REFLECTING ON SOCIAL JUSTICE, AND ETHNOMATHEMATICS, AND CULTURALLY RELEVANT PEDAGOGY IN MATHEMATICS EDUCATION

REFLETINDO SOBRE A JUSTIÇA SOCIAL, A ETNOMATEMÁTICA E A PEDAGOGIA CULTURALMENTE RELEVANTE NA EDUCAÇÃO MATEMÁTICA

Milton Rosa
milton@cead.ufop.br
Universidade Federal de Ouro Preto

Daniel Clark Orey
oreydc@gmail.com
Universidade Federal de Ouro Preto

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 and culturally relevant pedagogy-based 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: Culturally relevant pedagogy; Ethnomathematics; Mathematics education; Pedagogical action; Social justice.

RESUMO

Um dos desafios enfrentados pelos sistemas educacionais em todo o mundo está relacionado com o crescente número de estudantes de origens linguísticas e culturalmente diversas. As diversidades cultural e linguística atraem a atenção de muitos professores e pesquisadores, pois são áreas que têm conexões com sistemas educacionais falidos. Assim, existe uma crescente sensação de urgência para resolver essa incapacidade de educar efetivamente todos os alunos. No contexto da justiça social, é necessário examinar a incorporação da matemática nas culturas e, ao mesmo tempo, alicerçá-la nas abordagens da etnomatemática e da pedagogia culturalmente que podem assumir, nos currículos matemáticos, as formas linguísticas e culturais de produção do conhecimento. Essa abordagem visa promover a justiça social e a qualidade integral da experiência educacional dos alunos.

Palavras-chave: Pedagogia culturalmente relevante; Etnomatemática; Educação matemática; Ação pedagógica; Justiça social.

1. Introduction

With a push towards the improvement of education, comes increased growth of diverse student populations around the world. The traditional school curricula need to reflect the students' socio-linguistic and cultural backgrounds in the mathematics classrooms. Teachers need to gear education towards students' different languages and cultures. Thus, an important change in mathematics instruction and curriculum needs to take place in order to accommodate the demographic change in school populations in distinct societies.

In this context, D'Ambrosio (2016) criticizes the "fact that the mainstream image of mathematics education is focused mainly on the transmission of mathematical content, with less attention given to social justice and cultural issues" (p. 6). Concerns about equity in mathematics education have been coming to the forefront in many countries in the world. This event, along with the consequences of the content, includes questions related to how do current mathematics content may empower corruption and violence, is also becoming prominent.

Educating students mathematically for social justice consists in teaching them mathematical concepts as well to help them to develop awareness of the values that underlies cultural and linguistic aspects of their knowledge. According to Bishop (1991), it is necessary to educate students about the mathematics they learn, as well as through and within this knowledge field. This approach reminds teachers that mathematical knowledge may be meaningless unless it is embedded in contextual understanding first.

Thus, social justice relies on relevant on the political dimension of mathematics in order to guide teaching and instruction. Hence, teaching for social justice encourages the exploration, interpretation, and reconsideration about the role and nature of mathematical knowledge in society (D'Ambrosio, 2007).

The reflection on social and political dimensions of mathematics offers important perspectives for dynamic and *glocalized*[1] modern societies. These communities have come to recognize that all cultures and all people develop unique methods and explanations that allow them to understand, act, and transform their own reality (Rosa & Orey, 2017).

This inclusion can improve student academic achievement, help move classrooms towards an equitable learning environment, and can help students to build positive beliefs about mathematics as they integrate mathematical power with other disciplines (D'Ambrosio & Rosa, 2008).

When students feel that the mathematics they encounter in their schools does not relate to their experiences and/or their culture; they feel unconnected and uncomfortable in participating in the proposed activities in the classrooms (Davidson & Kramer, 1997). Students' cultural backgrounds provide a means for students to fully participate in the

[1]Glocalizantion is the ability of a culture, when it encounters other cultures, to absorb influences that naturally fit into and can enrich that culture, to resist those things that are truly alien and to compartmentalize those things that, while different can nevertheless be enjoyed and celebrated as different (Rosa & Orey, 2016).

mathematics classrooms and help them to make connections to the mathematical content they are learning (Rosa, 2010).

Looking at mathematical ideas, procedures, and practices from different cultures enable students to perceive mathematics in ways that is not distinguished in the traditional mathematics curriculum. In this context, Rosa (2010) argued that teachers need to be supportive in constructing understanding between mathematics and the language and culture of students in order to encourage the development of reflective and critical thinking abilities.

This approach is based on *border pedagogies* that create borderlands in which the diverse cultural resources allow for the fashioning of new identities within existing configurations of power. It also encourages critical thinking, debating of power structures, meaning, and identity by encouraging tolerance, ethical sophistication, and openness (Giroux & McLaren, 1994). Thus, it is important to:

> (…) assess students within three domains to ensure equality. The three domains are using traditional assessment, assessing students' knowledge of other literacy, and determining how students' perceive and respond to the process of learning a new language and culture (Jiminez, 2004, p. 576).

In this regard, border pedagogies work to decolonize and revitalize teaching/learning that promotes liberty and social justice for all students. It particularly engages students in multiple references that constitute different cultural codes, diverse experiences, and distinct languages that help them construct their own narratives and histories, and revise a sense of democracy through linguistic, social, and cultural negotiations (Romo & Chavez, 2006).

Consequently, it is necessary that teachers are committed to equity in order to enhance student advancement in mathematics (Gutiérrez, 2000). Such equity depends on teachers' careful attention to the ways students from diverse culturally and linguistically backgrounds need to be helped to participate in the learning practices that can occur in the classrooms (Boaler, 2002). As well, teachers' understanding of the quality mathematics instruction and how to support it are influenced by their perceptions about the nature of mathematics and their pedagogical practices (Rosa, 2010).

In this direction, Sergiovanni and Starrat (1998) argued that teacher development is shaped by a set of "beliefs, opinion, values, and attitudes which provide a foundation of practice" (p. 133). This foundation includes personal educational values and beliefs that are known as an "educational platform" (p. 133), which guides teacher pedagogical action and decision-making. In this regard, Sergiovanni and Starrat (2001) stated that teachers "carry on their [pedagogical] work, make decisions, and plan instruction based on their educational platform" (p. 70).

According to this context, we highlight that some investigations are related to the development of social justice in mathematics education that focus on ethnomathematics in response to the concerns of marginalization of distinct cultural groups members (Rosa & Orey, 2010) while others have focused on the impact of culturally relevant pedagogy in regards to the academic achievement of minority students (Darling-Hammond, 1997).

Therefore, we discuss, in this theoretical article, the role of culturally relevant pedagogy, ethnomathematics, social justice, and their inherent connections to mathematics education.

2. Culturally Relevant Pedagogy

The focus of culturally relevant pedagogy is to value diverse home cultures of students in order to teach mathematics in a culturally appropriate manner (Ladson-Billings, 1995). The process of culturally relevant pedagogy underscores student connections to their home culture and provides ways for teachers to support cultural connections in school while use it to scaffold learning. It validates and incorporates student cultural backgrounds, ethnic history, and current societal interests into the daily pedagogical instructional practices.

Culturally relevant pedagogy addresses student socio-emotional needs and uses ethnically and culturally diverse materials for pedagogical action in classrooms (Scheurich & Skrla, 2003). In this context, Ladson-Billings (1994) stated that this educational approach empowers students intellectually, socially, emotionally, and politically through the use of cultural and historical references to convey knowledge, impart academic skills; and change students and educators attitudes towards academic instruction.

A culturally relevant pedagogy delineates and promotes the academic achievement for all students because effective teaching and learning take place in an environment that is culturally supported and learner-centered, whereby the strengths students bring to school are identified, nurtured, and utilized to promote their educational achievement (Richards et al., 2006). Thus, the academic achievement of students who come from culturally and linguistically diverse backgrounds improve when educators ensure that classroom instruction is relevant to their home and community contexts (Gay, 2000).

The basic premise of a culturally relevant pedagogy is that "teachers should teach using philosophies and methods that respect, value, and positively use the strengths of a students' home culture, context, and language" (Scheurich & Skrla, 2003, p.48). For example, Moll et al. (1992) studied minority students in Mexican-American communities in Tucson, Arizona, as a means to empower student and support school achievement. They examined the influence of teachers as co-learners, learning students' home culture, practicing reciprocal teaching, and in turn connecting the culture of the students in order to improve their academic achievement.

Further evidence of this phenomenon resulted from the study conducted by Lipka and Adams (2001), which addressed the application of culturally relevant pedagogy in order to determine the effectiveness of a culturally-based unit of instruction on mathematics, which dealt with the learning of perimeter and area by sixth grade students. Their conclusion was in favor of the effectiveness of the culturally relevant based curriculum treatments as implemented in their study.

Similarly, Irvine and Armento (2001) suggested that culturally relevant pedagogies allow teachers to provide and use meaningful pedagogical materials; create learning environments, which include the cultures, customs, and traditions that maybe different from their own; and include the lessons that assist students in making meaningful connections between their lives and school-related experiences.

A culturally relevant pedagogy provides student access to a rigorous academic school curriculum that values their cultural experiences and prior knowledge regardless of

whether they are represented by dominant or non-dominant cultural backgrounds (Klotz, 2006). It can be defined as an educational system that "honors, respects, and values diversity in theory and in practice and where teaching and learning are made relevant and meaningful to students of various cultures" (Klotz, 2006, p. 11).

Because this pedagogy utilizes the backgrounds, knowledge, and experiences of the students to inform the teacher's planning mathematical lessons and methodologies in the classrooms, participating in culturally relevant teaching means that teachers create a bridge between a students' home and school environments while still meeting the expectations of curricular requirements (Ladson-Billings, 1995).

Culturally relevant pedagogies provide ways for students to maintain their cultural identity while succeeding academically. Thus, it is important that educators contextualize instruction and schooling by applying a culturally relevant pedagogy in their pedagogical practices as well as embodying relevance and rigor to the educational process (Ogbu, 1992). This is one of the goals of the ethnomathematics program for the development of social justice in the schools.

3. Ethnomathematics

Currently, both a greater and more sensitive understanding of mathematical ideas, procedures, and practices developed by the members of diverse cultural groups have become available through the growth of the study fields of multiculturalism, anthropology, linguistics, and ethnomathematics.

The term ethnomathematics was first coined by D'Ambrosio (1985) to describe the mathematical practices of identifiable cultural groups, and may be regarded as the study of mathematical ideas found in any culture. The search for solutions for specific problems that help the development of mathematics are always imbedded in a cultural context because in order to understand how mathematics (*tics*) is created, it is necessary to understand the problems (*mathema*) that precipitate it in this contexto.

In order to understand those problems (*mathema*), it is necessary to consider the cultural context (*ethnos*) that drives them. Ethnomathematics is the study of mathematical ideas developed by different sociocultural groups offers a contextualization of the curriculum that contributes to the elaboration of pedagogical practices in multicultural classrooms (Rosa & Orey, 2007) towards social justice.

One of the characteristics of ethnomathematics is to help to develop concepts of what mathematics really is through it is connection with culture (D'Ambrosio, 1985). The purpose of ethnomathematics is to trace the development and transformation of mathematical ideas by developing research on how an ethnomathematical perspective in the mathematics curriculum contributes to a new approach on mathematics education.

Currently, an ethnomathematics program offers a broader view of mathematics, which embraces tacit knowledge, ideas, processes, procedures, techniques, methods, and practices related to different cultural environments. This aspect leads to increased evidence of cognitive processes, learning capabilities, and attitudes that may direct learning processes occurring in many mathematics classrooms.

For example, Masingila and King (1997) stated that ethnomathematics becomes a workable tool that helps students to make connections and develop deeper mathematical understanding. They also argued that ethnomathematics helps students to learn about

procedures of *other* peoples as well as develop a deeper understanding of their own practices. As students learn about the culture of *other* peoples, they can also learn about their mathematical knowledge, since mathematics is an integral part of their own culture (Rosa & Orey, 2007).

Ethnomathematics may be used as a tool to motivate disenfranchised students to pursue a study of mathematics (D'Ambrosio, 2001). It facilitates the achievement of two objectives in mathematics teaching: a) it can establish a multicultural context for the development of mathematical knowledge and skills and b) it can help students in making connections among other disciplines (D'Ambrosio & Rosa, 2008).

Consequently, students maximize the possibilities for improving their attitude towards mathematics at the same time that they are improving their skills. Hence, Rosa (2010) argues that ethnomathematics is a program through which teachers may have positive impacts on affective and cognitive domains of students who are underachieving in academic mathematics. Ethnomathematics is a program that investigates the ways in which different cultural groups comprehend, articulate, and apply ideas and concepts that can be identified as mathematical practices (Barton, 1996).

The essence of an ethnomathematics program is to acknowledge that there are different ways of doing mathematics by taking the time to consider the appropriation of the academic mathematical knowledge developed by different sectors of society. As well, it considers different modes in which diverse cultures negotiated problem-solving techniques and developed mathematical ideas, procedures, and practices (D'Ambrosio, 2001).

Moreover, ethnomathematics may be described as a way in which people from a particular culture use mathematical ideas and concepts for dealing with quantitative, relational, and spatial aspects of their lives. This way of viewing mathematics validates and affirms the diverse experiences demonstrated how mathematical thinking is inherent to all our lives.

Further evidence of this assertion is given by Orey (2000) who stated that the "paradigm that diverse cultures use or work within involves out of unique interactions between their language, culture and environment" (p. 248). Within this context, D'Ambrosio (1985) argued that from an ethnomathematical perspective, mathematical thinking is developed in different cultures in accordance to common problems that are encountered within distinct cultural contexts.

In this perspective, in order to solve specific problems, *ad hoc*[2] solutions are created, generalized methods are developed from those solutions to solve similar problems, and theories are developed from these generalized methods. In the context of ethnomathematics, many cultural differentiated groups *know* mathematics in ways that are quite different from academic mathematics as taught in schools (D'Ambrosio, 2007).

Mathematics is identified in cultural activities in both traditional and non-traditional societies. This refers to the mathematical concepts embedded in cultural practices and it recognizes that all cultures develop unique methods and sophisticated explications to understand, comprehend, and transform their own reality (Orey, 2000).

[2]*Ad hoc* is a Latin expression that means *for this purpose*. It generally means a solution designed for a specific problem or task, non-generalizable, and which cannot be adapted to other purposes.

Ethnomathematics means the study of how people within various cultural groups come to develop techniques used to explain and understand their world in response to the unique problems, struggles, and endeavors of human survival (D'Ambrosio & Rosa, 2008).

This approach includes their material needs as well as art and spirituality through the use of the development of artifacts, which are objects created by members of a specific cultural group that inherently give cultural clues about the culture of its creator and users. This perspective provides an important opportunity for teachers to link current events and the importance of these artifacts in the context of ethnomathematics, history, and culture.

Another presupposition of ethnomathematics is that it validates forms of explaining and understanding the world that are formulated and accumulated by different cultural groups (D'Ambrosio, 2001). This knowledge is regarded as part of an evolutionary process of change part of the same cultural dynamism present as each group comes into contact with each other (Zaslavsky, 1996).

A study of the different ways in which people resolve problems and the practical algorithms on which they base these mathematical perspectives becomes relevant for any real comprehension of the concepts and the practices in the mathematics that they have developed over time (Rosa & Orey, 2008).

Ethnomathematics aims to draw from the cultural experiences and practices of students, their communities, and the society at large in using them as vehicles to make mathematics learning meaningful, but, more importantly, to provide students with the insights of mathematical knowledge as embedded in their unique linguistic and cultural contexts. The main goal of an ethnomathematics program is to accomplish this equity among students by incorporating social justice into the mathematics curriculum.

4. Social Justice

It is increasingly necessary to empower students by teaching them about real-world issues in connection to their linguistic and cultural backgrounds in order instill in them a desire to seek out and work towards their personal goals. In this context, D'Ambrosio (2007) stated that individuals who do not believe in, or have not learned how to value their mathematical background, or their own cultural roots, can easily assimilate the dominant culture without critically reflecting on its values. This essentially is pedagogical colonization.

It is important to contextualize mathematics as knowledge emerges from the needs and expectations of the members of distinct cultural groups. Teaching for social justice focuses on the context of the understanding of mathematical ideas, procedures, and practices developed by members of these communities, which force confrontations in relation to assumptions about *truth* and *knowledge*, and which can easily be confused with the *right* and *wrong* in mathematics (Rosa & Orey, 2016).

Hence, teachers need to understand the historical and cultural variations of mathematical ideas, procedures, and practices that vary across time, culture of origin, race, ethnicity, gender, sexual orientation, and other sociocultural characteristics. It is recommended that mathematics curriculum must be:

> (...) concerned with interrogating oppression or promoting more social justice focus on teaching and curriculum — in particular, the ways in which teacher beliefs, teacher practices, and school policies like tracking can be viewed as forms of racism. At a practical classroom level, it is important for teachers and teacher candidates to recognize how popular educational reforms in mathematics can have different affects on students who historically have been marginalized (Gutiérrez, 2015, p. 13).

In this regard, when the focus of a study is the pedagogy of mathematics, the attention must be directed towards both around legitimizing students' knowledge, originated from experiences built in their own ways, as well around the study of pedagogical possibilities of how to work with the learning processes that occur both outside and inside the school environment.

Indeed, a discussion of educational aspects of mathematics can help teachers establish models of beliefs, thought, and behavior. This can be done by contemplating the potential of pedagogical work that takes into account the sociocultural background of students, as well as a more meaningful and empowering mathematical learning experience (Rosa & Orey, 2016). The suggestion of starting with a student's existing mathematical concepts is another way to provide a critical examination of such concepts.

The consequence of this approach for teacher education is quite significant. It means that teachers must be supported and encouraged to know more about mathematics and additional pedagogical competencies found in their own communities in order to help students undertake critical and reflective examinations of their own growing mathematical knowledge. Teaching is considered a higher order task that helps researchers, educators, and students understand the connection between mathematics and culture.

According to Rosa and Orey (2016), mathematics for social justice has to be equal for students from different cultural backgrounds. An important change in mathematics instruction needs to take place in order to accommodate social and cultural changes in society. Therefore, teachers need to have support, which enables them to gear education towards students from distinct cultures.

The main aspect of social justice is to help students to understand alternative mathematical systems to gain a better comprehension of the importance of mathematics in society. The justification for conducting investigations in relation to the development of social justice in mathematics education are related to its implications for curriculum innovation and development, teaching practices, teacher education, policy making, and its connection to the efforts to erase arrogance, inequity, and bigotry in society.

5. Connecting Ethnomathematics, Culturally Relevant Pedagogy, and Social Justice

Because it proposes that teachers contextualize mathematics learning by relating mathematical content to students' real life-experiences, an important change in mathematical instruction needs to take place in order to accommodate continuous and ongoing changes in the demographics of students in classrooms.

The guidelines of both the *National Council of Teacher of Mathematics* (NCTM, 1991) and the *Brazilian Ministry of Education and Culture* (Brasil, 1996) highlighted the

importance of building connections between mathematics and students' personal lives and cultures. In this context, Rosa and Orey (2007) affirmed that when practical or culturally-based problems are examined in a proper social context, the practical mathematics of social groups is not trivial because they reflect themes that are profoundly linked to the daily lives of students.

Educators working from culturally relevant perspectives demonstrate a belief that all students can be competent regardless of gender, race or social class, and provide students with scaffolding between what they know and what they do not know, focus on instruction during class rather than busy-work or behavior management, extend students' thinking beyond what they already know, and exhibit in-depth knowledge of students as well as subject matter (Ladson-Billings, 1995).

In this regard, students may be successful in mathematics when their understanding of it "is linked to meaningful cultural referents, and when the instruction assumes that all students are capable of mastering the subject matter" (Ladson-Billings, 1995, p. 141).

Because *ethno* is defined as all culturally identifiable groups with their own jargons, codes, symbols, myths, and even specific ways of reasoning and inferring; *mathema* defined as categories of analysis; and *tics* defined as methods or techniques, knowledge developed from culturally relevant perspectives can be perceived as a version of an ethnomathematics program.

According to Gutstein et al. (1997), in the culturally relevant mathematics classroom, the teacher builds from the students' knowledge (*ethno*) or informal mathematics and orients the lesson toward their culture and experiences (*mathema*), while developing the students' critical thinking (*tics*).

Ethnomathematics refers to forms of mathematics that varies as a consequence of being embedded in the values and cultural activities. In this perspective, Orey (2000) affirmed that "ethnomathematics might be characterized as a tool to act in the world" (p. 250) and it provides insights into the social role of academic mathematics in the search for social justice. By seeking the development of social justice in society, a culturally relevant pedagogy focuses on the role of mathematics in socio-cultural contexts that involves ideas and concepts for solving daily problems (Rosa & Orey, 2008).

Teaching mathematics for social justice explores different methods of organizing mathematical ideas, practices, and problem solving. Rosa (2010) argued that ethnomathematics as pedagogical action demonstrates how mathematics is contextualized and grounded in the needs and expectations of the community that utilizes it. The main goal of ethnomathematics is to contribute both to the comprehension of culture and to the understanding of mathematics, but mainly to the relationship between these two objectives.

An important component of mathematics education should be to reaffirm and restore the cultural dignity of all students. As students experience multicultural activities that reflect the knowledge and behaviors of people from diverse cultural environments, they can learn to see and value the mathematics found therein. As well, they can develop a greater respect for those who are different from themselves. Teaching for social justice enables students to acquire mathematical skills while maintaining cultural dignity in order to prepare them for participation in society (D'Ambrosio, 2007).

Participants in an ethnomathematics program learn to understand and accept the cultural roots of the *dominated* cultural group by coming to understand and value their

mathematical idea, procedures, and practices. They also recognize the applications of academic mathematics and promote mathematical ideas, procedures, and practices that were developed by *others*. This program also supports the learning of the mathematics of the dominant culture because the dominated cultural groups need to have equal access and be knowledgeable about the mathematics of the dominator (Rosa & Orey, 2007).

Educators must critically reflect on their own pedagogical practices in order to avoid a compliant thinking and to foster equity and social justice. Educators who understand historical and cultural variations of mathematical ideas, procedures, and practices that vary across time, culture of origin, race, ethnicity, gender, sexual orientation, and other sociocultural characteristics are better equipped to do this (Rosa & Orey, 2010).

This context supports educators to deeply understand, analyze, and review their own pedagogical practices and actions. For example, the results of the study conducted by Pinheiro (2017) showed the importance of teacher collaboration that enabled them to promote the development of academic and professional skills that assisted in the inclusion of deaf students in a productive life and in the full exercise of their rights to citizenship.

The main objective was to propose an innovative methodology in the teaching and learning of mathematics for deaf students based on the assumptions of an ethnomathematics program related to the development of financial education content for this student population.

Particularly, the role played by teachers is of vital importance for culturally and linguistically diverse students because they influence the learning experience outcomes for these students as well as their transformation into active and empowered members of society (Rosa, 2010).

Furthermore, teachers need to both know and understand the complex relations of students' cultural and linguistic backgrounds in relation to school performance and achievement goals in mathematics. In this regard, it is crucial that these teachers become sensitive to the multicultural needs of their students (Cummins, 2000).

Teachers need to recognize and address any preconceived notions that they might hold about students' linguistic and cultural backgrounds because they are faced with the challenge of providing opportunities for these students to learn and perform at the same rate of achievement as mainstream learners because they frequently experience failure and frustration as a result of negative societal perceptions about their academic abilities, achievement, and successes.

These perceptions create an environment of neglect and low expectation in relation to this student population. Teachers' perceptions serve as one tool to guide them in order to provide different paths that ensure the academic success of all students.

Teachers might use their own perceptions as a judgment of their capabilities to structure a particular pedagogical action in order to produce desired outcomes for students from diverse cultural and linguistic contexts. In this regard, "perceptions can be powerful drivers of behavior" (VanTassel-Baska & Baska, 2004, p. 7).

For example, it is documented that teacher perceptions about differences in student achievement frequently appear between groups of educators and students of different races because their performance is erroneously compared to different student groups. One of the distorted perceptions created by this is that student achievement gaps are

related to their skin color and linguistic and cultural backgrounds (Bainbridge & Lasley II, 2000). This is obviously wrong.

Culturally relevant pedagogies using ethnomathematics allow for a deep examination of the cultural and socioeconomic influences on teaching and learning processes and include a commitment to the challenging of social injustices and reflections upon educational challenges by identifying obvious and subtle individual, institutional, linguistic, and cultural actions that perpetuate social structures (Rosa, 2010). It instills a sense of ethics, mindfulness, caring, respect, and responsibility in the "professionals who serve culturally and linguistically diverse students" (Klingner et al., 2005, p. 8).

Pedagogical practices such as these implement supportive environments for teacher reflection, inquiry, and mutual support. As well, educators working with issues of linguistic and cultural difference encourage an understanding and respect for individual differences and strive for higher levels of achievement for all students (Beauboeuf-Lafontant, 1999).

For example, Torres-Velasquez and Lobo (2004) affirmed that this perspective is an essential component of culturally relevant education because it proposes that teachers contextualize mathematics learning by relating mathematical content to students' linguistic, cultural, and real-life experiences.

Ethnomathematics also supports the learning of academic mathematics as individuals from minority or marginalized groups have equal access to knowledge and be knowledgeable about the mathematics used by the dominators (D'Ambrosio, 2001; Rosa & Orey, 2007). This also links students' diverse ways of knowing, learning, and culturally embedded knowledge to academic mathematics.

This program explores academic and culturally ways to provide more inclusive developmental programs for the diverse populations served at educational institutions (D'Ambrosio, 2007). According to Rosa and Orey (2007), an ethnomathematics approach to a mathematics curriculum is the pedagogical vehicle for achieving such a goal.

Classrooms can no longer be isolated from the communities in which they are embedded in because they are part of an environment with defined cultural practices focused on the process of teaching and learning mathematics. For example, Bandeira and Lucena (2004) and Lean (1994) identified cultural mathematics and its acquisition in traditional school settings.

Borba (1993) stated that classrooms are environments that facilitate pedagogical practices, which are developed by using an ethnomathematical approaches. Because these practices embrace sociocultural contexts of students, Chieus (2004) affirmed that the pedagogical work towards an ethnomathematics perspective allows for a broader analysis of school contexts in which pedagogical practices transcend traditional the classroom environments. Similarly, Damazio (2004) suggested that pedagogical elements necessary to develop a mathematics curriculum are found in the school community context.

It is necessary to support teachers to develop different approaches to mathematics instruction that empower students to understand mathematics more critically and, at the same time, by considering the effects of culture on mathematical knowledge and work with them to uncover the distorted and hidden history of the development of this knowledge area.

In this context, Rosa (2010) argued that this approach is essential in developing the curricular practice of ethnomathematics and culturally relevant education for social justice through the investigation of the cultural aspects of mathematics and an elaboration upon mathematics curricula that considers the contributions of people from other cultures.

Even though culture is embedded in mathematics, teachers are not always aware of its influence in the learning of mathematical concepts. As a result, they may fail to see culture explicitly as it relates to the teaching of mathematics (Rosa, 2010). Therefore, teachers need the support that enables them to develop and create pedagogical actions related to the cultural and linguistic backgrounds of their students.

6. Curricular Implications

It is necessary to both incorporate and integrate diverse ways of knowing, understanding, and representing information for teachers and students. This is especially important when instruction and learning take place in environments that both encourage multicultural viewpoints and allows for the inclusion of knowledge that is relevant to students.

It is recommended that teachers gain support in order to develop learning environments that are relevant to and reflective of student social, cultural, and linguistic experiences so that they can be able to act more as coaches, guides, mediators, facilitators, consultants, instructors, and advocates for students in order to effectively connect students' community-based knowledge to the classroom learning experiences.

Educational leaders must provide both teachers and students with relevant mathematical experiences by integrating into the curriculum mathematical topics from their own cultures (Rosa, 2010).

Moreover, Eglash (1997) argued that including cultural aspects in the curriculum have long-term benefits for students while Rosa and Orey (2007) affirmed that knowing students' cultural and linguistic background is essential for providing successful learning opportunities for all learners that enhance their ability to make meaningful connections and deepening their understanding of mathematics.

This approach includes cultural relevance and builds school curricula around local interests, language, and the culture of students. Teaching mathematics through cultural relevance and personal experience helps students to know more about reality, culture, society, and environmental issues by providing them with mathematics content and approaches that enable them to successfully master academic mathematics (Rosa, 2010).

It is important that teachers are prepared to apply pedagogical strategies that effectively help them to serve students from culturally and linguistically diverse environments. However, in order to make decisions about how to modify pedagogies in response to the needs of their students, equal support must be given to teachers so that they gain increased and effective research-based instructional practices to help students to develop proposed curricular activities in the classrooms.

A culturally relevant mathematics curriculum based on ethnomathematical perspectives for social justice infuses student cultural backgrounds in a holistic manner (Adam et al., 2003; Rosa & Orey, 2010). In this curriculum, mathematics is taught in a meaningful

context in which students are given opportunities to relate new content and learning experiences to knowledge and skills they have previously acquired.

For example, a mathematics curriculum conceived in an ethnomathematical perspective helps to develop mathematical concepts and practices that originate in student culture by linking them to academic mathematics (Bandeira & Lucena, 2004). The understanding of conventional mathematics feeds back and contributes to a broader understanding of culturally based mathematical principles.

The work of Lipka (2002) in Alaska is an example of this type of approach to the mathematicus curriculum innovation. The results of his study showed that this curriculum motivates students to recognize mathematics as part of everyday life and enhances their ability to make meaningful mathematical connections by deepening their understanding of all forms of mathematics.

An implementation of this pedagogical practice helps students in further developing their cultural identity and encourages them to strive for academic excellence and outstanding participation (Rosa, 2010). The main implication for teachers is that they have to consider student linguistic and cultural backgrounds in designing and selecting classroom activities by incorporating ethnomathematics into mathematics curriculum.

For students to reach their full potential, instruction should promote the acquisition of complex mathematical knowledge and language skills in a social climate that fosters collaboration and interactions among students and teachers. Such classrooms are inclusive in their emphasis on high expectations and outcomes for all students (Rosa, 2010).

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 students' needs in order to enhance their mathematical learning and achievement.

7. Final Considerations

The challenges of an increased accountability demands a different kind of teaching strategy that enables teachers to serve students more effectively for the development of social justice orientation. Therefore, mathematics educators need to develop educational platforms and engage in reflection.

In order to teach for social justice, it is necessary to recognize how reflecting on and/or pondering about issues, perceptions, beliefs, and problems lead teachers to enhance their 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.

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

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

In this regard, if teachers are to facilitate successful learning opportunities for all students, they must know them and acknowledge their 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 understand the linguistic and cultural differences of their students, strive for intentional variety in instruction, curriculum, 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 recommended that teachers discuss this issue not only in terms of mathematical viability, but also in terms of equity. 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.

8. References

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