

## Culturally relevant pedagogy: an ethnomathematical approach

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### Abstract

The implementation of a culturally relevant pedagogy in the school curriculum helps to develop students' intellectual, social, emotional, and political learning by using their own cultural referents to impart their knowledge, skills, and attitudes. A culturally relevant pedagogy provides ways for students to maintain their identity while succeeding academically. In the context of culturally relevant pedagogy, there is a need to examine the embeddedness of mathematics in culture, drawing from an ethnomathematical perspective that takes on the cultural nature of knowledge production into the mathematics curriculum. Ethnomathematics and culturally relevant pedagogy-based approaches to mathematics curriculum are intended to make school mathematics relevant and meaningful as well as to promote the overall quality of students' educational experience. In this perspective, the theoretical framework used in this article is Culturally Relevant Education Theory. Since Culturally Relevant Pedagogy and the Cultural Aspects of Ethnomathematics are interrelated to Culturally Relevant Education, this article is also framed by applying these theoretical approaches.

*Keywords:* Culturally Relevant Pedagogy; Ethnomathematics; Academic Mathematics; Ethnomathematics Curriculum; Culturally Relevant Curriculum; Cultural Aspects of Mathematics.

### Pedagogia culturalmente relevante: uma abordagem etnomatemática

### Resumo

A implementação de uma pedagogia culturalmente relevante no currículo escolar auxilia a desenvolver o aprendizado intelectual, social, emocional, e político dos alunos através da utilização das próprias referências culturais para a divulgação do conhecimento, das habilidades e das atitudes desses alunos. A pedagogia culturalmente relevante fornece as maneiras pelas quais os alunos mantêm a própria identidade enquanto são bem sucedidos academicamente. No conteúdo da pedagogia culturalmente relevante, existe a necessidade de examinar a inserção da matemática na cultura através da perspectiva etnomatemática que considera a natureza cultural da produção do conhecimento no currículo matemático. As abordagens da etnomatemática e da pedagogia culturalmente relevante no currículo matemático têm a pretensão de tornar a matemática escolar mais relevante e significativa bem como promover a qualidade da experiência educacional dos alunos. Nessa perspectiva, o enquadramento teórico utilizado nesse artigo é a Teoria da Educação Culturalmente Relevante. Como a Pedagogia Culturalmente Relevante e os Aspectos Culturais da Matemática estão interrelacionados com a Educação Culturalmente Relevante, esse artigo também é enquadrado com a aplicação dessas abordagens teóricas.

*Palavras-chave:* Pedagogia Culturalmente Relevante; Etnomatemática; Matemática Acadêmica; Currículo Etnomatemático; Currículo Culturalmente Relevante; Aspectos Culturais da Matemática.

### Introduction

Some scholars have developed a theory of culturally relevant pedagogy which examines the teaching-learning process within a critical paradigm and through explicit connections between the home culture and the subject matter of students (Gay, 2000; Ladson-Billings, 1995). In this regard, Gay (2000) stated that a culturally relevant pedagogy “can be defined as using cultural knowledge, prior experiences, frames of reference, and performance styles of ethnically diverse students to make learning

encounters more relevant and effective for them” (p. 29).

A culturally relevant pedagogy builds upon research in educational anthropology, which examines cultural congruence between students' community and school. Along with this line, Gerdes (1996) stated that ethnomathematics is “the cultural anthropology of mathematics and mathematical education ... [lying] at the confluence of mathematics and cultural anthropology” (p. 909). In relation to the pedagogical work in schools, Hart (2003) affirmed that “The views of pedagogy within the literature on

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ethnomathematics are compatible with work on culturally relevant pedagogy” (p. 42). In other words, cultural congruence indicates teachers’ respect for the cultural and linguistic backgrounds of their students. According to Zeichner (1996), in order for teachers to implement the principle of cultural congruence, they should have knowledge of and respect for the various cultural traditions and languages of students in their classrooms. In so doing, Rosa (2010) stated that they should develop a clear sense of their own ethnic and cultural identities in order to be able to understand and appreciate those of their students.

Since mathematics usually tends to be presented as a set of objective and universal facts and rules, these subjects are often viewed as *culture free* and not considered socially and culturally constructed disciplines (Banks, 1991; Lee, 1999). In so doing, teachers need to understand what counts as knowledge in mathematics as well as how knowledge may be related to norms and values of diverse cultures and languages. In other words, dealing with integrating diverse cultures and languages in the classroom needs a conceptual framework in order to make coherent decisions as a teacher. This may help teachers understand how their own cultural biases influence judgments about students’ performance and obstruct their ability to learn mathematics.

### Theoretical Framework

The theoretical framework used in this article is Culturally Relevant Education Theory. Since Culturally Relevant Pedagogy and the Cultural Aspects of Ethnomathematics are interrelated to Culturally Relevant Education, this article is also framed by applying these theoretical approaches.

Gay (2000) and Nieto (2000) stated that Culturally Relevant Education was developed out of concern for the serious academic achievement gap experienced by low-income students, students of color, and students from linguistically and culturally diverse environments. According to Gay (2000), Kalyanpur (2003), and Klotz (2006), Culturally Relevant Education uses the cultural knowledge, prior experiences, frames of reference, and learning styles of ethnically and linguistically diverse students to make learning more relevant and effective with the objective to strengthen their connectedness with schools and as consequence reduce behavior problems and enhance learning. In this regard, Klotz (2006) and Ladson-Billings (1995) affirmed that schools benefit from being culturally relevant by contextualizing instruction and schooling practices

while maintaining academic rigor and helping students to achieve their academic potential. In Rosa’ (2010) point of view, this is one of the most important goals of Culturally Relevant Education.

However, Ladson-Billings (1995) stated that in order to achieve this goal, it is necessary to implement culturally relevant pedagogy into the school curriculum because it helps to develop students’ intellectual, social, emotional, and political learning by using their cultural referents to impart knowledge, skills, and attitudes. According to Ogbu and Simons (1998), a culturally relevant pedagogy provides ways for students to maintain their cultural identity while succeeding academically. This means that a culturally relevant pedagogy is a teaching methodology designed to fit school culture together with students’ culture to form the basis for helping them to understand themselves and their peers, develop and structure social interactions, and conceptualize mathematical knowledge.

On the other hand, ethnomathematics studies the cultural aspects of mathematics. It presents mathematical concepts of the school curriculum in a way in which concepts are related to the students’ cultural backgrounds (D’Ambrosio, 1990), thereby enhancing their abilities to make meaningful connections and deepening their understandings of mathematics. In the context of culturally relevant pedagogy, there is a need to examine the embeddedness of mathematics in culture, drawing from a body of literature that takes on the students’ cultural root of knowledge production into the mathematics curriculum (D’Ambrosio, 1990; Rogoff, 2003; Vygotsky, 1978). In this perspective, Rosa (2010) affirmed that the application of ethnomathematical approaches and culturally relevant pedagogy into the mathematics curriculum are intended to make school mathematics more relevant and meaningful to students and to promote the overall quality of their education.

### Mathematics and Culture

Mathematics was, for a long time, regarded as neutral and culturally free, and also considered free of social values (Bishop, 1993; D’Ambrosio, 1990). It was always taught in schools as a culturally neutral or free subject that involved learning supposedly universally accepted facts, concepts, and contents. In other words, Western or academic mathematics consists of a body of knowledge of facts, algorithms, axioms, and theorems.

Ethnomathematicians such as D’Ambrosio

(1990), Gerdes (1996), Joseph (2000), Powell and Frankenstein (1997), and Rosa and Orey (2007a) argued that mathematics is a cultural product and that every culture has developed its own forms of mathematics. In this perspective, Gerdes (1996) stated that:

*Ethnomathematicians emphasize and analyze the influences of sociocultural factors of the teaching, learning, and development of mathematics ... They look for cultural elements ... [that] reveal mathematical and other scientific thinking. [In addition,] ethnomathematicians also look for ... activities that may serve as a starting point for doing and elaborating mathematics in the classroom (p. 917-918).*

These ethnomathematicians also argued that the pervasive view of mathematics as Eurocentric and value-free misrepresents the evolution of modern mathematics. This perception is also reinforced by the students' experience of the way mathematics is taught in schools. Brown, Cooney, and Jones (1990) suggested that teachers' view of mathematics is transmitted to the students in their instruction and this fact helps to shape students' views about the nature of mathematics. Even though the universality of mathematical truths is not questioned, it is only in the last three decades that mathematics as *culture free* has been challenged (Bishop, 1988; D'Ambrosio, 1985; Rosa & Orey, 2006).

According to Bishop, Hart, Lerman, and Nunes (1993), "there is no sense in regarding mathematics learning as abstract and culture free" (p. 1) because the learning process cannot be abstract and context free, that is, learning cannot be free of environmental and societal influences. Some studies (Bandeira & Lucena, 2004; Chieus, 2004; Gerdes, 1994; Harris, 1991; Nunes, 1992) that looked at mathematics in a variety of contexts confirm this assertion. Researchers, philosophers, educators, scholars, and mathematicians (D'Ambrosio, 1985; Fasheh, 1997; Moses & Cobb, 2001; Nasir & Cobb, 2007; Orey, 2000; Powell & Frankenstein, 1997; Rios, 2000; Zaslavsky, 1997) argued that it is worth noting that the contextualization of mathematics has been described as the identification of mathematical practices developed in different cultural groups.

Because mathematics is a cultural construct; it is a product of cultural development. In this regard, this claim of mathematics contradicts the claims that are made by modern mathematics as universal,

objective, and culturally neutral. This is an important issue that leads to the development and inquiries of culturally relevant pedagogy and ethnomathematics (D'Ambrosio, 1990; Nasir, Hand, & Taylor, 2008). According to this perspective, Rosa and Orey (2006) affirmed that ethnomathematics as a program was developed "to confront the taboos that the mathematics as a field of study is universal and acculturated" (p. 20).

### **Ethnomathematics and the Cultural Aspects of Mathematics**

The term ethnomathematics was 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. D'Ambrosio (1993) argued that in order to understand those problems (*mathema*), it is necessary to consider the cultural context (*ethnos*) that drives them.

The essence of the ethnomathematics program is to acknowledge that there are different ways of doing mathematics by considering the appropriation of the academic mathematical knowledge developed by different sectors of the society as well as by considering different modes in which different cultures negotiate their mathematical ideas and practices (D'Ambrosio, 2001). In this conception, 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).

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 (Borba, 1997). This way of viewing mathematics validates and affirms all people's experience of mathematics because it demonstrates that mathematical thinking is inherent to their 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 (1990)

argued that in an ethnomathematical perspective, mathematical thinking is developed in different cultures in accordance to common problems that are encountered within a cultural context. In D'Ambrosio's (1993) perspective, in order to solve specific problems, *ad hoc*<sup>1</sup> 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, 1990). The tendency has been to consider these *ad hoc* mathematical practices as non-systematic and non-theoretical. In contrast, the study of ethnomathematics underlies a structure of inquiry in *ad hoc* mathematical practices by considering how these practices and problem solving can be developed into methods and theories. Since different types of problems are common in different cultures, the kinds of solutions, methods, and theories that are developed may differ from culture to culture. In this regard, D'Ambrosio (1993) stated that what is recognized as a problem and a solution in one culture may have no meaning in another culture.

Mathematics is identified in cultural activities in traditional and non-traditional societies (D'Ambrosio, 1985; Dowling, 1991; Orey, 2000). This means that ethnomathematics refers to mathematical concepts embedded in cultural practices and it recognizes that all cultures and all people develop unique methods and sophisticated explications to understand, comprehend, and transform their own reality (D'Ambrosio, 1990; Rosa & Orey, 2007B). It also recognizes that the accumulated methods of these cultures are engaged in a constant, dynamic, and natural process of evolution and growth in every society. D'Ambrosio (1993) stated that ethnomathematics has come to mean the study of how people within various cultural groups develop techniques to explain and understand their world in response to problems, struggles, and endeavors of human survival, including 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. Rosa and Orey (2008) affirmed that this perspective "provides an important opportunity for educators to link current events and the importance of these artifacts in the context of ethnomathematics, history, and culture" (p. 33).

Another presupposition of ethnomathematics is that it validates all forms of mathematical explaining and understanding formulated and accumulated by different cultural groups (D'Ambrosio, 1993). This knowledge is regarded as part of an evolutionary process of change that is part of the same cultural dynamism present as each group comes into contact with each other (Rosa, 2005; 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 (D'Ambrosio, 2006; Rosa & Orey, 2008). Ethnomathematics refers to forms of mathematics that vary as a consequence of being embedded in cultural activities whose purpose is other than doing mathematics. In this perspective, Orey (2000) affirmed that "Ethnomathematics might be characterized as a tool to act in the world" (p.250) and as such, it provides insights into the social role of academic mathematics.

### Culturally Relevant Pedagogy

A culturally relevant pedagogy focuses on the need for teachers to not only value the diverse home cultures of students they teach, but explicitly address the home culture and students' understanding of it in the classroom, to teach mathematics in a culturally appropriate manner situated within students' funds of knowledge (Moll, Amanti, Neff, & Gonzalez, 1992) that they bring to school, and to be educated with an understanding of the historical legacy of racism in society and its current impact on education (Ladson-Billings, 1995). The understandings and processes of culturally relevant pedagogy underscore students' connections to their home culture, and provide ways for school leaders and teachers to support cultural connections in school and use them to scaffold learning.

Culturally relevant pedagogy is a teaching style that validates and incorporates students' cultural background, ethnic history, and current societal interests into teachers' daily instruction. It addresses students' socio-emotional needs and uses ethnically and culturally diverse materials for its pedagogical action in classrooms (Banks, 1991; Gay, 2000; Scheurich & Skrla, 2003). In this perspective, Ladson-Billings (1994) stated that culturally relevant pedagogy is an educational approach that empowers students intellectually, socially, emotionally, and

politically through the use of cultural and historical references to convey knowledge, impart academic skills, and change students' attitudes towards academic instruction.

Some researchers (Gay, 2000; Howard, 2003; Klug & Whitfield, 2003; townsend, 2000) have taken their studies a step further with the development of culturally relevant pedagogy, which is a theoretical framework for education that attempts to integrate the culture of different racial and ethnic groups into the overall academic program. In this point of view, Scheurich and Skrla (2003) argued that the basic premise of culturally relevant pedagogy "is that teachers should teach using philosophies and methods that respect, value, and use positively the strengths of students' home cultures, contexts, and languages" (p.48).

Richards, Brown, and Forde (2000) affirmed that culturally relevant pedagogy delineates and promotes the achievement for all students because effective teaching and learning take place in an environment that is culturally supported, learner-centered context, whereby the strengths students bring to school are identified, nurtured, and utilized to promote their achievement. Some studies of culturally relevant environments (Banks, 1991; Gay, 2000, Ladson-Billings, 1994) showed that the academic achievement of students who come from culturally and linguistically diverse backgrounds improve if schools and teachers ensure that classroom instruction is conducted in a manner that is relevant to their home and community cultures. For example, Moll, Amanti, Neff, & Gonzalez (1992) studied ethnic minority students in Mexican-American communities in Tucson, Arizona, as a means to empower student and support academic achievement. They examined the effect 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 clearly addressed the application of culturally relevant pedagogy. The purpose of their study was 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 treatment as implemented in their study.

Irvine and Armento (2001) suggested that culturally relevant pedagogy allows teachers to

provide and use meaningful learning materials; create environments, which include cultures, customs, and traditions that are different from their own; and include lessons that assist students in making meaningful connections between their lives and school-related experiences. In other words, participating in culturally relevant teaching essentially means that teachers create a bridge between students' home and school lives, while they still meet the expectations of the district, state, and federal curricular requirements because this kind of instructional pedagogy utilizes the backgrounds, knowledge, and experiences of the students to inform the teacher's planning mathematical lessons and methodology. Ogbu (1992) stated that a culturally relevant pedagogy must provide a way for students to maintain their cultural identity while succeeding academically. In other words, it is important that teachers contextualize instruction and schooling by applying culturally relevant pedagogy in their pedagogical practices as well as embodying relevance and rigor to the educational process. In this regard, Rosa (2010) affirmed that this is one of the goals of the ethnomathematics as a program.

### **Ethnomathematics and Culturally Relevant Pedagogy**

An important change in mathematical instruction needs to take place in order to accommodate continuous and ongoing change in the demographics of students in mathematics classrooms. According to Torres-Velasquez and Lobo (2004), it is necessary to integrate a culturally relevant pedagogy into the existing mathematics curriculum because it proposes that teachers contextualize mathematics learning by relating mathematical content to students' real life-experiences.

In this context, the guidelines of both the National Council of Teacher of Mathematics (NCTM, 1991) and the Brazilian Ministry of Education and Culture (MEC, 1996) highlighted the importance of building connections between mathematics and students' personal lives and cultures. Along with this line, Rosa & Orey (2006) 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" (p. 34). According to Rosa & Orey (2008), the culturally relevant mathematical pedagogy should focus on the role of mathematics in a socio-cultural context that involves the ideas and concepts

associated with ethnomathematics, which uses an ethnomathematical perspective for solving problems. In this regard, Ladson-Billings (1995) stated that teachers working from a culturally relevant perspective demonstrate a belief that students can be competent regardless of race or social class, 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. In this perspective, 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).

According to this context, Rosa (2010) affirmed that mathematics knowledge in the culturally relevant perspective is viewed as a version of ethnomathematics program because *ethno* is defined as all culturally identifiable groups with their 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. According to Gutstein, Lipman, Hernandez, & de los Reyes (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 skills (*tics*).

### A Culturally Relevant Curriculum

Teachers need to make use of culturally diverse curriculum content in the classroom because effective teaching and learning for ethnically diverse students may be expedited through the use of instructional materials that recognize the contributions that people of diverse ethnic groups have made to the current bank of knowledge. When students see visions of people who look and live like those of their culture, both currently and historically, it not only breeds interest but also provides motivation for students to believe they can achieve, and that their achievement is not only expected but valued. In a culturally relevant pedagogy, the curriculum bridges the academic learning with students' prior understanding, knowledge, native language, and values (Conrad, Gong, Sipp, & Wright, 2004; Ginsberg & Wlodkowski, 2000; Powers, Potthoff, Bearinger, & Resnick, 2003; Waxman &

Tellez, 2002). This perspective into the school curriculum allows teachers to learn from and about their students' culture, language, and learning styles to make instruction more meaningful and relevant to their students' lives (Apthorp, D'Amato, & Richardson, 2003; Lee, 2003; Lipka, 2002). For example, Demmert and Towner (2003) have examined the research based on Native education and found six critical elements of culturally relevant education, which suggested an impact on academic achievement of Native-American students. These critical elements are the recognition and use of Native languages; the implementation of a pedagogy that uses traditional cultural characteristics; the application of teaching strategies and curriculum that are congruent with traditional culture and traditional ways of knowing; strong Native community participation in education; and knowledge and use of political mores of the community.

In the context of culturally relevant pedagogy, there is a need to examine the embeddedness of mathematics in culture, drawing from a body of literature that takes on the cultural nature of knowledge production into the mathematics curriculum (D'Ambrosio, 1990; Rogoff, 2003; Vygotsky, 1978). Mathematics as part of the school curriculum must reinforce and value cultural knowledge of students rather than ignore or negate it because a culturally relevant curriculum should fully integrate ELL students' cultural mathematics knowledge. Rosa and Orey (2007b) argued that this mathematics curriculum must be grounded in a constructivist approach to learning and seeks to change the way mathematics teachers construct their learning environments by producing teachers who are able to facilitate a mathematics learning environment grounded in real life experiences and to support students in the social construction of mathematics.

### An Ethnomathematics Curriculum

There are evidences from research (Bishop, 1988; Boaler, 1993; Eglash, 1997; Rosa & Orey, 2007A, Zaslavsky, 1996) that including cultural aspects in the curriculum will have long-term benefits for mathematics learners; that is; cultural aspects contribute to recognizing mathematics as part of daily life, enhancing the ability to make meaningful connections, and deepening the understanding of mathematics. In this regard, Chieus (2004) stated that the pedagogical work towards an ethnomathematics perspective allows for a broader analysis of the school context in which the pedagogical practices

transcend the classroom environment because these practices embrace the sociocultural context of the students. Damazio (2004) agreed with this perspective by suggesting that the pedagogical elements necessary to develop the mathematics curriculum are found in the school community. This means that the field of ethnomathematics presents some possibilities for educational initiatives that help to reach this goal. In D'Ambrosio's (1990) point of view, it is important to recognize that ethnomathematics is a research program that guides educational pedagogical practices. However, according to Monteiro, Orey, and Domite (2004), it is necessary to point out that the incorporation of the objectives of the ethnomathematics program as pedagogical practice in the school curricula and its operationalization and transmission in the field of education is a recent field of study that is still developing its own identity in the pedagogical arena.

The trend towards ethnomathematical approaches to mathematics curriculum and pedagogy reflects a comprehensive development in mathematics education. Ethnomathematical approaches are intended to make school mathematics more relevant and meaningful to students, and to promote the overall quality of education. Some researchers plead for a more culturally sensitive view of mathematics to be incorporated into the school curriculum (Adam, 2002; D'Ambrosio, 1985; Zaslavsky, 1991). For example, Powell and Frankenstein (1997) proposed the elaboration of a mathematics curriculum that is based on students' knowledge, which allows teachers to have more freedom and creativity to choose academic mathematical topics to be covered in the lessons. They suggested that through dialogue with students, teachers can apply mathematical themes that help them to elaborate the mathematics curriculum. In their point of view, teachers can engage students in the critical analysis of the dominant culture as well as the analysis of their own culture through an ethnomathematical perspective. In this context, Knijnik (1996) and Ferreira (1997) stated that it is necessary to investigate the conceptions, traditions, and mathematical practices of a particular social group such as ELL students, with the intention to incorporate them into the mathematics curriculum.

Further, Adam, Alanguai, and Barton (2003) and Rosa and Orey (2003) stated that a culturally relevant mathematics curriculum based on an ethnomathematical perspective infuses the students' cultural backgrounds in the learning environment in a holistic manner. One possibility for an

ethnomathematical curriculum may be labeled as mathematics in a meaningful context in which students are given opportunities to relate their new learning experiences to knowledge and skills they have previously learned (Adam, Alanguai, & Barton, 2003; Bandeira & Lucena, 2004). In this regard, it is particularly important that the mathematical learning experiences of ELL students acknowledge their cultural backgrounds and experiences in the learning of mathematics. This mathematical approach is presented as a cultural response to students' needs by making connections between their cultural background and mathematics (Rosa, 2005; Rosa, 2010). This approach supports the view that "mathematics ... is conceived as a cultural product which has developed as a result of various activities" (Bishop, 1988, P. 182) with the objective of making mathematics more relevant to students because every culture is assumed to have such mathematical responses and these responses are valid content for a mathematics classroom. A classroom using this type of ethnomathematical curriculum would be full of examples that draw on the students' own experiences and on experiences that are common in their cultural environment. These examples would be vehicles for communicating mathematical ideas, which themselves would be relatively unchanged. In so doing, ethnomathematics aims to draw from the students cultural experiences and practices of the individual learners, the 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 environments (Rosa & Orey, 2008).

It is assumed that this kind of curriculum motivates students to recognize mathematics as part of their everyday life and enhances students' ability to make meaningful mathematical connections by deepening their understanding of all forms of mathematics (Adam, 2002; Barton, 1996; Boaler, 1993). For example, Duarte (2004) investigated the uniqueness of mathematical knowledge produced by workers in the home construction industry through the study of mathematical ideas and practices that they develop in the construction sites. Duarte (2004) reflected on the mathematical knowledge possessed by the members of this working class in order to academically legitimate their knowledge and determine the pedagogical and curricular implications that are inferred in the process of productions of this knowledge.

The objective of developing an

ethnomathematical curriculum model for classrooms is to assist students to become aware of how people mathematize and think mathematically in their culture, to use this awareness to learn about formal mathematics, and to increase their ability to mathematize in any context in the future (Duarte, 2004; Rios, 2000; Rosa & Orey, 2006). This ethnomathematical curriculum leads to the development of a sequence of instructional cultural activities that enables students to become aware of potential practices in mathematics in their culture so that they are able to understand the nature, development, and origins of academic mathematics (Rosa & Orey, 2007A). Students also value and appreciate their own previous mathematical knowledge, which allows them to understand and experience these cultural activities from a mathematical point of view, thereby allowing them to make the link between school mathematics and the real world and daily life in this globalized society (Knijnik, 1993; Orey & Rosa, 2003; Rios, 2000).

An ethnomathematical curriculum brings a broader understanding about mathematics into the classroom mathematics program (Borba, 1993). Most mathematics curricula focus on mastery of skills, accumulation of facts, rules, and algorithms that are necessary for examinations. The curriculum is experienced as mathematical content (Begg, 1994), so most students leave school thinking that mathematics is something to be done only at school and that it has no relevance to their real lives. According to Rosa and Orey (2003), an ethnomathematical culturally relevant curriculum introduces an understanding about mathematics as part of mathematics education. They also stated that when students understand the nature of mathematics, they acquire the tools to better comprehend the relevance of mathematics in the various aspects of their everyday life.

Rosa and Orey (2003) argued that an ethnomathematics curriculum offers to the students, especially minority students, motivation to perceive mathematics as an important cultural tool that facilitates their mathematical learning. They also affirmed that the establishment of cultural connections is a fundamental aspect in the development of new strategies to the process of teaching and learning mathematics because it allows students to perceive mathematics as a significant part of their own cultural identity. Some studies (Hankes, 1998; Hale-Benson, 1994, Warschauer, 1999) demonstrated that the use ethnomathematics in the school curricula is an effective tool that contributes to

improve the learning of mathematics of minority students.

This curriculum focuses on mathematics as a process, rather than a collection of facts, and it is based on the idea that mathematics is a human creation that emerges as people attempt to understand their world. Therefore, mathematics is seen as a process, and as a human activity, rather than just as a set of academic content (D'Ambrosio, 2000; Rosa, 2010). This implies that an ethnomathematical curriculum is not just about the application of relevant contexts in learning and teaching mathematics, but is also about generating formal mathematics from cultural ideas (Gerdes, 1993). Thus formal mathematics is better understood, appreciated, and made more meaningful to its learners.

### Final Considerations

Culturally relevant pedagogy is a teaching methodology that is designed to fit the school culture of the students' culture as the basis for helping them to understand themselves and their peers, develop and structure social interactions, and conceptualize knowledge (Ladson-Billings, 1994). It builds on and values the cultural experiences and knowledge of all students regardless of whether they are represented by dominant or non-dominant cultural systems and empowers students intellectually, socially, emotionally, and politically by using cultural referents to impart their knowledge, skills, and attitudes in the pedagogical work in schools. Culturally relevant pedagogy combines an examination of the cultural and socioeconomic influences on teaching and learning. As well, it includes knowledge, with a commitment to challenging social injustices and reflecting on educational injustices by identifying obvious and subtle individual, institutional, and cultural actions that perpetuate social structures.

According to this perspective, ethnomathematics studies the cultural aspects of mathematics and presents the mathematical concepts of the school curriculum in a way that are related to the students' cultural backgrounds by enhancing their ability to make meaningful connections and deepening their understanding of mathematics. Ethnomathematics links student's diverse ways of knowing and learning and culturally embedded knowledge with academic mathematics because it explores academic and culturally rich ways to provide more inclusive developmental programs for the diverse populations served at educational institutions



(D'Ambrosio, 1990). It is a program that includes curricular relevance and which builds a curriculum around the local interests and culture of the learners (Rosa, 2005; Rosa, 2010). Teaching mathematics through cultural relevance and ethnomathematical perspective helps students to know more about reality, culture, society, environmental issues, and themselves by providing them with mathematics content and approaches that enable them to successfully master academic mathematics. Rosa and Orey (2007b) affirmed that an ethnomathematics approach to the mathematics curriculum is considered a pedagogical vehicle for achieving such a goal.

#### Nota

<sup>1</sup> 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.

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