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Mathematics Pre-Service Teachers' Perceptions About Culturally Responsive Mathematics Teaching and Teaching Mathematics for Social Justice

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ABSTRACT

This article explores how one mathematics teacher educator working with mathematics pre-service teachers provided opportunities for their learning about culturally responsive mathematics teaching and teaching mathematics for social justice. Findings have implications for mathematics teacher preparation. In particular, it is important to allay pre-service teachers' concerns by building partnerships and having conversations with school administrators and other stakeholders. Mathematics teacher educators must also help broaden pre-service teachers' perceptions about teaching and learning of mathematics.

KEYWORDS

Mathematics pre-service teachers; mathematics teacher preparation; mathematics and social justice; culturally responsive pedagogy

Introduction

In this paper, I describe how one mathematics teacher educator working with mathematics pre-service teachers (PTs) provided opportunities for their learning about culturally responsive mathematics teaching and teaching mathematics for social justice. Culturally responsive mathematics teaching builds on mathematics, mathematical thinking, community-based funds of knowledge, identity, and power (Aguirre & del Rosario Zavala, 2013; Bartell, 2013) and teaching mathematics for social justice empowers students to use mathematics to identify and fight against oppression (Aguirre et al., 2019; Frankenstein, 1990; Freire, 1970).

To become culturally responsive mathematics teachers, educators must understand the broader social and cultural factors that influence their students' learning and how they can prepare their students to be active participants in society (Aguirre & del Rosario Zavala, 2013). This article suggests that introducing PTs to the ideas of culturally responsive mathematics teaching and teaching mathematics for social justice is beneficial for them. Providing opportunities to discuss these ideas can help the mathematics teacher educator to become aware of PTs' concerns and design supports to scaffold PTs' understanding of culturally responsive mathematics teaching and teaching mathematics for social justice.

In the United States, pre-service teachers are required to take a variety of courses as part of their teacher preparation programs. The majority of teachers in the US are prepared in undergraduate programs at post-secondary institutions. Many teacher education programs

in general have three main components: mathematics content courses, methods courses and clinical experiences in a school setting (Martin et al., 2020). Mathematics PTs take courses that focus on understanding the mathematical concepts they will be responsible for teaching; these courses are termed *content courses*. The PTs also take courses that focus on pedagogical methods for teaching mathematics; these courses are termed *methods courses*. Clinical experience involves PTs working with host-teachers in school classrooms. Each of the three components usually could involve a different set of faculty members. For example, faculty teaching content courses can be housed inside a mathematics department, and faculty teaching methods can be housed inside a college of education. In addition, the teachers who host the students are generally situated in nearby school districts (Martin et al., 2020).

Need for the Study

Incorporating culturally responsive pedagogy (CRP) in a mathematical context is not always clear (Nasir et al., 2008). Culturally responsive pedagogy helps students develop content knowledge and sociopolitical awareness (Ladson-Billings, 1994, 1995a, 1995b, 1995c). PTs in their methods courses must experience ways to weave CRP with the content they teach (Cochran-Smith et al., 2004). Further, mathematics education research with a focus on social justice views mathematics as a tool to analyze social justice issues locally or globally (Aguirre, 2009; Gay, 2009; Gutiérrez, 2009; Gutstein, 2006). Teachers should incorporate students' wider experiences into teaching mathematics (Moll & González, 2004) including issues of equity and social justice (Aguirre & del Rosario Zavala, 2013; del Rosario Zavala & Aguirre, 2023).

Preparing mathematics teachers to engage in culturally responsive mathematics teaching and teaching mathematics for social justice is a challenging exercise, as it requires achieving a balance between mathematics and social justice goals (Bartell, 2013; Leonard et al., 2010). In particular, a big challenge is the perception that mathematics teaching and learning is of greater importance than social justice issues or that such topics are not a good fit for a mathematics classroom (Simic-Muller et al., 2015). In addition, there are pedagogical concerns in creating and implementing social justice mathematics tasks (Aguirre, 2009; Aguirre et al., 2012; Harper & Cox, 2023).

Existing mathematics methods and content courses focus on developing PTs' mathematical content knowledge as well as their pedagogical content knowledge (Aguirre et al., 2017). While this knowledge is necessary to prepare the PTs, a focus on equity-based teaching practices often appears in their courses as an afterthought (Aguirre et al., 2017). This communicates to the PTs that a focus on equity-based teaching practice such as CRP is of lesser value than knowing mathematics and ways to teach it (Bartell & Aguirre, 2019). An exclusive focus on mathematics impacts the attention and time required to learn about mathematical instruction that builds upon children's cultural and community-based knowledge and their lived experiences (Civil & Khan, 2001; González et al., 2001, 2005; del Rosario Zavala & Aguirre, 2023).

My experience, teaching middle and high school mathematics methods courses echoes research from Leonard, Moore, and Brooks (2014), with PTs' statements like, "I do not see how culture has anything to do with math or how I teach it" (p. 330). Such comments reflect the common perception of mathematics as objective and devoid of any context (Friedman, 1983) stressing the need for mathematics PTs to have experiences in their teacher preparation programs that challenge their biases. Nieto and Bode (2018) stress that teachers' past

experiences and their education shape how they teach their students from diverse backgrounds. For example, teachers' lack of experience with diversity can make discussions about topics like racism difficult (Nieto & Bode, 2018). Their past experience and education can lead to a gap between the lived experiences of predominantly white and middle-class teachers and their diverse students (Howard, 1999; Wiggins & Follo, 1999; Nieto & Bode, 2018). Learning to become effective mathematics teachers for diverse learners requires development of knowledge, beliefs, and skills to build on students' cultural, linguistic and community-based knowledge (Civil, 2002, 2007; Felton-Koestler, 2020; González et al., 2001; Leonard, 2008).

As mentioned earlier, PTs in their methods courses must experience ways to connect mathematics and CRP. To learn about PTs' opportunities for learning about culturally responsive mathematics teaching and teaching mathematics for social justice in a mathematics methods course, a project was designed and implemented at a mid-sized university in the Mid-Atlantic region of the United States. Participants were 27 PTs enrolled in a middle school mathematics methods course during Fall 2020, Spring 2021 and Fall 2021 semesters. The PTs were assigned reading assignments about culturally responsive mathematics teaching and teaching mathematics for social justice. The reading assignments were followed by online discussions where PTs shared their thoughts and asked questions. The readings introduced the PTs to the ideas of culturally responsive mathematics teaching and teaching mathematics for social justice and provided examples of lessons and tasks (Koestler, 2012; Aguirre et al., 2012). PTs' discussion responses were analyzed to learn about their perceptions about culturally responsive mathematics teaching and teaching mathematics for social justice. The specific research question guiding this study is: What are mathematics pre-service teachers' initial perceptions about culturally responsive mathematics teaching and teaching mathematics for social justice? Answering this question provided insights about PTs' opportunities for learning in their methods courses.

Conceptual Framework

It is crucial to achieve equity in mathematics education (NCTM, 2000). Research stresses that Science, Technology, Engineering and Mathematics (STEM) teachers address the needs of diverse students, be mindful of achievement gap between groups, become aware of their own biases and change their beliefs about cultural diversity (Brown et al., 2019; Johnson & Atwater, 2014; Lemons-Smith, 2013; Leonard, 2008; Lewis et al., 2002; Mark & Id-Deen, 2022). Catering to the needs of a diverse student body is beneficial for all students (Nieto & Bode, 2018; Skovsmose, 2016). When students learn mathematics contextualized in socio-political terms, they are more interested in the mathematics itself (Hubert, 2014; Rubel et al., 2016b). This helps them to learn the mathematics and develop an understanding of the issues connected to their own lives as well as the lives of others (Friedman, 1995, 2009; Gutstein, 2003, 2006, 2016; Leonard et al., 2010; Rubel et al., 2016a, 2016b; Turner et al., 2009).

I use the concepts of culturally responsive pedagogy (Ladson-Billings, 1994, 1995a, 1995b, 1995c), teaching mathematics for social justice (Gutstein, 2003) and culturally responsive mathematics teaching (Aguirre & del Rosario Zavala, 2013) to frame my PTs' discussions and to make sense of their comments.

Culturally Relevant Pedagogy

Ladson-Billings (1994) outlined education for marginalized students, in particular African American students to develop knowledge, skills and beliefs that help them navigate oppressive systems. Culturally relevant pedagogy can help students develop content knowledge as well as sociopolitical awareness (Ladson-Billings 1994, 1995a, 1995b, 1995c). According to Ladson-Billings, an emancipatory education cannot neglect content knowledge. In fact, learning specific subjects such as mathematics can help one better understand the sociopolitical context of one's life. making sense of sociopolitical contexts as well as mastery of subjects like mathematics are both essential components of culturally responsive pedagogy.

The foundation of culturally relevant pedagogy is built on three main areas: (1) students' academic success; (2) students' development of cultural competence; and (3) students' development of critical consciousness. Rigorous academic success in the areas of literacy, numeracy, technological, social, and political skills allow students to become active participants in a democracy. In addition, they must become adept at identifying and questioning their social surroundings. Culturally relevant teaching maintains a balance between students' cultural integrity and their academic success and considers both as equally important. The third component focuses on students' development of a broader socio-political consciousness. Freire (1992) called this development of understanding, asking questions and analyzing society as *conscientização*. In order to become active change agents, students need to develop their identities as individuals who can make a difference.

Teaching Mathematics for Social Justice

Social justice in mathematics education encourages the use of mathematics to investigate and to challenge oppressive structures and actions (Aguirre et al., 2019; Frankenstein, 1990; Freire, 1970). Teaching for social justice has three main goals. To develop: (1) socio-political consciousness, (2) a sense of agency, and (3) positive social and cultural identities. Gutstein (2018) sees mathematics for social justice as using and learning, “mathematics to study social reality, as a way to deepen learners’ understanding of the roots of injustice and to prepare them to change the world” (p. 133). A crucial part of social justice pedagogy is that students are key players in finding solutions to injustice (Gutstein, 2003). In order to play this role, students must become aware of their own lives as well as understand the socio-political context around them (Gutstein, 2003). Here, again Freire’s concept of *conscientização* (1992) comes into play, by encouraging students to use their agency to be active critics and actors in their worlds (Freire & Macedo, 1987).

In addition to facilitating students' development of agency, educators can also work toward helping them develop positive social and cultural identities. This can be done by validating their language and culture and helping them uncover and understand their history (Murrell, 1997). This can be challenging for teachers when their own backgrounds are different from that of their students (Gutstein, 2003). However, developing spaces where students are heard and the knowledge they bring to the classroom is respected, can help them develop such identities (Delpit, 1988).

Culturally Responsive Mathematics Teaching

Culturally responsive mathematics teaching builds upon the ideas of social justice education and culturally responsive pedagogy. It includes a focus on mathematics, community, identity,

and power (Aguirre & del Rosario Zavala, 2013; Bartell, 2013). Mathematics teacher educators geared toward culturally responsive mathematics teaching, aim to develop learning experiences for a deeper understanding of mathematics, make connections to students' lived experiences, and help students use mathematics to make sense of and change their world (Aguirre, 2009; Gutstein & Peterson, 2013; Simic-Muller, 2015).

According to Aguirre and del Rosario Zavala (2013), developing culturally responsive mathematics teachers requires that they become aware of the larger context within which they teach mathematics. They must conceptualize their role as a teacher to prepare their students to become engaged members of a larger social, cultural, or political context. Teachers must recognize that teaching mathematics is a political activity, and mathematics is not the neutral subject it is often perceived to be. This means becoming aware of inequities in mathematics education and the role of mathematics as a gatekeeper to advance courses and careers. Culturally responsive mathematics teaching includes knowledge, beliefs, and teaching practices that highlight mathematical thinking, culture, language, as well as issues of social justice (Aguirre, 2009; Aguirre & del Rosario Zavala, 2013; Gay, 2009; Gutiérrez, 2009; Kitchen, 2005; Leonard et al., 2009; Turner et al., 2012). It includes eight dimensions that incorporate elements of pedagogical content knowledge (PCK) and CRP to provide guidelines for equitable mathematics teaching. These dimensions are: (1) intellectual support; (2) depth of student knowledge and understanding; (3) mathematical analysis; (4) mathematical discourse; (5) communication and student engagement; (6a) academic language support for ELL; (6b) use of ESL scaffolding strategies; (7) funds of knowledge/culture/community Support); and (8) social justice.

Material and Methods

Qualitative research methodology, in particular phenomenology, was employed to learn about PTs' perceptions regarding culturally responsive mathematics teaching and teaching mathematics for social justice. Phenomenology allows the researcher to learn about the essence or basic underlying structure of a phenomenon (Merriam, 2015). In this study, my goal was to learn about PTs' understandings, their questions and concerns about culturally responsive mathematics teaching and teaching mathematics for social justice to support the development of PTs' teaching philosophy and teaching practice related to culturally responsive mathematics teaching and teaching mathematics for social justice.

Setting

The study took place at a mid-sized university in the Mid-Atlantic region of the United States. The university serves a majority of white students and the majority of faculty members are white as well. The PTs were enrolled in a mathematics methods course for middle school pedagogy. This course was offered by the Middle, Secondary and Mathematics Education department. As part of the program, PTs were required to take both content and pedagogy courses. PTs were also required to participate in field experience where they taught mathematics content in their host teacher's classrooms.

As part of their teacher education program, the PTs were required to take a course about teaching in a diverse society. The course focused on examining how personal and professional values, attitudes, beliefs, and behaviors affect teaching and learning. This course exposed the PTs to learning needs of a diverse group of students. However, this course was not mathematics

specific and was meant as a general requirement course. For all the PTs, the mathematics methods course was the first time they had a chance to learn about culturally responsive mathematics teaching and teaching mathematics for social justice.

Participants

Twenty-seven PTs enrolled in a middle school mathematics methods course during Fall 2020, Spring 2021 and Fall 2021 semesters. The students were all enrolled in the Master of Arts in Teaching (MAT) program representing the program's two strands. Secondary education group taking this course were mathematics majors intending to become high school mathematics teachers (grades 9 through 12) and the Middle grades education group that were non-math majors intending to become middle-school teachers (grades 6 through 8).

Data Collection

The readings introduced the PTs to the ideas of culturally responsive mathematics teaching and teaching mathematics for social justice and provided examples of lessons and tasks that can be used in a mathematics classroom (Aguirre, et al., 2012; Dean, 2013; Koestler, 2012). The reading assignment was followed by online discussion that took place on Canvas, an online educational platform. Discussions on Canvas allowed the PTs to upload their posts, read their peers' posts and comment on them. PTs shared their thoughts, asked questions, and responded to their peers. PTs' discussions were analyzed to learn about their perceptions about culturally responsive mathematics teaching and teaching mathematics for social justice.

Analysis

PTs were assigned reading assignments about culturally responsive mathematics teaching and teaching mathematics for social justice (Aguirre et al., 2012; Dean, 2013; Koestler, 2012) and after reading the articles, they were asked to share their responses through discussion posts. The discussion prompt for the discussion is seen in [Figure 1](#).

I used open coding (Strauss & Corbin, 1998) to analyze data from the 27 participants with the goal to learn about PTs' initial perceptions about culturally responsive mathematics teaching and teaching mathematics for social justice. PTs' discussion posts were already guided by the discussion prompt which asked them to share connections, questions and key ideas. I began analysis using open coding to learn about emergent themes and then grouped the open codes into axial codes.

To answer the research question, I initially analyzed the data to come up with open codes (for example, *practicum teacher does not use culturally responsive mathematics teaching/teaching mathematics for social justice, concerned about parents, did not experience culturally responsive mathematics teaching/teaching mathematics for social justice in school etc.*) I then used axial coding to organize these initial codes into themes. These themes were: Favorable to culturally responsive mathematics teaching/teaching mathematics for social justice; Connection to practicum; Connection to K-12 Experience; Own teaching practice; Need to learn more about culturally responsive mathematics teaching/teaching mathematics for social justice; Concerns about teaching culturally responsive mathematics teaching/teaching mathematics for social

This discussion has two parts.

1) Post a comment on the discussion board regarding the following 3 points:

- a. Connections between the reading and your own teaching practice.
- b. Questions you have about the readings.
- c. Your key takeaway from the readings.

(Use a separate paragraph for each of the prompts above)

2) Post a response on two different peer's comments.

Figure 1. Discussion prompt for online posts about readings.

justice. Further analysis pointed to the dual lens that PTs used to process the ideas presented in the readings. They made connections between the reading and their experiences as a student in K-12 classrooms as well as their practicum classrooms. They also considered the pedagogical ideas shared in the readings as future in-service teachers.

Findings

Engagement in the activity provided the PTs an opportunity to bring their concerns out into the open and think about their own teaching practice as future mathematics teachers. Data revealed that all the PTs found culturally responsive mathematics teaching and teaching mathematics for social justice to be valuable for their future students (27 out of 27). In addition, most PTs considered it valuable for their future students to connect mathematics to the world outside the classroom. One PT shared, "Kids want to feel a connection to what they are doing or they usually tune out. Giving them this connection with things that really matter in the world, not just their favourite colours, is so powerful" (Fall 2020). Statements like this point toward a general positive view of perceiving mathematics as more than just a series of abstract concepts devoid of meaning for the students. Another PT elaborated, "Math education can be framed in a way that incorporates students' informal knowledge and relevant current events to help them make sense of the world" (Spring 2021). This comment alludes to the need for teaching mathematics to help students develop their sense making which can help them better navigate their lives.

For all PTs it was their first time reading about culturally responsive mathematics teaching or teaching mathematics for social justice (27 out of 27). They had limited to no experience with culturally responsive mathematics teaching or teaching mathematics for social justice themselves as students learning mathematics. In addition, the PTs had questions about actionable steps teachers can take toward planning and implementation of these pedagogies (20 out of 27). Some of the PTs mentioned that their experience in their practicum classroom did not provide them with examples of what they read (4 out of 27), and they wanted to see actionable steps on how such pedagogies could be implemented.

The PTs also had concerns about repercussions of engaging in culturally responsive mathematics teaching and teaching mathematics for social justice in their future school

districts (11 out of 27). In particular, they worried about how their actions supporting social justice issues would be perceived by their students, the parents and their future school administrators.

In this section, I provide PTs' perceptions about culturally responsive mathematics teaching and teaching mathematics for social justice both as learners and as future teachers of mathematics (see *Table 1* for various categories that PTs' perceptions fell into). Please note that there is overlap between each category as PTs tried to make sense of these new pedagogies that were introduced to them. PTs were making sense of these pedagogies that they felt would be useful for students, had never experienced in their course work and were not experiencing in their practicum classrooms. In *Table 1*, the left column shows PTs' perceptions as learners. This includes their past experience learning mathematics and also their experience learning about teaching of mathematics in their practicum classrooms. The right column shows PTs' perceptions as a teacher. This includes their practicum experience with the lens of a teacher of mathematics as well as ideas about their future teaching practice in K-12 classrooms.

PTs' Perceptions as Learners

When it came to the practical actions of how to incorporate culturally responsive mathematics teaching and teaching mathematics for social justice in a math classroom, the PTs were at a loss. Their experience learning mathematics as students did not provide them many examples of these pedagogies. There were several comments that pointed toward this lack of experience as described here.

Influence of Past Experience—PTs Had Limited to No Experience with Culturally Responsive Mathematics Teaching or Teaching Mathematics for Social Justice Themselves as Students

In the PTs own experience learning mathematics, they did not notice teaching where application of mathematical concepts was provided. A PT recalled, "I very rarely had math teachers use real world examples as questions or simply to describe how the mathematics could be used" (Spring 2021). There were some instances where their math teacher did connect mathematics to the world outside the classroom which made the mathematics interesting and the lesson memorable. As one PT shared, "I will say, one time in my Algebra II course in high school, we did a project about the optimization of a can. We proved, using Algebra, that the way a tuna can is designed is not optimized" (Spring 2021). Such experiences made the PTs excited about the mathematics they learned, as seen in this comment, "While my favourite math classroom experience was not using any social justice angles, my teacher did make a

Table 1. PTs' perceptions about CRMT and TMSJ.

PTs' perceptions as learners	PTs' perceptions as teachers
<i>Past experience learning mathematics</i> – PTs did not have any experience learning mathematics with a focus on CRMT or TMSJ.	<i>Past and current experience</i> – PTs became concerned about implementing CRMT or TMSJ in light of their past experience learning mathematics and their practicum experience.
<i>Current experience in practicum</i> – PT did not experience learning CRMT or TMSJ focused pedagogy in their practicum classrooms.	<i>Future experience in own classroom</i> – PTs started to ask questions about how to navigate challenges in their future school districts to adopt CRMT and TMSJ.

point to show us the many different ways each Pre-calc topic could be represented in the real world" (Fall 2021). While rare, there were times when the PTs experienced some connections between mathematics and the real world. What was never experienced was a connection between mathematics and social justice. There was consensus on this sentiment that math and social justice was never experienced by any of the PTs in their mathematics content courses either in school or college. The following two comments reflect this idea, "Throughout my schooling I've never had a math educator incorporate social justice into a lesson. However, some teachers did apply real-world situations into projects but it never included social justice" (Fall 2021), and "I haven't experienced social equity/justice being tackled in a mathematics classroom during my college experience" (Spring 2021). Comments like these were common among the discussions.

Influence of Current Experience – PTs' Experience in Their Practicum Often Mirrored Their Own Experience as Students in Mathematics Classrooms

PTs enrolled in a Practicum course as part of their teacher preparation program. Practicum allowed the PTs a chance to learn from in-service teachers that they were paired with. These mathematics teachers called host-teachers, allowed the PTs into their classrooms so the PTs could gain valuable in-class experience. The classroom environments they experienced during their school visits reflected their own experience when learning mathematics. Their host-teachers provided some connections between mathematics and the real world but not much. As a PT described,

My host teacher always includes a couple word problems of the day in which they include activities that students in her classroom are interested in or participate in. For example, today there was a word problem about traveling on an airplane (Fall 2021).

However, the PTs did not experience any inclusion of culturally responsive mathematics teaching or teaching mathematics for social justice in their practicum experience. PTs were curious to see these pedagogies in action to help them connect theory with practice. One PT shared, "It's so much more helpful to see it in action rather than just reading about it" (Fall 2020). Since the PTs were not observing these pedagogies in their host-teachers' classrooms, they wondered if they could ask their host-teachers about it. In addition, the PTs had reservations about bringing culturally responsive mathematics teaching and teaching mathematics for social justice into their practicum if their host-teachers were not incorporating these pedagogies in their classroom already. A PT explained this struggle, "I know practicum students and [host] teachers are on very different aspects of power but working collaboratively is a huge part of teaching which benefits all involved, therefore I believe we should use it in this aspect, but how?" (Fall 2021). The PTs wanted to ask the host-teachers about culturally responsive mathematics teaching and teaching mathematics for social justice but needed support in having these conversations.

The PTs were also nervous about getting their host-teacher in any kind of trouble if they asked to develop and implement mathematics lessons incorporating social justice elements. A PT shared their experience, "I am placed in [Name] County which is highly conservative and as much as I am passionate about incorporating social justice into the math curriculum I'm nervous that it may get the school in trouble" (Fall 2020). While the PTs were onboard with the ideas of culturally responsive mathematics teaching and teaching mathematics for

social justice, they needed guidance on having difficult conversations with host-teachers, and to collaborate with them in developing mathematics learning resources incorporating culturally responsive mathematics teaching and teaching mathematics for social justice.

PTs' Perceptions as Teachers

The PTs experiences as students, learning mathematics in their content courses and experiencing teaching of mathematics in their host-teachers' classrooms influenced their own perceptions about teaching mathematics as future teachers. They were concerned about repercussions of engaging in culturally responsive mathematics teaching and teaching mathematics for social justice in their future school districts.

A major portion of their discussions was devoted to their concerns and fears about incorporating culturally responsive mathematics teaching and teaching mathematics for social justice in their own classrooms. A PT shared,

Take the social justice events of 2020 for example, while I would absolutely love nothing more than to teach my kids about Black Lives Matter and other important organizations, there will definitely be parents that have issues with that. So, I guess my question is how to teach about social justice while also keeping my job? (Spring 2021).

Another PT said, "A question that I keep thinking about as we learn about this topic is, how will we know if the social justice lesson we are planning is supported by the parents and school?" (Fall 2020). The PTs found culturally responsive mathematics teaching and teaching mathematics for social justice to be beneficial for their future students. However, their future school districts and their future students' parents were both a source of concern for them. A PT explained, "I always think about what the parents will do. Parents ALWAYS have something to say or complain about. It's sad that we have to think this way because the parents should trust us, but it is our reality" (Fall 2020). The PTs had questions and concerns about actionable steps they could take in their future classrooms and what it meant to be a mathematics teacher. These findings are described here.

Influence of Past and Current Experience – PTs Had Questions About the Role of a Math Teacher

Based on their past experience learning mathematics as a student as well as experiencing teaching of mathematics in their host-teachers' classrooms, the PTs had developed ideas about the role of a mathematics teacher. In their experience this role included teaching mathematical concepts and strategies lacking context for the most part. It also included occasionally bringing in connections between mathematics and the real world, such as a lesson on the design of tuna cans or traveling on an airplane. However, this image did not include culturally responsive mathematics teaching and teaching mathematics for social justice. Learning about these ideas provided a challenge for the PTs as they had to reconsider their ideas about the role of a mathematics teacher. A PT explained,

Being a teacher is only becoming more difficult and confusing and involved but has more and more room for really making an impact on the world. I feel like I am preparing myself for what I was meant to be here for, which is very emotional and pretty strange. I am terrified of going into a profession that is changing (and needs to) and where the lines are becoming more blurred (Fall 2020).

The contrast between their past experiences and the new ideas they had come across presented a challenge and the PTs needed guidance in making sense of these new ideas.

During discussion, the PTs had the space to share their thoughts as well as their fears. They took different sides either agreeing with including culturally responsive mathematics teaching and teaching mathematics for social justice in their classroom or not. One PT explained,

My key takeaway from this article is that mathematics is not neutral. There is definitely a stigma around politics in the school, but math shouldn't be the only subject that doesn't have a voice. All subjects should be an avenue for discussing social justice and connecting it with mathematical content. (Fall 2020)

Another PT shared,

I also agree that I was a little thrown off about pushing politics. It can be hard to talk about politics within the classroom without most likely offending some students. I think a way politics could be introduced is if the teacher takes a neutral stance and talks about both sides. (Spring 2021)

The PTs had started to think about culturally responsive mathematics teaching and teaching mathematics for social justice, their own role as a mathematics teacher and what actionable steps they would take in their own classrooms. The PTs wanted to learn what resources were available for them to learn about culturally responsive mathematics teaching and teaching mathematics for social justice.

Thinking About Future Experience in Own classroom – The PTs Had Questions About Actionable Steps Teachers Can Take Toward Planning and Implementation of Culturally Responsive Mathematics Teaching and Teaching Mathematics for Social Justice

Thinking about their own teaching practice, the PTs had questions about how to incorporate culturally responsive mathematics teaching and teaching mathematics for social justice into their syllabus. Such questions were about planning, for example, “How do we create lesson plans that include social justice and where would that be located in the lesson plan?” (Fall 2020). These questions were technical in nature, where the PTs wanted to know how to develop learning resources for the students that balanced teaching mathematics with discussing social justice issues.

Other questions were about pacing of their curriculum. One PT asked:

I want to teach Algebra in the future but I don't think I can incorporate social justice when teaching basic principles of Algebra. I think it's important that students learn the fundamentals of Algebra first and then I could create an application problem that includes social justice. How do I include social justice into basic fundamentals of math and will I have enough time to cover all of the learning standards if I do this? (Fall 2021)

Such concerns were about their day-to-day plans when teaching mathematics, especially a concern about pacing of their classes. For example, if they spent time on unpacking social justice issues would they run out of time for discussing mathematics? Another PT elaborated, “A question I would have is, if I do find a way to make math culturally relevant, will that take time away from teaching content” (Fall 2021). These were valid concerns expressed by the

PTs. Since they had not experienced culturally responsive mathematics teaching and teaching mathematics for social justice included in mathematics teaching and learning, they did not know what actions to take to make such a change happen in their classrooms.

Discussion and Implications

Findings suggest that PTs' perceived culturally responsive mathematics teaching and teaching mathematics for social justice as beneficial for their students. They themselves found their mathematics learning experiences meaningful when they were connected to real world contexts. Since the PTs had no prior experience with culturally responsive mathematics teaching and teaching mathematics for social justice it was natural for them to have concerns about their pedagogical choices. PTs need support to learn about culturally responsive mathematics teaching and teaching mathematics for social justice, especially in the absence of widespread implementation of these pedagogies in mathematics classrooms. In this section, I provide actionable steps that teacher preparation programs can take to support their PTs in learning about culturally responsive mathematics teaching and teaching mathematics for social justice. In particular, I discuss three actions that can prove useful for PTs and help in allaying their concerns: (1) Building partnerships and conversations with school administrators and other stakeholders; (2) Broadening PTs' perceptions about teaching and learning of mathematics; and (3) Supporting PTs to plan and implement culturally responsive mathematics teaching and teaching mathematics for social justice in the methods courses.

For PTs that do not have previous experience with culturally responsive mathematics teaching and teaching mathematics for social justice in the mathematics courses they took as students they need this experience to develop an understanding of equity-based pedagogies. Such experiences cannot take place in just their methods courses. Instead, the students must experience these pedagogies in their host-teachers' classrooms, in their methods courses, as well as their content courses. A first step in allaying the PTs' concerns is to develop relationships with multiple stakeholders and collaboratively provide cohesive learning experiences for them.

Building Partnerships and Having Conversations with School Administrators and Other Stakeholders

In order for the mathematics teacher educator to support their PTs in experiencing culturally responsive mathematics teaching and teaching mathematics for social justice in their host-teachers' classrooms, it is important for the mathematics teacher educator to not just support the PT but also the host teacher. As shared in the findings section a common PT concern was parent and administrative backlash. This concern is shared by in-service teachers as well. Teachers sometimes worry that parents will disapprove of their students' inquiry into difficult or controversial topics (Howell et al., 2019). To plan for this pushback in advance, it is important to get support from school administration. Administrators can be listed as allies by communicating clearly the ways in which a planned class project will enhance student engagement and learning. In addition, it is important to establish positive relationships with parents and families. For mathematics teacher educators, this means getting involved with the local school districts where PTs engage in clinical experience. Continued conversation between university and school district personnel means that PTs get a more concise experience and are supported (Martin et al., 2020).

Such partnerships between university and school personnel can help in expanding the narrow view of teaching and learning of mathematics. As mentioned by PTs, they were concerned about the time they would spend on discussing real world issues and if this would impact their requirements of the course syllabus. Once again, this concern is warranted. Teachers feel limited by curricular constraints, intense accountability pressures, and limited time that is available to them (Powell et al., 2016). These pressures make it difficult for teachers to consider new pedagogical ideas, especially if they are not aligned with their curriculum. Teachers can weave social justice topics that are aligned with curricular goals and standards to expand the narrow interpretation of mathematics standards (Howell et al., 2019).

Mathematics teacher educators can support both host-teachers as well as PTs to expand their view of teaching and learning of mathematics. When school administration is on board, a partnership can be formed to provide fruitful learning experiences for PTs.

Broadening PTs' Perceptions About Teaching and Learning of Mathematics

Developing partnerships between university and school districts can help the PTs in experiencing culturally responsive mathematics teaching and teaching mathematics for social justice in their host-teachers' classrooms. In addition, it would also be beneficial for the PTs to get a cohesive message in their teacher education program, especially in their mathematics methods and content courses. In the United States, there is a need to align coursework and fieldwork allowing PTs to learn about the teaching practices of in-service teachers (Allen & Wright, 2014; Ball & Forzani, 2009; Brouwer & Korthagen, 2005; Darling-Hammond, 2006; Forzani, 2014; Grossman, Compton, et al., 2009; Grossman, Hammerness, et al., 2009; Horn & Campbell, 2015; Lampert et al., 2013). It is also important to recognize that PTs' university experience may differ depending upon their coursework (e.g. methods or content courses). A distinction between theoretical and practical worlds is widely acknowledged, with each world having its own set of rules and values (Beyer & Trice, 1982). PTs need to experience a cohesive view of teaching and learning of mathematics both in their content and methods courses. PTs' first experience with mathematics teaching methods begins in their university methods courses leading to actual K-12 classrooms (McDonald et al., 2013). There is a need for collaboration between faculty teaching mathematics methods and content courses. With dialogue and mutual support PTs will begin to expand their view of teaching and learning of mathematics and learn about actionable steps to include culturally responsive mathematics teaching and teaching mathematics for social justice in their own mathematics classrooms.

Supporting PTs' to Plan and Implement Culturally Responsive Mathematics Teaching and Teaching Mathematics for Social Justice in Their Methods Courses

Finally, it is important that PTs develop communication skills to ask for the actionable steps they want to take first in their host-teachers' classroom and then in their own classrooms as mathematics teachers. PTs need support to have uncomfortable conversations and self-advocacy especially in their host-teachers' classrooms. Their host-teachers might worry about implementing social justice projects because of fears about the discomfort from controversial conversations and the host-teachers might not have the experience to articulate ideas constructively (Howell et al., 2019). Mathematics teacher educators can model such conversations

inside the PTs methods courses and support the PTs so they can advocate for culturally responsive mathematics teaching and teaching mathematics for social justice.

Limitations

A limitation of this study relates to sample size given that this paper focuses on one mathematics teacher educator, and students in their methods course. A second limitation is grounded in the open-ended nature of the PTs' discussion posts and responses. There were opportunities in the discussion to have the PTs provide a greater explanation of their concerns and to direct their responses toward their own teaching practice.

Conclusion

The readings assigned by the mathematics teacher educator as well as the ensuing discussion allowed the mathematics teacher educator to gather knowledge of their PTs' perceptions about culturally responsive mathematics teaching and teaching mathematics for social justice. Findings can guide mathematics teacher educators in supporting their PTs to experience culturally responsive mathematics teaching and teaching mathematics for social justice not only in their methods courses but also in their content courses and their clinical experience. PTs need to experience culturally responsive mathematics teaching and teaching mathematics for social justice and these pedagogies should be modeled for them so they can incorporate them in their future mathematics classrooms. More work is needed in the area of developing cohesive learning experience for PTs in their mathematics teacher education programs. In particular, it is important that their dearth of experience with culturally responsive mathematics teaching and teaching mathematics for social justice in their mathematics courses is remedied by planning and taking mindful actions throughout their teacher education programs. Cochran-Smith (2009) theorized teacher education for social justice as a "coherent and intellectual approach" (p. 447) which is broader than a focus on methods and activities alone. Cochran-Smith stresses that teacher preparation should include not only teaching practices but also developing a teaching philosophy so teachers can make sense of the school environment, ask questions, make decisions and form relationships (p. 454). PTs need to engage in a cohesive teacher preparation experience while developing their teaching philosophy.

Allaying PTs' concerns during their teacher education programs may encourage them to incorporate culturally responsive mathematics teaching and teaching mathematics for social justice into their teaching practice. There is a need to broaden PTs' perception about teaching and learning of mathematics. It is imperative that the various stakeholders involved in design and operation of mathematics teacher education programs take into account PTs' concerns and their learning needs. Ongoing research is also warranted in the area of developing cohesive learning experiences for mathematics PTs both in general and as connected to culturally responsive mathematics teaching and teaching mathematics for social justice.

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