billings, 1995)
- (2) Ethnomathematics (D'Ambrosio, 1985; Furuto, 2016)
- (3) Identify diverse cultural contributions. (Various Websites)
- (4) Explore mathematics using cultural artifacts. (Variety of Resources)
- (5) Use mathematics to study social or cultural issues. (Gutstein, 2003, 2006)
- (6) General uses of mathematics. (Various websites)
- (7) Use multicultural literature as a context for mathematical problem solving. (Strutchens, 2002)

These lessons help teacher candidates to think about teaching mathematics in a variety of cultural contexts. One social justice lesson that is shared with students is called Double Periods (Conway et al., 2018). In this lesson, students developed a statistical question and gathered data, which suggested inequities in course enrollment by race/ethnicity. The question was personally meaningful to many students, as their teacher had provided opportunities for students who were not on the “honors” track but who had good grades in ninth-grade Algebra I to accelerate their course taking so that they could enroll in AP statistics. While some members of the class were initially taken aback by the implication that race/ethnicity may play a role in course taking, the personal experiences of these “non-honors” students helped to frame the class’ discourse about causes for this inequity in course taking as being largely about opportunity rather than ability or interest. Students’ use of mathematics and data empowered them to inform the principal of the school of their findings and start making changes in their school culture (Conway et al., 2018).

Moreover, teacher candidates continue reflecting on equitable practices during their Clinical Residency and Management Seminar. They constantly reflect on implementing the MTPs and other equitable practices (Strutchens et al., 2022). Some prospective teachers are in pairs which enables them and their teachers to create professional learning communities focused on student learning. Below are quotes from prospective teachers related to access and equity in their clinical experiences:

Overall, my partner’s lesson went really well. I really liked how she noticed students using a variety of strategies so when it came time for the students to present their solutions, she had the students who solved the problems using different methods all present. This allowed all of the students to see there was more than one way to solve this problem and that not one method is “better” than the other. I also thought the problem she selected for the students to explore today was a good example of a multiple entry level problem. There were several entry points to the problem that allowed students who struggle and students who are advanced the productive struggle they needed.”

Second period ran a lot smoother today than it has in the past. The parallel teaching seemed to work out today. The students were given the opportunity to work in small groups and have an instructor with them the whole time. In my group, I feel like my students got to ask all of the questions they were confused on. I also didn’t hear any arguing over the groups. I really appreciated the willingness the students had to make this new strategy work.

1.3. Prospective teachers should examine and overcome barriers related to student engagement and achievement

Socio-politically aware teachers need to be aware of the barriers that prevent students from learning mathematics. These barriers can range from physical resources and opportunities to learn to teachers’, students’, parents’, and school administrators’ beliefs and stereotypes. The continuum of caring as discussed by Secada (2003) is

something that we discuss with students: “Caring could be used to protect students’ emotional and psychological well-being, where teachers seek to avoid all risk of adding further to their children’s trauma, or caring could be used to motivate proactive interventions, where teachers push students to increase their knowledge to have a variety of options. This continuum is in alignment with the challenge posed by Aguirre et al. (2017):

There is a longstanding, thoroughly documented, and seemingly intractable problem in mathematics education: inequity. Children of certain racial, ethnic, language, gender, ability, and socio-economic backgrounds experience mathematics education in school differently, and many are disaffected by their mathematics education experience. (p. 125)

We share a video of an African American student, Amari Mitchell, who at the time was a junior at Hoover High School, describing an experience in his mathematics classroom (Dunigan, 2017). Amari described how his mathematics teacher went out of his way to provide the White students in his class with additional attention and support, while he was left struggling to make sense of the teachers’ instructions. As a result, Amari learned to depend on his parents to teach him the mathematics he didn’t learn in school. Amari conjectured that while some teachers, like the mathematics educator, only care about the students that look like them, others do not. In the second half of the year, a new mathematics teacher was assigned to his class, which led to a completely different, positive educational experience. By challenging this space which previously marginalized his school mathematics experience (Aguirre et al., 2013), the new teacher worked collaboratively with Amari and his parents to ensure his success. This video challenges the teacher candidates to think about what students are learning beyond mathematics in the classroom.

It is important that teacher candidates think about these issues and other social context issues, such as addressing beliefs related to gender abilities in STEM fields, addressing the beliefs about and needs of emergent multilinguals, addressing the beliefs about and needs of Indigenous students, addressing beliefs about and needs of lesbian, gay, bisexual, transgender, queer or questioning (LGBTQ) students, addressing the beliefs about and needs of students in poverty situations, and addressing the needs of students who identify as being in the intersection of multiple groups. Below are prospective teachers’ quotes related to access and equity in their clinical experiences:

Something I noticed my cooperating teacher doing was not calling on a variety of students. She allows the students to sit in “comfortable seating” around the room. One of those options is a round table in the back of the classroom. Throughout the day I noticed several times when a student sitting back there would raise [their] hand to answer a question get overlooked by someone in the middle of the room. If this were my room, I would try and make a mental note

of where everyone is sitting to ensure I am calling on students in an equitable way.

During homeroom today, we had a student come to school with a giant hole in his shorts. He happened to have some gym shorts in his backpack, so he chose to change. A little while later in that same class. I noticed my cooperating teacher hand sewing the [student's] shorts. It reminded me that teachers are more than just teachers.

These quotes show that the teacher candidates are reflecting on their observations beyond the topics they are teaching.

Mathematics identity is another topic that we discuss in class that teachers may impact in both positive and negative ways. Mathematics identity includes beliefs about self as a mathematics learner; one's perceptions of how others perceive him or her as a mathematics learner, beliefs about the nature of mathematics, engagement in mathematics, and perception of self as a potential participant in mathematics (Solomon, 2009). We ask teacher candidates to think about their own mathematics identities through a self-assessment as a mathematics learner: They write down and discuss at least three adjectives which describe themselves as a mathematics learner. They also are asked to think about the factors, which helped to shape their beliefs about themselves as learners and doers of mathematics. We also do an activity where they examine and discuss three cases: Calvin, Caroline and Craig. They examine each of the cases and answer the questions on their own, then share their thoughts with their elbow partners. We then discuss how teachers affirm mathematics identities by providing opportunities for students to make sense of and persevere in challenging mathematics. This form of participation builds a high sense of agency in students.

Students with a high sense of agency make decisions about their participation in mathematics. Below is prospective teacher's quote related mathematics identity from a paired placement experience:

One student constantly raised her hand for us to validate her solutions. My partner and I both told her to really think about what she is doing and to use her prior knowledge and what she learned the previous days to try on her own. By the end of the period, her mathematical identity was boosted.

Social Identity Petals Activity is an activity that we do with the prospective teachers during one of their pedagogical courses. They are asked to write their identities on the petals of the flower, drawing from the following categories: ethnic background, geographic origin, religious background, gender, talent/ability, hobbies, personal and family influences, race, socio economic class, age, and/or other cultural influences. After they have written their personal identities on the petals, they are asked to think about those that are readily identified in social situations and those that are not. They are also asked to discuss how characteristics that are readily identified by others affect how others interact with them? They then share their petals with their groups. Similarities and differences are also discussed. As a group, they also discuss how they

are similar and different from their students. They also discuss beliefs or customs that they have that may conflict with the beliefs and customs of their students. Then they are asked what they can do to make their classroom environment more inclusive? This activity leads to a rich discuss about the different groups of people to which we each belong.

1.4. *Prospective Teachers must confront negative beliefs about students from different race /ethnicity, socio-economic status, gender, ability; and sociolinguistics groups and move forward in a positive manner*

The social identity petals activity leads into a discussion on stereotypes or other beliefs held by people that impede the mathematical empowerment of groups of students. We discuss how they have the power to increase access and success for students in nontraditional programs by interrupting the cycle of negative micro-messages, bolstering student self-efficacy, and challenging cultural stereotypes. (National Alliance for Partnerships in Equity, 2015). Next, prior to viewing a video, we discuss words like privilege that may cause teacher candidates to not hear what is being said by the student. Privilege is a special right or advantage that only one person or group has. Recognizing privilege simply means being aware that some people must work much harder just to experience the things one takes for granted (if they ever can experience them at all) (Gina Crosley Corcoran, 2017, HuffPost). The concept of intersectionality recognizes that people can be privileged in some ways and not privileged in others (Gina Crosley Corcoran, 2017, HuffPost). The video comes from Black Students Talk about the Achievement Gap in Alabama Schools (Dunigan, 2017). The student talks about her experiences as a black student. Kameryn, a 2017 graduate of Clay-Chalkville High School, mentioned the decrease in the number of Black students taking AP classes at her high school and how she believed school personnel held deficit perspectives about their academic abilities. Instead of being encouraged to enroll in AP courses, Kameryn felt Black students were often urged to pursue athletic opportunities. After mentioning that the responsibility for change lies with the teachers and Black students, Kameryn encouraged Black students to resist the temptation of only pursuing athletics. She also suggested teachers should disclose the existence of a wider selection of post-secondary opportunities to all students. Kameryn also believed that due to White privilege, Black students were often forced to double their efforts to achieve the same level of academic access that their White counterparts were afforded. After viewing the video, we discuss micromessages. According to the National Alliance for Partnerships in Equity (2015): Cultural stereotypes exist about people and careers, because of stereotypes, we have implicit biases; micromessages are the manifestation of implicit biases; positive and negative micromessages accumulate which causes high or low self-efficacy and behavior is the result of self-efficacy.

1.5. Prospective teachers need to develop an advocacy stance

To help teacher candidates develop empathy for students and an advocacy stance, teacher candidates follow a student around for a day. They learn much about what students experience on a day-to-day basis. Vignette 7.4. A Student Teacher's Revelation Related to Emergent Multilingual Students (AMTE, 2017) highlights the importance of teacher candidates following a student around for a day. The vignette also shares the secondary prospective teacher candidate's revelations in learning to meet the needs of her emerging multilingual students. This story illustrates the importance of not only having teacher candidates work with a diversity of learners but also having them reflect on and process those experiences to better understand how they can build on the cultural and linguistic resources that students bring to the classroom to support the learning of each student.

This vignette may be used in a methods course to help teacher candidates consider what they would do if faced with a similar situation. Prospective teachers are asked to think about the following questions: What role did reflection play in the student teacher's ability to advance the mathematics learning of her multilingual students?

What could preservice teachers gain from reading this vignette? What could be done in programs to prepare preservice teachers for this experience? (AMTE, 2017, pp. 131–132). Here is a quote from a prospective teacher's related to access and equity during their clinical experiences:

Something I have been learning recently is that being a teacher means balancing a lot of responsibilities at once. I really want to improve on making sure I'm taking action to meet my students' needs. I need to consider students with an IEP, advanced students, students who need to makeup work, students in ISS, etc. My goal is to take notes of what I need to do for each student in order to help them all succeed.

In addition to working with other teachers and school personnel, teacher candidates need to involve parents as partners in their students' education. We share strategies for working with parents and resources for families. Below are some resources:

- (1) The Algebra Project (Moses et al., 1989; Moses and Cobb, 2001)
- (2) Multicultural Literature as a Context for Mathematical Problem Solving: Children and Parents Learning Together (Strutchens, 2002).

Another way that we help teacher candidates to develop an advocacy stance is to help them to become aware of the dangers of tracking and other policies that keep students from reaching their full potential (NCTM, 2018). We encourage them to interrogate situations that are not inclusive or look like they are separating students base on their demographics in ways that lessen the students' opportunity to learn. We

also encourage teacher candidates to interrogate situations that are inequitable to teachers which in most cases are simultaneously inequitable to students.

2. Conclusion

Throughout the paper, I discussed a list of goals and strategies used during the mathematics education program at Auburn University: 1) Understand what it means to achieve equity, access, and empowerment in a mathematics classroom; 2) Develop equitable pedagogical strategies, 3) Examine and overcome barriers related to student engagement and achievement, 4) Confront negative beliefs about students from different race/ethnicity, socio-economic status, gender, ability; and sociolinguistics groups and move forward in a positive manner, 5) Develop an advocacy stance. These goals have led us to foster the growth of well-prepared beginning teachers who use equity-based strategies and care deeply about their students.

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