CENTERING SECONDARY MULTICULTURAL MATHEMATICS EDUCATION ON IDENTITY

An Interpretation Of Multicultural Frameworks Through The Identity Construct

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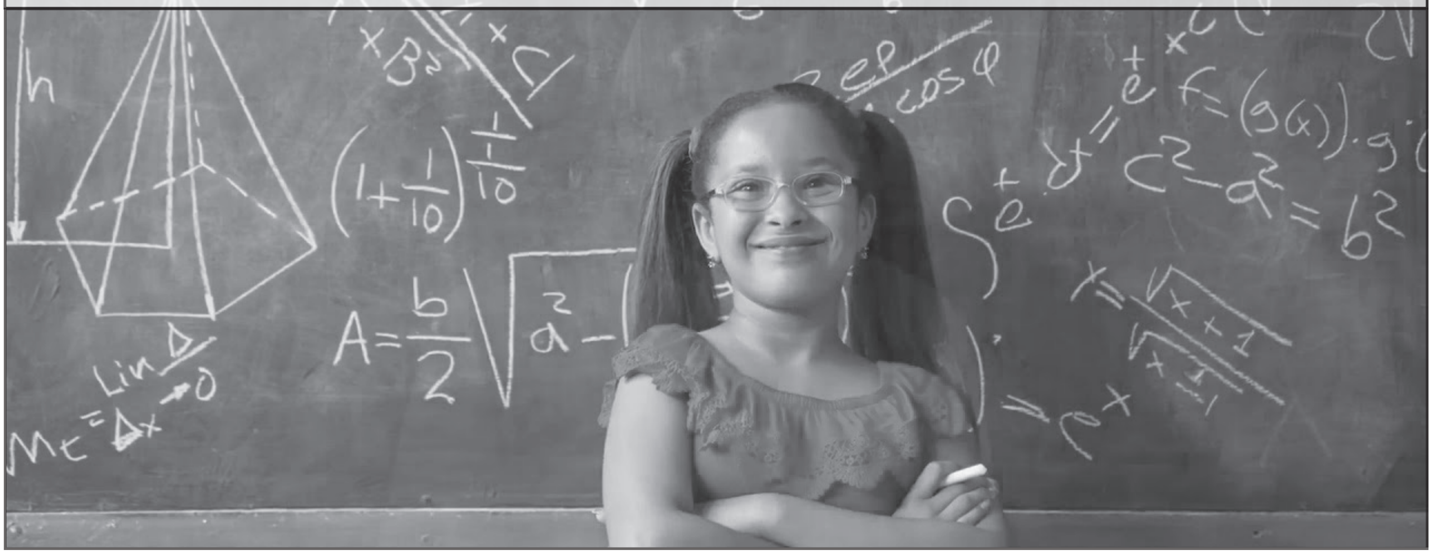

Introduction

In the context of a research paper on the professional development of mathematics teachers, Christine Sleeter (1997), a well-known multicultural education theorist and researcher, abstracted four themes involving culturally responsive mathematics education which relate to identity. Over the last decade, a large body of work, including our own work with adults, has emerged around identity in the mathematics classroom.

Identity is shaped by an interaction between culture, individual psychology, and sociopolitical factors. These factors themselves evolve through historical time and form the cultural, educational, and governmental environments that students must navigate. A rereading of Sleeter's framework in the context of current research reveals some interesting parallels between her framework and a classification of the current work on identity.

We believe that her themes are still relevant and provide much-needed guidance toward a more effective enactment of multicultural practices in mathematics education. This article discusses the four themes' progression, which will focus on secondary education practices. It is essential to re-examine Sleeter's work because there is limited research about how the four factors guide multicultural mathematics education enactment for that level.

Although classroom-level investigations offer some guidance and framework evidence that attend to some multicultural goals (such as social justice mathematics and critical mathematics education), there is no holistic model for secondary mathematics education. Given the tumultuous nature of our current times (pandemic inequality, racial unrest, economic uncertainty), our young people deserve a better chance to participate fully in transforming our society toward a more democratic one, in which, as adults, they assume more fulfilling lives.

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Culturally Relevant Curriculum

Capitalistic economics and racism filter into schools as the primary means of reproducing caste structures to ensure the status quo (Anyon, 2005, 2017; Davidson, 1996; Willis, 1977). In the mathematics domain, racialization has also been a critical component of education (Martin, 2006), as a means to keep White middle-class culture and its position of authority and access in place.

We begin from the inside out, where teachers use the classroom, sometimes unwittingly, to acculturate and enforce mainstream structures. Sleeter's (1997) first theme appropriately focuses on developing a culturally relevant mathematics curriculum, whereby students participate in and identify themselves as creators of mathematics.

It is crucial to examine the factors that perpetuate students' negative perceptions of themselves concerning the curriculum. That mathematical notions are presented as existing outside of human activity and are thus placed under a Cartesian perspective of the world that is stripped from its relation to individual struggle and culture as well as economics is certainly problematic (Seah & Bishop, 2000). Because of this, it becomes exclusionary as educational authorities (teachers, textbooks, etc.) present mathematics as outside a student's cultural experience (D'Ambrosio, 1999).

Furthermore, many students cannot foreground experiences where they will use mathematics (Vithal & Skovsmose, 1997). Conversely, the "real-world" mathematics movement uses contrived situations that only artificially make math "real" (Klein, 2007). Real-life mathematics hardly ever enters classroom dialogue, particularly the affective experiences of learning mathematics (François & Stathopoulou, 2012; Moreno & Rutledge, 2018).

D'Ambrosio (1985) popularized the idea of *ethnomathematics*. The term refers to the relationship between culture and mathematical practices among specific cultural groups that can include indigenous peoples, students of particular social classes, workers in specific professions, and so on. Some examples include how the Mayans imbued mathematics into pre-Columbian elements such as the Mayan calendar and the development of the Incan quipu, a counting tool made of different textiles used for everything from collecting data to calculating and solving mathematical problems (Ortiz-Franco, 1993).

More contemporary versions of ethnomathematics include Saxe's (1988) investigation of the practices of children selling candy in Brazil and Carraher, Carraher, and Schliemann's (1985) similar study of contextualized mathematics in which young people and their families were also involved in the selling of goods in Brazil.

Another example of ethnomathematics involves the work-based mathematics that experienced nurses used to calculate drug concentration dosages based on a single taught method they acquired outside of their practice, which revealed a classification scheme for proportional reasoning (Hoyles, Noss, & Pozzi, 2001). The works of Marcia Ascher (1994), Claudia Zaslavsky (1999), and Ron Eglash (2014) are also replete with examples of ethnomathematics that can inspire individuals from marginalized populations to identify themselves as capable and competent in mathematics. Early in the development of multicultural mathematics education, scholars drew from these sources to create a culturally relevant curriculum (Zaslavsky, 1993).

In addition to a concretely culturally situated mathematics curriculum, we offer that strategies that require higher order thinking must be the target of a culturally relevant curriculum. Anyon's (1980) famous uncovering of the "hidden curriculum of work" is echoed in our current learning environment (Wells, 2018). Furthermore, values in mathematics education are tools that cultural groups use to define the relative importance of different mathematics attributes and their pedagogy.

Thus we agree, as others have noted, that rather than only starting with mathematics content, curricula can start with cultural mathematical values (Seah, Andersson, Bishop, & Clarkson, 2016). Inquiry-based learning can shift the curriculum toward marginalized students to participate in the making of mathematics (Seah et al., 2016).

Culturally Relevant Pedagogy

The second theme of Sleeter's (1997) framework is based on the premise that an effective multicultural mathematics teacher understands how to empower underserved students from diverse sociocultural groups to succeed in mathematics by using their cultural backgrounds as a pedagogical resource. Many students feel that to succeed in a mathematics classroom, they need to adopt new behaviors and perspectives. However, for many students, this is seen as a betrayal of one's ethnic social group because it involves adopting mainstream White patterns of behavior. However, even after those beliefs and patterns are adopted, many students feel that they do not entirely fit in.

These feelings may continue even when academic identities and aptitudes indicate that students do belong within a mathematics-based career (Tate & Linn, 2005). Aside from ethnicity, it is well known that girls begin to be pushed out of mathematics in the middle and high school grades and that this continues throughout university level study. As Packard and Wong (1997) and Holland, Eisenhart, and Eisenhart (1990) have pointed out, social expectations such as meeting feminine social norms can also compete with views of oneself in a STEM career pathway.

What happens in the classroom can be crucial in redefining identity roles. Cobb, Gresalfi, and Hodge (2009), who explored identity development in contrasting mathematics classrooms, found that teaching philosophy matters. In the classroom where the authority was centered on the teacher, the students' identities were marked by dependency on the teacher. Contrastively, in the other classroom that was student centered, students developed a sense that they were responsible for their learning.

Black et al. (2010) discussed the idea of a leading identity that is partially defined through positive experiences one has with a learning domain. They used two case studies to show that a student who had had positive STEM learning experiences could draw on them to overcome barriers to learning, whereas a second student who did not more easily gave up on the student's STEM goals. While these examples do not deal directly with the racialized and gendered mathematics learning environment, we can draw inferences about restructuring teaching practices to empower students.

Emancipatory pedagogies can begin the process of freeing students from being marginalized because of their race or gender toward developing agency to overcome barriers. In a study, Grant, Crompton, and Ford (2015) evaluated the identity development of a cohort of Black male students, using a participation lens, in an "Algebra Project" (Moses & Cobb, 2002) classroom over four years. According to the results, there was an increase in agentic behaviors such as better communication and reliance on themselves to learn the material. They noted that approaches that did not stress remediation would allow students to develop mathematical identities that supported their success.

Another study that examined identity development in adolescents in a science and math program found that the program allowed students to begin to see themselves as insiders through mentoring and research (Rahm & Moore, 2016). Before participating in the program, students identified their positive character traits, such as being hardworking, as important attributes in their identity in science and toward success in STEM, and in time, these views grew into a more insider view of themselves.

In another study that examined the identity development in mathematics through participation in the Young Peoples Project (YPP), the researchers found that the project provided opportunities for young people to organize their political motivations around learning mathematics and computer programming and to create curricula to teach their younger peers. The authors argued that the students developed a new sense of themselves through a larger purpose that included relationship building and commitment with other members of YPP (Tucker-Raymond, Lewis, Moses, & Milner, 2016).

In addition to the approaches used in addressing marginalized student populations' mathematical identities, it is also worth investigating the approaches used to address students' academic needs with disabilities. In one study, Kalambouka, Pampaka, Omuvwie, and Wo (2016) found that students with special education needs are particularly in need of interactive, fun, and connective learning to feel motivated and engaged in mainstream classrooms. Kalambouka et al. (2016) also found that to meet the needs of students with disabilities in mainstream and inclusive settings, educators need to adapt their educational practices and provide additional support.

These adaptations, whether environmental or academic, need to follow two criteria. First, they need to be research based and applicable to all learners, and second, they must take into account the specific needs of all learners (see Pampaka et al., 2012). Furthermore, contrary to deficit thinking models of learning, differences in students with mild learning disabilities need to be reconceptualized to identify more accurate diagnostic and remediation approaches (Lewis, 2014).

However, there are limitations to effective in-class pedagogy, as many students must still deal with the realities they face out of the classroom, including those resulting from deficient national politics that blatantly work to draw lines between privileged students and others. For example, immigrant students and their parents worry about losing a family member due to deportation practices or being deported themselves (Knudson-Martin, 2013). These all too real threats may lead to wariness among these populations, which can further result in unproductive behaviors that keep them from participating in the broader school community (Knudson-Martin, 2013).

Also, the parents of many of these students work at low-paying jobs as manual laborers in the agricultural, construction, or service industries and have additional duties and responsibilities at home that often interfere with helping their children with their school work (Knudson-Martin, 2013). Making matters worse, many parents have little to no formal education to draw on that helps them understand how their children may navigate schools in the United States, which further keeps them from helping their children with their school work (Knudson-Martin, 2013). These realities are often ignored by well-meaning educators seeking merely to transform their classrooms.

Social Justice and Critical Mathematics

The third pillar of Sleeter's (1997) framework focuses on the concept that multicultural educators can connect mathematics concepts and students' lives by using complex mathematical reasoning to examine social issues and advance an agenda for change in social-conflict contexts. Multiple intersecting trends make this aspect of her framework the most meaningful for students to reflect on in a mathematics classroom, including the technological advances around which our lives revolve, environmental concerns that can only be solved through scientific thinking and respect for nature, and the use of economic policy to disempower people particularly under the guise of populism.

Two related approaches use critical pedagogy as the foundation for rethinking mathematics teaching. Early in the development of critical mathematics educational thinking, Ole Skovsmose (1994) published an article showing how he and a colleague crafted a project, based on the idea that mathematics structures/formats society. The project consisted of having his students produce social benefit formulas to help the students understand that services are defined by people and politics. In this way, he showed that mathematics must be reflected on in a technology-based society because its use is not apolitical.

Similarly, Klein (2007) discussed the crafting of place-based mathematics lessons. Critical place-based pedagogy allows for exploration of the "nature of place and mathematics, what they are, how they relate, and ways of engaging the two through a pedagogical turn guided by ethics of eco-justice and critical approaches to decolonization and re-inhabitation" (Klein, 2007, p. 2). He expressed these activities and supported more realistic and meaningful ways of expressing that "mathematics is everywhere." He illustrated this type of approach by explaining how mathematics and statistics are used to understand and address local problems.

Social justice mathematics, which draws heavily from the writings of Paolo Freire (1970), was popularized by Enrico Gutstein. He has published multiple examples of the implementation of social justice mathematics in the classroom. For example, he reported on the interrogation of school boundary policy by students who found a disproportionate enrollment of one ethnic group over another by using ratios and proportions (Gutstein, 2009). Mathematics educators need not simply look to mathematics teaching examples for inspiration.

For example, the transformative activist stance that is reported on by Vianna and Stetsenko (2011) can inform educators about the meaning of critical pedagogy–infused academic learning even though their case study did not involve mathematics. These studies epitomize how students contextualize problems and can use academic knowledge to critique society, how it is structured against them, and, more importantly, how they can use their knowledge to make changes in themselves and society.

Negotiating Barriers and Strengthening Supports/Access

The following section will address what we believe is the most important yet least understood factor in conversations about success in mathematics, that is, structural barriers to education. We relate this to Sleeter's (1997) final pillar, which challenges multicultural mathematics teachers to institutionalize high expectations for mathematics achievement and move from low expectations to more rigorous mathematics.

While Sleeter's focus was at the classroom level, which is crucial, we suggest that changes must also come at the institutional level. Structural barriers, often experienced by students as personal deterrents, work to directly prevent marginalized students from entering into academic environments that will lead to better economic and fulfilled futures.

Dealing with these barriers must be at the forefront of measures to improve mathematics education. Even significant classroom culture and curricular changes will end up being tentative if they are not supported by structural changes that facilitate global and sustainable change or measures to develop students' capacity to navigate prohibitive systems.

The lack of systems that recognize all aspects of diverse individuals is pervasive in schools. Language barriers are some of the most disadvantageous challenges for students. According to the students in one study, understanding the teachers and the instructions that teachers provided to them and using the English language to participate in class and complete assignments were the most challenging aspects of their school experience (Knudson-Martin, 2013).

In addition to the language barriers, other concrete economic and social barriers to STEM education include the cost of college education, which may cause a financial burden for students; limited information about career options and college admission requirements; lack of information in students' native languages; and anti-undocumented policies and regulations (Hernandez, Rana, Alemdar, Rao, & Usselman, 2016). Tracking, which involves lowering content requirements, is still prevalent as a means to hold back students of color and to avoid holding teachers responsible for preparing these students for college (Knudson-Martin, 2013).

Lack of motivation can become an issue as students in secondary school are already planning what their future work lives will entail and are thinking about what opportunities are available for them (Hernandez et al., 2016; Vithal & Skovsmose, 1997).

As Rahm and Moore (2016) noted, students in their study had felt that their dreams had been cut short because they are not expected to be successful past secondary education. This is true for American Indian students, too, who, though they recognize they must do well in school to obtain a good job, do not do so due to lack of motivation because of perceived barriers to economic and social mobility (Wood & Clay, 1996).

The complexity of personal and cultural experience in relation to social structures and power is not easy to tease out. Students must be able to live in two worlds to be successful in academics. As Wood and Clay (1996) noted, although there is an association with Anglo orientation and self-efficacy beliefs among American Indian students, identifying with one's culture does not impact academic success.

In fact, a strong connection to their culture did not impact their grades one way or another; however, socialization into Anglo behavior patterns and beliefs did impact their academic achievement. This suggests that successfully learning to navigate both cultures could substantially impact "cultural discontinuity" barriers that affect student success (Wood & Clay, 1996, p. 57).

According to Gonzalez, Stein, and Huq (2013), who conducted a similar study that analyzed the impact that cultural identity variables had on Latinx students' perceptions of self-efficacy beliefs and college attendance barriers, one's own cultural validation was associated with self-efficacy, and that resilience was related to college-going self-efficacy. Interestingly, educational aspirations are not related to whether one's orientation is toward Anglo or Latino cultures (acculturative status); instead, it is negatively associated with personal regard, meaning that increased positive evaluation of one's group decreased college-going aspirations (Gonzalez et al., 2013).

Many of these barriers are often not recognized by students as stemming from institutional racism; instead, they are seen as individual experiences and are viewed ambivalently. Individuals in students' lives are often seen as both supports and barriers. For example, family and school are often identified as the most salient sources of support; however, family, school, and peers have been identified as barriers as well, sometimes by the same individuals (Fouad et al., 2010; Kenny et al., 2007). Even students who were low achievers perceived the school's quality and teaching as a barrier, despite recognizing the teachers at the school as a source of support. Fouad et al. (2010) found that "supports and barriers for students in math and science, while somewhat consistent by educational level, may be idiosyncratic in terms of their influence on educational and career choices, and may emerge in a variety of combinations and from a variety of sources" (p. 369).

Discussion and Conclusion

Research has indicated that minoritized students have much to contend with in classrooms where educational practices devalue diversity and where traditional teaching practices dominate to create barriers within the school and social structures. These approaches tend to exclude minoritized learner populations from pursuing STEM careers by ignoring their cultural capital and impeding them from constructing their mathematical identities. Sleeter's framework, situated in a multicultural philosophical view of teaching, can be reinvented toward fostering students' mathematical identities.

To mitigate the impact of classroom, pedagogical, and structural barriers, schools and teachers must partner with parents and students to raise expectations. Students can only meet those expectations if they have the learning tools they need, if the teachers have the knowledge to promote the development of marginalized students, if students are given preparatory and social responsibility experiences, and if policies and money are allocated to make these things happen. This must be done because the transition of disadvantaged students to higher education must be a key aspect on which to focus in high school.

Through collaboration, public schools and universities can ensure that students successfully navigate the walls of the public school to reach the halls of higher education institutions. It is also crucial that classroom teachers, who daily build relationships with students, support them and foster the resilience these students will need as they will undoubtedly encounter disappointing situations. Finally, a primary function for multicultural educators must be to help students think critically about their educational choices and overcome obstacles through action (Moreno & Rutledge, 2018).

Understanding how educators can foster identity development is an emergent and essential priority in secondary mathematics education. Indeed, during these times, when nativist politics are meant to marginalize our young people further, we must work harder to ensure their participation in education, work, and democratic society.

However, identity development is largely dependent on the recommitment of mathematics educators to implementing multimodal practices that include the areas outlined in Sleeter's framework—areas that focus on providing students with culturally relevant pedagogy, embedding social justice and critical mathematics into the curriculum, negotiating barriers, and strengthening supports and access to STEM education. Sleeter's framework recognizes students' differences, validates students' cultures, and asserts that classroom practices' cultural congruence increases students' success and provides a framework for program and policy approaches to STEM.

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