

EXPLORING CULTURE IN MATHEMATICS EDUCATION FROM THE PERSPECTIVES OF PRESERVICE TEACHERS OF COLOR

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Studies on culture, equity, and social justice issues in mathematics teacher preparation have called for preparing teachers to build on students' mathematical and cultural backgrounds. Yet few studies have examined the preparation of preservice teachers of color (PSTCs), especially those attending Historically Black Colleges and Universities (HBCUs) or Hispanic Serving Institutions (HSIs). We present preliminary findings from a cross-site research project documenting PSTCs' perspectives on culture in mathematics education. We analyzed PSTCs' engagement in a culture unit during their mathematics methods course and their expressed views on cultures other than their own. Our findings reveal that these PSTCs often defined culture based on nationality and would repeat dominant deficit discourses about minoritized students. We provide insights for the importance of culture discussions in mathematics.

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Introduction

Mathematics education research has acknowledged the role of culture in teaching and learning, and specifically how mathematics classrooms create a context that legitimizes or invalidates various forms of knowledge (Nasir et al., 2008). Mathematics teacher educators (MTEs) have the opportunity to expose preservice teachers (PSTs) to the different ways students reason about and learn mathematics and teach them how to build on students' mathematical and cultural backgrounds. MTEs have incorporated into their courses culture activities such as classroom observations and lesson planning (Koestler, 2012), field placements and student interviews in diverse settings (Fernandes, 2012), storytelling to challenge PSTs' color blindness (Ullucci & Battey, 2011), and family and community exploration projects (Bartell et al., 2019; Zavala & Stoehr, 2019). These activities are designed to help PSTs become "culturally conscious" (Gay, 2010) by recognizing their own cultural socialization and understanding how this affects their attitudes and behaviors toward other ethnic group cultures in mathematics education.

Although previous literature on MTEs has explored opportunities in which PSTs engage in deeper discussions and reflections on the role of culture in their teaching and learning, most studies have reported on the experiences of White PSTs only. Few studies have examined the ways in which PSTs from culturally diverse backgrounds engage in and respond to similar activities. As Montecinos (2004) cautions, assumptions based on the experiences of White monolingual teachers do not translate to the experiences of all PSTs. There remains a need to understand how PSTs of Color (PSTCs) navigate their teacher education programs. MTEs would also benefit from learning about PSTCs' views on teaching mathematics and culture, enabling them to prepare all future teachers to teach equitably. Our work sought to answer the following research question: *What are PSTCs' perceptions of other cultures in the teaching and learning of mathematics?*

Conceptual Framework

A discussion of the role of racism in mathematics education and its implications for teacher education programs is beyond the scope of this paper (Martin, 2009, 2019; Rousseau Anderson, 2019). However, highlighting the “structural phenomenon” of racism in education (Rousseau Anderson, 2019) affords us the opportunity to examine how messages about certain groups of students and their mathematical identities continue to permeate mathematics classrooms. Recent research on the mathematics learning experiences of minoritized students has found that students have had racialized experiences in which “socially and personally constructed meanings of race emerge as salient in interactional experiences related to mathematics” (Martin, 2019, p. 461). Thus, PSTCs are likely to have experienced mathematics classrooms as White institutional spaces in which non-white cultural knowledge may be positioned as inferior or lacking. This recognition highlights the need for all PSTs to learn to question and understand issues of power, race, culture, and identity in mathematics classrooms (Gutiérrez, 2015; Rubel, 2017).

In discussing how to prepare PSTs to enter culturally diverse communities, Bartell and Aguirre (2019) warn MTEs about the deficit perspectives some PSTs hold about children and their communities and their potential resistance to engaging with families and communities that are different from their own. Thus, preparing PSTCs must include recognizing and creatively responding to discourse that positions minoritized students as incapable and developing the PSTC’s role as an advocate (Gutiérrez, 2015). This is especially important because when PSTCs become teachers, they may “carry problematic beliefs into the classroom and replicate the cultural alienation students of color experience in schools” (Kohli, 2014, p. 371). Unless PSTCs have been required to reflect on their own racialized schooling experiences and engage in conversations and activities focused on creating rehumanizing mathematics classrooms that counter deficit views of minoritized students, they may unintentionally perpetuate structural inequities in their mathematics classrooms (Chao et al., 2019; Zavala, 2017).

Methods and Data Sources

CAM Up! (Cultural Awareness in Mathematics Unit Project) is a cross-site research study that seeks to illuminate PSTs’ interests, perspectives, and dispositions toward teaching mathematics to culturally diverse student populations. Three institutions serve as research sites: one Historically Black College and University (HBCU), one Hispanic-serving institution (HSI), and one Predominantly White institution (PWI). We purposefully selected these sites to include PSTs who are culturally diverse across racial, ethnic, language, socioeconomic, and geographical backgrounds.

We used a modified version of a cultural awareness unit (White et al., 2016) to explore the PSTCs’ perspectives. The unit included three components: (1) an article critique paper; (2) audiotaped class discussions in which PSTCs share their article critiques, describe their own culture, examine stereotypes in mathematics education, and discuss culturally relevant math teaching strategies; and (3) a post-discussion reflection paper. Project data include recorded class observations, unit artifacts, and researchers’ field notes.

In this paper, we present preliminary findings for 10 female PSTCs (HBCU=3, HSI=4, PWI=3) to convey key themes on culture that emerged across the three sites. These PSTCs were randomly selected from a larger group of 52 PSTCs. Four of the PSTCs self-identified as African American/Black, one as Asian, and five as Hispanic/Latina.

The findings presented here focus solely on our analysis of the article critique assignment. This assignment required PSTs to find, read, and write a critique of an article that focused on teaching mathematics to students from a cultural group other than their own. We intentionally did not define culture prior to the assignment so as not to influence their perspectives on culture.

For the first cycle of coding/data analysis, all authors read the PSTCs' article critiques, met, and created a list of holistic codes, keeping the research question in mind (Saldaña, 2016). These holistic codes captured the overall ways PSTCs positioned themselves in relation to the culture discussed in their selected article. For the second cycle, each author re-coded holistic categories individually using values coding to arrive at more precise categories that captured the values, attitudes, and beliefs represented in the data. This cycle uncovered how PSTCs perceived the culture of others with regard to teaching and learning math. Analyzing the critiques and unit artifacts allowed us to triangulate the data, yielding two emergent themes that identified the common mathematics discourses we discuss in our findings.

Findings

A preliminary analysis of the article critiques revealed that PSTCs have complex views of culture, as evidenced by which cultures they selected and why they made that choice. Several insights emerged into how PSTCs view the intersection of culture and mathematics teaching and learning. In this section, we describe the PSTCs' views on culture and their acceptance or rejection of dominant cultural views about minoritized students in mathematics education.

Views of Culture

Understanding and unpacking the participants' descriptions of culture shed light on how they view their own culture in the context of teaching and learning mathematics. The PSTCs described culture in three ways: *culture as nationality*, *culture as language acquisition*, and *culture as socioeconomic status (SES)*. Six PSTCs ascribed to *culture as nationality*, comparing the way mathematics was taught in their "American culture" to the way it was taught in the cultures of other countries. In their article critiques, the PSTCs identified cultural nuances that emerged in the descriptions of the mathematical teaching strategies. For example, one PSTC noted, "One way the Chinese culture is different from my American culture is based on differences in language structure."

Three PSTCs noted that language plays an important role in learning mathematics. PSTCs who ascribed to *culture as language acquisition* contrasted their use of "standard academic English" with the language of non-native English speakers. Moreover, some PSTCs discussed the role that language played in their own identity. For example, one PSTC stated, "The primary culture described in the article is that of English language learners (ELL) . . . growing up, I could not define myself as an ELL."

Several PSTCs also viewed *culture as SES*, suggesting in their critiques that students' socioeconomic status represented an aspect of culture that influenced their mathematics learning. One PSTC wrote, "I grew up in a middle- to upper-middle-class area, therefore I don't share the low-income aspect of the students' culture either." None of the 10 PSTCs saw culture as the shared norms among a group of people.

Views of Mathematics and Culture

The PSTCs expressed interest in learning about various cultures because they recognized both the changing demographics in schools and the achievement gaps that persist. Although they wanted to learn about other cultures, however, the PSTCs were often unaware of asset-based teaching strategies. Many PSTCs expressed agreement with or repeated dominant deficit mathematics discourses about minoritized students in the article critiques. These discourses included: *language is a barrier*, *caring parents are involved in their child's education*, and *Asian teaching methods are better in math*.

Some PSTCs viewed speaking a primary language other than standard English as a barrier to learning mathematics in the U.S. One PSTC wrote, "Although I am Asian and grew up in a bilingual household, I was never classified as an ELL nor did I need any type of additional academic

instruction due to language barriers.” Another PSTC wrote, “English Language Learners (ELL) and African American English (AAE) speakers are groups who suffer greatly from culturally skewed word problems . . . [M]y family always spoke Standard English. Therefore, I never faced the barrier of making sense of the Standard Academic English that is used in schools.” These PSTCs viewed language as a barrier to rather than a resource for mathematics teaching and learning. In describing strategies for teaching mathematics to English language learners, the PSTCs recommended removing the complex language from word problems instead of incorporating words from the students’ cultures.

Some PSTCs accepted the deficit discourse that certain cultures value parental involvement and that without it, learning mathematics is more difficult. Moreover, these PSTCs suggested that parents who care will be actively engaged in their child’s education. One PSTC identified parent support as a family value, noting, “Asians are more likely to listen to their parents in regard to educational and vocational decisions, due to an innate need to not disappoint or bring shame to the family. Family is at the center of their culture, something that was once essential to the African-American community and their survival but is sadly no longer valuable.”

While the critiques of eight PSTCs reflected dominant narratives, two resisted stereotypes such as, “All Asians are good at math.” These participants perceived culture as learned and adaptable. One PSTC expressed a desire to examine the Asian model minority stereotype more closely, stating,

This theory jeopardizes the students who actually need help in academics . . . I particularly like that the author says students can respond using their ‘own mathematical power.’ I truly believe that everyone can achieve mathematics, but we just have our own ‘super power’ that we cannot project.

Discussion

This study’s preliminary findings uncovered three views of culture expressed by PSTCs—culture as *nationality*, *language acquisition*, and *socioeconomic status*—that reflect the dominant narratives of culture in the contemporary U.S. We also uncovered two themes related to how PSTCs perceived math and culture: agreement with deficit narratives/stereotypes about how mathematics is taught and learned, and rejection of these narratives/stereotypes.

These findings suggest several implications for methods courses and the faculty who teach them. As MTEs, we are aware of the racialized mathematical experiences of PSTCs (Martin et al., 2019), and we believe it is incumbent upon us to guide PSTCs to reflect on the cultural footprint they bring to the mathematics classroom. Moreover, we must push back against narratives that assume PSTCs will automatically make cultural connections with students of color in their classrooms. We concur with Gist (2017) that teacher educators need to “value teacher candidates’ cultural and linguistic diversity and understand how to draw on and develop their multicultural capital” (p. 930). Only then will we develop PSTCs’ cultural consciousness, enabling them to dismantle deficit narratives in mathematics teaching by honoring and incorporating their students’ assets and strengths.

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