



## The Role of Ethnomathematics and Social Justice in Mathematics Education

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### Abstract

One of the challenges faced by educational systems around the world is related to the growing number of students from linguistic and culturally diverse backgrounds. Both cultural and linguistic diversity draw increased attention by many teachers and researchers as areas identified as having connections to failed educational systems. There is a growing sense of urgency to resolve this inability to effectively educate all students. In the context of social justice, it is necessary to examine the embeddedness of mathematics in cultures, while drawing from ethnomathematical approaches that take on linguistic and cultural forms of knowledge production in the mathematics curricula. This pedagogical approach intends to promote social justice and the overall quality of students' educational experience.

*Keywords:* ethnomathematics, mathematics education, pedagogical action, social justice.

In the 21<sup>st</sup> century, a greater and more sensitive understanding of mathematical ideas, previous knowledge, and practices from members of diverse cultural groups has become increasingly available through the growth of the fields of ethnology, culture, history, multiculturalism, anthropology, linguistics, and ethnomathematics. One of the characteristics of ethnomathematics is to help to develop the concept of what mathematics really is through its connection with culture (D'Ambrosio, 2007).

An ethnomathematics program offers a broad view of mathematics, which embraces ideas, processes, methods, previous knowledge, and practices related to different cultural environments, which lead to increased evidence of cognitive processes, learning capabilities, and attitudes that may direct a learning process occurring in mathematics classrooms.

The reflection on the social and political dimensions of mathematics offers an important perspective for a dynamic and globalized society, and which recognizes that all cultures and all people develop unique methods and explanations that allow them to understand, act, and transform their own reality (Rosa & Orey, 2007).

Ethnomathematics research emphasizes education for social justice, wherein it is necessary to empower students by teaching them about real-world issues and instills in them a desire to seek out and work towards this goal. In this regard, individuals who do not believe in their own cultural roots can easily assimilate dominant cultural values without critically reflecting on the values of the new culture (Rosa, 2010).

In this context, an ethnomathematics program can assist both school leaders and teachers to understand and accept the cultural roots of their students by valuing the mathematical ideas, practices, and previous knowledge as well as recognizing the applications of academic mathematics.

This program supports the learning of mathematics of academic mathematics because individuals from minority groups need to have equal access and be knowledgeable about academic and standardized mathematics (Rosa & Orey, 2007). It is crucial to ensure that the learning of mathematics that is contextualized and grounded in the needs and expectations of the students and the community that utilizes it, means teaching mathematics for social justice and in a non-colonial manner.

Teaching mathematics for social justice through an ethnomathematical perspective reminds school leaders and teachers that information may be meaningless unless it is embedded in appropriate contextual understanding. In other words, social justice relies on the relevant political and cultural aspects of mathematics in order to guide its instruction because teaching for social justice encourages the exploration, interpretation, and reconsideration about what is understood about mathematics (D'Ambrosio, 2007).

It is thought that the processes of mathematics are not easily amendable to teaching for social justice considerations. However, there is one exception found in the field of ethnomathematics, as it explores different methods of organizing mathematical ideas, practices, previous knowledge, and problem solving that individuals face daily in often non-academic contexts.

In this regard, one aspect of ethnomathematics explores how different cultures organize and classify mathematical knowledge. Thus, Rosa and Orey (2007) argue that this is because individuals from minority groups have the right to equal access and become knowledgeable about the mathematics of the dominators/colonizers.

The pedagogical action of the Program Ethnomathematics demonstrates that mathematics is contextualized and grounded in the needs and expectations of the community that utilizes it. Along this line, the goal of ethnomathematics is to contribute both to the understanding of culture and to the understanding of mathematics, but mainly to the relationship between the two.

Educating students mathematically consists of much more than just teaching them some mathematical concepts or algorithms.

Given the current political climate in many places, this is often complex, and difficult to accomplish. The problems and issues are much more challenging when it requires a fundamental awareness of the values that underlie mathematics and recognition of the complexity of educating students about these values. It is not enough just to teach students *mathematics*, it is necessary to educate them about the mathematics they encounter, and to educate them through and with mathematics (Bishop, 1991).

An important change in mathematics instruction and curriculum needs to take place in order to accommodate the demographic change in the school population. School leaders and teachers need to be instructed in gearing education more toward students of different languages and cultures.

Despite dire political conditions in many places, concerns about equity in relation to mathematics education have moved to the forefront in many countries in the world, most notably the *STEM Education*<sup>1</sup>. Related to this a goal for both school leaders and teachers is to accomplish this mathematical equity by incorporating an ethnomathematics perspective into the mathematics curriculum and instruction.

Ethnomathematics draws from the cultural experiences and practices of individual students, their communities, and the society at large in using them as vehicles to not only make mathematics learning more meaningful, but more importantly, to provide students with the insights of mathematical knowledge as embedded in their social and cultural environment.

One important implication of this approach is to emphasize connections between mathematics and often local culture in the mathematics curriculum. In so doing, it is paramount that school leaders consider students' linguistic and cultural backgrounds in designing and selecting school activities.

With the increased growth of a diverse student population, the school curricula need to reflect on the intrinsic and cultural learning of all students. This means that school leaders and teachers must be prepared to address students' linguistic and cultural backgrounds in the mathematics classroom.

According to D'Ambrosio and Rosa (2008), this inclusion improves students' academic achievement, helps move classrooms towards an equitable learning environment, helps students have positive beliefs about mathematics, integrates mathematics with other disciplines, and to promote mathematical understanding.

When students feel that the mathematics in the classroom does not relate to them or their experiences, backgrounds, and culture, they feel disconnected from the material. Student backgrounds and contexts provide a rich means for them who usually do not fully participate in the mathematics class, to make connections to the mathematical content (D'Ambrosio, 2007).

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<sup>1</sup>Through STEM (Science, Technology, Engineering, and Mathematics) Education students are taught through constructivist methods that aimed to build content understanding and application of general knowledge. It enables students to become conscious citizens because they must be able to apply their knowledge in meaningful ways, which allow them to address issues that better the lives of the members of societies (Rosa & Orey, 2017).

Ethnomathematics is a usable tool in the mathematics classroom, which helps students to make connections and develop deeper mathematical understanding and help them to learn about mathematical practices of other peoples as well as develop a deeper understanding of their own mathematical practices. In this regard, as students learn about other peoples, they can also learn about the mathematics and sciences used by them (Rosa & Orey, 2007).

One of the most important implications of social justice for mathematics education is that ethnomathematics is a tool to motivate disenfranchised students to pursue study of mathematics (D'Ambrosio, 2007). Educators must provide students with relevant mathematical experiences by integrating into the curriculum mathematical topics from their own cultures (Rosa & Orey, 2007).

Ethnomathematics facilitates the achievement of two objectives in mathematics teaching: a) it can establish a multicultural context for mathematics knowledge and skills and b) and it can help students in making connections among other disciplines (D'Ambrosio & Rosa, 2008). In this regard, students can learn to maximize possibilities for improving their attitude towards mathematics as the same time that they are improving their mathematics skills.

School leaders must be supported not only in terms of equity, but also in terms of mathematical viability. By placing the onus of mathematics education, at all levels, teachers and students recognize how mathematics is vital to maintaining and developing the technological underpinnings of a globalized society.

Overall, there is hope that school leaders, teachers, and students begin to recognize that mathematics is ubiquitous even if it is not visible and it has meaning beyond its numbers or the academic context that most experience it in.

Given the almost universal standardized requirements in mathematics content, certain mathematical concepts and skills must be covered, but often even these can be treated from the point of view of mathematics from the structures of languages and cultures. Looking at mathematics from diverse perspectives does more than teach students about mathematics because it also teaches school leaders, teachers, and students about mathematics in ways they would never see in traditional mathematics curriculum (Rosa, 2010).

In this context, Rosa and Orey (2007) argue that school leaders and teachers need to be challenged as professionals in order to perceive connections between language, mathematics, and culture and provoke deeper thought and critical thinking skills for all their students.

According to Giroux and McLaren (1994), *border pedagogy* creates borderlands in which diverse cultural resources allow the fashioning of new identities within existing configurations of power. It also works to *decolonize*<sup>2</sup> and revitalize teaching and learning to promote social justice for all students. Particularly, it engages students in multiple references that constitute different cultural codes, experiences, and languages in order to help them construct their own knowledge through sociocultural negotiation.

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<sup>2</sup>Educational systems most certainly play a role in perpetuating colonialism. Thus, there is a need for the decolonization of the school curricula (Wane, 2013). Decolonization is the meaningful and active resistance to the forces of colonialism that perpetuate the subjugation and/or exploitation of our minds, bodies, and lands. "Decolonization is engaged for the ultimate purpose of overturning the colonial structure and realizing Indigenous liberation" (Waziyatawin & Yellow Bird, 2012, p. 3).

Border pedagogies teach students to develop the skills of thinking critically and debating power, meaning, and identity by encouraging tolerance, ethical sophistication, and openness to alternative forms of thinking (Giroux & McLaren, 1994). It is necessary for educators to be committed to equity in order to enhance all students' achievement and advancement in mathematics (Gutiérrez, 2007).

For minority students to reach their full potential, instruction should be provided in ways that promote the acquisition of increasingly complex mathematical knowledge and language skills in a democratic climate that fosters social justice, collaboration and positive interactions among students, school leaders and teachers.

Such classrooms are inclusive in their emphasis on high standards, expectations, and outcomes for all students. Important features of such settings include high expectations, and exposure to academically rich curricula, materials, resources, and approaches that are culturally and linguistically relevant to the minority students' needs in order to enhance mathematical learning and achievement (D'Ambrosio 1999). Consequently, knowing the cultural and linguistic background of our students is essential for providing successful learning opportunities and social justice for all.

Currently, the challenges for an increased accountability for both educators and learners demand different teaching strategies that enable educators to serve the community and their students more effectively for the development of social justice orientation. Therefore, mathematics educators need to be supported to develop educational opportunities linked to culturally relevant pedagogy and engage in reflection about their own teaching-learning practices.

In order to teach for social justice, it is necessary to recognize how reflections on and/or pondering about issues, perceptions, beliefs, and problems can lead teachers to enhance their own teaching practices (Airasian & Gullickson, 1997). Since reflection constitutes a valued strategy for enhancing pedagogical practices, it is necessary for educators to be given space to create opportunities and reflect upon their own pedagogical practices and to critique them and modify them (Rosa, 2010).

In this regard, "reflection is a central process of constructing knowledge and developing professionally" (Airasian & Gullickson, 1997, p. 219). In addition, an understanding of both culture and language and connections to mathematics is an important source of knowledge for teachers to reflect upon in order to transform their own practices.

Ethnomathematics emphasizes education for social justice, wherein it is necessary to empower individuals by teaching them about real-world issues and instill in them the desire to seek out and work towards this goal. Mathematics for social justice must be equal for students from different cultural backgrounds. An important change in instruction needs to take place in order to accommodate ongoing social and cultural changes.

In this regard, if educators are encouraged to facilitate successful learning opportunities for all students, they must know and acknowledge the community and prior experiences and perceptions about the world. This also includes respecting and getting to know student linguistic backgrounds and cultural values, which are essential for pursuing social justice for all learners (D'Ambrosio, 2001).

In conclusion, teachers who come to appreciate and understand diverse linguistic and cultural differences, strive for intentional variety in instruction, curricula, and assessments that lead to an improvement in the learning of mathematics. Teachers play a key role in encouraging and supporting pedagogical practices for their students.

It is our hope that this theoretical paper adds to the existing body of the literature in relation to the development of teaching for social justice in order to provide a useful perspective for decision-makers in the teaching mathematics to students from culturally and linguistically diverse backgrounds. It is recommended that educators discuss this issue not only in terms of mathematical viability, but also in terms of equity.

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