A THEORETICAL DISCUSSION TO REVEAL THE PRINCIPLES OF CULTURALLY RELEVANT EDUCATION IN AN ETNOMATHEMATICAL PERSPECTIVE

Milton Rosa
milrosa@hotmail.com
Daniel Clark Orey
oreydc@gmail.com

Universidade Federal de Ouro Preto - UFOP

ABSTRACT

The implementation of Culturally Relevant Education helps to develop student intellectual, social, and political learning by using their cultural referents to acquire knowledge. It uses prior experiences of minority students to make learning more relevant and effective in order to strengthen their connectedness with school. Culturally relevant schools contextualize instruction and schooling practices while maintaining academic rigor. In these schools, school leaders, teachers, and staff members are able to recognize and build upon the strengths of students by applying instructional strategies that are culturally relevant. Culturally relevant leadership is grounded in the belief that minority students are able to excel in academic endeavors. Thus, it is necessary to enable the implementation of culturally relevant pedagogy into school curricula, which is designed to fit together school culture with students' cultural backgrounds to help them to conceptualize knowledge. There is a need to examine the embeddedness of culture mathematics, which 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 mathematical content relevant to students. The objective of this theoretical article is to discuss the principles of culturally relevant education according to an ethnomathematical perspective.

Keywords: Culturally Relevant Education, Culturally Relevant Schools, Culturally Relevant Leadership, Culturally Relevant Pedagogy, Ethnomathematics.

RESUMO

A implementação da educação culturalmente relevante auxilia a desenvolver o aprendizado intelectual, social e político dos alunos por meio da utilização de referências culturais para desencadear o conhecimento. Esse tipo de educação utiliza a experiências prévias de alunos provenientes das minorias para tornar o aprendizado relevante e efetivo, pois visa reforçar a sua conexão com as atividades escolares. As escolas culturalmente relevantes contextualizam a instrução e as práticas escolares enquanto mantém o rigor acadêmico. Nessas escolas, os líderes escolares, os professores e os funcionários são capazes de reconhecer e construir com base nos pontos fortes dos alunos por meio da aplicação de estratégias instrucionais que são culturalmente relevantes. A liderança culturalmente relevante está enraizada na crença de que os alunos provenientes das minorias são capazes de se destacarem em projetos acadêmicos. Então, existe a

necessidade de facilitar a implementação da pedagogia culturalmente relevante nos currículos escolares, que é projetada para embeber a cultura escolar nos backgrounds culturais dos alunos, auxiliando-os a conceituar o conhecimento. Existe a necessidade de analisar a inserção da cultura na matemática, que considera a natureza cultural da produção de conhecimento no currículo matemático. As abordagens da etnomatemática e da pedagogia culturalmente relevante no currículo matemático visam tornar o conteúdo matemático relevante para os alunos. Assim, o objetivo desse artigo teórico é discutir os princípios da educação culturalmente relevante de acordo com a perspectiva etnomatemática.

Palavras-chave: Educação Culturalmente Relevante, Escolas Culturalmente Relevantes, Liderança Culturalmente Relevante, Pedagogia Culturalmente Relevante, Etnomatemática.

1. Introduction

Major demographic shifts in most countries have led to increasing numbers of culturally, linguistically, socio-economically diverse, and minority students in the educational system (Bazron, Osher, & Fleischman, 2005). For example, in the United States, the passage of the *No Child Left Behind Act* (NCLB, 2001) and the resulting requirement that all schools report disaggregated data have brought increased attention to achievement gaps that have persisted for years between minority students and their mainstream peers (Gándara, Maxwell-Jolly, & Rumberger, 2008). According to a wide range of educational indicators including grades, significant inequities continue to exist for these students' scores on standardized tests, dropout and graduation rates, and enrollment in higher education (Education Trust, 2004).

One possible explanation for these gaps may be that disparities in achievement that stem in part from a lack of fit between traditional schools, in which practice is derived almost exclusively from Western cultures, and the home cultures of minority students (Ladson-Billings, 1995). Students whose cultural backgrounds are rooted in western ways of thinking possess an innate educational advantage as compared to students from alternative social cases and other cultural backgrounds. In this regard; minority students are required to learn through cultural ways of thinking and practices other than their own which students from dominate cultures do not contend with or have to do (Rosa, 2010).

This sociocultural mismatch is often a result of widely divergent worldviews about fundamental concepts such as human nature, natural and educational environments, and social relationships (Sowers, 2004). Related to this argument, an educational system rooted in the dominant culture is inherently biased (D'Ambrosio, 1990). In this regard, if one set of cultural beliefs is considered to be right, then the values of the members of other cultural groups may be treated as less valid, and students from those groups may be perceived as *culturally deficient* (Klingner, Artiles, & Barletta, 2006).

In the field of education, the *cultural deficiency*[1] model is often used to explain differences in achievement that exist among students from diverse and often very different social, racial, and

[1]The original definition of *cultural deficit* is found in Passow's Education in the book entitled *Depressed Areas* written in 1963, especially those chapters written by Goldberg and Deutsch. According to the National Commission on

ethnic groups (Katz, 1985). Any gaps in student achievement are based on environmental factors, lifestyles, and values of minority groups and form the basis for *cultural deprivation*, and highlights the so called *inferiority* of the members of a given cultural group while the absence[2] of a specific cultural background leads students to a sense of alienation not only from their school environment but from their traditional support system as well (Atkinson, Morten, & Sue, 1993).

The *deficit model* acts as if students do not have a sense of their own culture. This is most striking as often cultural deprivation is used to impose conservative white middle-class values in an attempt to link poor school performance, as well as low self-esteem and motivation, to problems with learners who come from homes, families, traditions, and cultural values (Trueba & Bartolomé, 1997) that do not match. These *deficient cultural values* include present versus future time orientation, immediate instead of deferred gratification, an emphasis on cooperation other than competition, and the placing less value on education and upward mobility (Carter & Segura, 1979) as seen by members of the dominant culture.

It is important to note that this model labels the internal social structure of minority families and students as *deficient*. Such perceived deficiency is seen to be the result of large, disorganized, female-headed families; where Spanish or other non-standard English is spoken at home; and patriarchal or matriarchal family structures (Trueba & Bartolomé, 1997). Proponents of this model contend that minority cultural values, as transmitted through the family, are dysfunctional and therefore cause low educational and occupational attainment (Valencia, 1991).

Furthermore, since parents of minority students fail to *assimilate* and *embrace* the educational values of the dominant culture and continue to transmit or socialize their children with values that inhibit educational mobility, they are to blame if low educational attainment continues into succeeding generations (Carter & Segura, 1979). In the cultural deficit model, students coming from minority cultures are described as failing to attain the levels of socioeconomic and academic status obtained by the majority culture due to the *disadvantages and failures* of the minority experience itself (Rosa, 2010).

Most criticism concerning cultural deficit model in education is related to the promotion of cultural stereotyping that contributes to unproductive efforts to show minority or low income students' home or school settings as the source of lower achievement. If researchers, school leaders, teachers, and educators assume a univocal view of culture as a universally valid ideal roughly equivalent to the condition of being civilized, then it is hard to determine how the label of culturally deficient adds to the common-sense notion of uneducated students and how cultural deficiency could be a cause of school failure (Kretovics & Nussel, 1994).

Excellence in Education (NCEE, 1983), the *cultural deficit* approach reappeared in the 1980s with the concept of *students at risk*.

[2]It is argued that "it is not clear of what culture these families and their children can be deprived, since no group can be deprived of its own culture. It appears therefore that the term becomes a euphemism for saying that working-class and ethnic groups have cultures which are at least dissonant with, if not inferior to, the 'mainstream' culture of the society at large" (Keddie, 1973, p. 8). In this context, if sociologists focus their attention on the supposed deficiencies of students, in terms of cultural deprivation, they may fail to notice the shortcomings of schools.

In practice, the deficit model is applied to schools to students of color and minority students by school leaders and teachers who are professionally trained in educational programs that utilize an individualistic and cultural deficit explanation of low educational attainment of minority students (Persell, 1977). The cultural deficit model remains the *hidden theory of choice* that many school leaders and teachers apply in their professional meetings and settings when the topic of minority educational inequality is discussed (McWhorter, 2000 *apud* Rosa, 2010).

In this educational environment, many school leaders and teachers struggle to connect with diverse student populations whose cultural backgrounds are distinctly different from their own (Marion, 2002). It is necessary that school leaders, teachers, and staff members embrace the relevance of culture as a means of helping all students reach high standards in a culturally relevant educational environment. In other words, by adopting a *culturally relevant education framework*, school leaders may be able to address issues of educational inequity and confront institutional bias and discrimination (Norton, 2005).

In so doing, school leaders and teachers may be able to avoid some of the consequences of the cultural deficit model such as higher rates of indiscipline and suspension among minority students (Rosa, 2010). However, in order to reach this goal, students' culture, native language, and cultural dialects must be valued and used as assets in their learning process rather than deficits, which is one of the main objectives of the ethnomathematics as a program.

In the last three decades, the theories of culturally relevant pedagogy and ethnomathematics were developed in order to ease these sociocultural concerns. This kind of pedagogy is considered as an oppositional pedagogy in which collective empowerment is its focus center. In other words, the overall goal of culturally relevant pedagogy is to empower students through learning activities that help them to develop their literacy, numeracy, technological, social, and political skills in order to be active participants in a democratic society (Ladson-Billings, 1995).

It is also important to emphasize here that culturally relevant pedagogy studies the cultural congruence between students' cultural backgrounds, communities, and schools. Along with this line, ethnomathematics is considered as "the cultural anthropology of mathematics and mathematical education (…) [lying] at the confluence of mathematics and cultural anthropology" (Gerdes, 1996, p. 909). In relation to the pedagogical work in schools, mathematical curricular activities must be relevant to the students' cultural backgrounds. In other words, the "views of pedagogy within the literature on ethnomathematics are compatible with work on culturally relevant pedagogy" (Hart, 2003, p. 42) because it examines the cultural congruence between students' community and school. This means that cultural congruence indicates teachers' respect for the social, cultural, and linguistic backgrounds of their students. However, it is necessary that schools leaders and teachers acquire knowledge of and respect for the students' various cultural traditions, languages, and mathematical knowledge so they are able to implement the principle of cultural congruence in their schools and classrooms (D'Ambrosio, 1990; Zeichner, 1996).

On the other hand, since mathematics usually tends to be presented as a set of objective and universal facts and rules, this subject is often viewed as *culture free* and not considered as a socially and culturally constructed discipline (Lee, 2003). However, to change this perception, it is necessary that school leaders and teachers understand what counts as knowledge in mathematics

as well as how knowledge may be related to norms and values of diverse cultures. If educators these professionals deal with integrating diverse cultures in the schools and classrooms, then they need a conceptual framework to make coherent decisions regarding to the curricular activities concerning the mathematics curriculum.

The aim of this paper is to show that there is a need to examine the embeddedness of mathematics in cultures by drawing from an ethnomathematical perspective that takes on the cultural nature of knowledge production into the mathematics curriculum. The argumentation is that culturally relevant education, culturally relevant schools, culturally relevant leadership, culturally relevant pedagogy may be considered as an ethnomathematical approach to the development of a mathematics curriculum because they intend to make school mathematics relevant and meaningful regarding the promotion of the overall quality of students' educational experience.

In so doing, it is necessary to provide a brief description of a related literature on these topics to show that these approaches help to develop students' intellectual, social, emotional, and political learning by using their own cultural referents to the acquisition of their knowledge, skills, and attitudes.

2. Culturally Relevant Education

Educational systems must be relevant to the emotional, psychological, and educational needs of all students (Darling-Hammond, 1997). Since there is a link between students' cognitive performance and their cultural environmental context, the development and implementation of a culturally relevant educational system is one of the best approaches needed to ameliorate minority student achievement gaps (Rosa, 2010).

For example, the main purpose of the study conducted by Maddahian (2004) was to gather evidence regarding the existence of a *Culturally Relevant Educational Programs* (CREP) in a large school district in California in which the random sample included 16 elementary, 12 middle, and 3 high schools that were selected for observation and data collection. This conceptual framework is considered as a comprehensive model dealing with all aspects of instruction and education. During the conduction of this study, Maddahian (2004) trained a team of fifteen data collectors to observe teachers and classroom environments in order to document evidence of culturally relevant instruction through detailed field notes; and in direct classroom observation.

The results of this study showed that there was almost no evidence of multicultural content in instructional delivery as well a sense of community presence were exceedingly rare in the schools. Finally, it was concluded that the implementation of CREP is a complex and challenging endeavor faced by schools in California. It becomes essential for school leaders to learn to respect and value all the cultural backgrounds of their student population and to apply instructional strategies where by all its students may benefit from their experiences and learning styles. School leaders and teachers need to possess a sociocultural awareness to be able to understand, appreciate and integrate the use all student needs and perspectives in order to build a school cultural climate in which all its students learn and achieve (Maddahian, 2004).

Culturally Relevant Education is defined as an educational theory "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). It is strengthened by incorporating a wider diversity of social, cognitive, and cultural experiences into a successful teaching and learning environment for all students by instilling the ethics of care, respect, and responsibility by the professionals who serve minority students such as school leaders, teachers, and staff (Rosa, 2010). In this theory, culturally relevant schools create and implement educational environments that facilitate processes of reflection, inquiry, and mutual support around issues of cultural difference for educators. The reflections that take place in these environments encourage and allow educators to understand, respect, often to encouraged individual differences as well as to strive for high educational standards and levels of achievement (Beauboeuf-Lafontant, 1999).

3. Culturally Relevant Schools

In culturally relevant schools, all students receive instruction through pedagogical actions that engage them intellectually by taking into account the pedagogical decisions affecting them most. This is especially important for those who have been traditionally marginalized by the school system (Ladson-Billings, 1995). It is important to highlight that "the benefits of culturally competent schools are numerous and include preventing academic failure, reducing drop-out rates, and engaging students and their families in the school community" (Klotz, 2006, p. 11). These schools are grounded in the belief that minority students are able to excel academically when their culture, language, heritage, and experiences are valued and used to facilitate their learning (Nieto, 1999).

For example, Lipka and McCarty (1994) conducted two case studies in which they described the transformation of the culture of schooling of two schools, one in Alaska and the other one in Arizona. Data were drawn from more than a decade of ethnographic and action-oriented research at Rough Rock Demonstration School, on the Navajo Nation in northeastern Arizona and in 10 Yup'ik community schools in southwestern Alaska. By coming together in native teacher study groups, Navajo and Yup'ik teachers and their elders found creative ways in which to use their own culture, knowledge, and language in the elaboration of curriculum and pedagogical activities. These teacher groups created zones of safety in which resistance to conventional practices could be expressed and innovative approaches to schooling could be investigated and practiced. The work of these teacher groups had theoretical implications for community-based teacher preparation. Factors influencing development of these groups and their ability to effect change were discussed along with the challenges of transferring their cultural creations to the wider institutions of schooling.

In culturally relevant schools, the teaching and learning process is relevant and meaningful to all students, specifically to students from various cultures. The "goals for culturally competent schools are to establish settings where all students are made to feel welcome; are engaged in learning; and are included in the full range of activities, curricula, and services" (Klotz, 2006, p. 11). In this perspective, all students, regardless of ethnicity or socioeconomic status, have an opportunity to learn to high standards and are encouraged to learn by acquiring knowledge in multi-dimensional pedagogical activities that are based on interests, experiences, knowledge, and skills that they bring daily to their classrooms (Burns, Keyes, & Kusimo, 2005).

4. The Implications of Culturally Relevant Leadership

The demands on school leaders in the public school system have escalated in response to changing demographics and pressures for high levels of student achievement. School cultural, linguistic and economic diversity requires school leaders to create communities that support learning and improve the achievement of all its members. School leaders are called to act on their commitment to culturally relevant pedagogy in the service of just, humane, and equitable school communities by collaborating with families and other community stakeholders (Farmer & Higham, 2007).

Culturally relevant school leaders recognize that culture means far more than recognizing racial and ethnic differences. School leaders must be willing to be in a state of learning in order to demonstrate an understanding of various cultures and be able to respond effectively to issues of culture and diversity in order to facilitate student learning (Lindsey, Robbins, & Terrell, 2003). They have to respond to diverse community interests and needs, and mobilize community resources in order to demonstrate and promote ethical standards of democracy, equity, diversity, and excellence and promote communication among diverse groups. Culturally relevant school leaders "create systems that support democratic education" (Davis, 2002, p. 5). However, for this to happen, it is necessary to develop a school-wide commitment that is dedicated to cultural relevancy and reciprocity in order to guide school leaders' work in order to influence their own practice.

An emphasis on the need for culturally relevant leaders reflects the influence culture has on the learning process. In so doing, in addition to leadership skills, school leaders need to acquire cultural intelligence in which is necessary that they learn about how other cultures define and exert leadership in order to gain and maintain cultural proficiency (Wibbeke, 2009). For example, a study conducted by Agbo (2002) focused specifically upon how the cultural roles of administrators of Native-American students translate into strategies that allow them to learn more effectively. This study reviewed the Mohawk Education Curriculum Development Project, which was developed though collaboration between administrators, public school teachers, and members of the school community to elaborate a culturally relevant standards-based curriculum that addressed problems of high dropout rates and underachievement of Mohawk students. It was recommended the implementation of cultural standards for teachers and administrators in addition to standards for parent-teacher communication.

Culturally relevant school leaders lead best by focusing attention and action on difficult questions while enduring problems faced by their schools. In so doing, they need to be culturally proficient in order to deal with the realities of oppression and to work with other stakeholders in order to eliminate oppression from their schools (Davis, 2002). However, they need to find their own voice, develop their political understanding and add advocacy to their leadership practices. This means that the development of culturally relevant leaders "is premised upon egalitarian principles that transcend individual cultural norms" (Farmer & Higham, 2007, p. 2). The core principles of culturally relevant leadership are sensitive to cultural nuances in communication processes, deliberate and sequential processes, appreciation of one's own cultural biases, and cultural responsiveness in education.

Because they expect an inclusive learning environment in which an appreciation of diversity, in culturally relevant leadership models, school leaders' values and leadership styles shape the school climate for learning and achievement by addressing cultural issues (Gay, 2000). This means that culturally relevant school leaders must be capable of motivating and energizing an increasingly heterogeneous student body in their schools in order to avoid *cultural dissonance*[3] (Ybarra, 2001), which is a disconnection between student cultural background and the corresponding thought processes of students in the classrooms' learning environment. In many educational systems, minority students often experience a sense of cultural dissonance, making them vulnerable to educational disadvantages.

Since culturally relevant leadership styles are rooted in the belief that students can learn and that every student has intrinsic cultural value, culturally relevant school leaders need to challenge students to their fullest potential because high expectations in schools must be the norm (Fullan, 2001). In this perspective, they must find ways to avoid the consequences of cultural dissonance, which is a tendency of students' abandonment of their inherent cultural values to adopt those of the school culture in order to achieve academic success (Ybarra, 2001). However, providing culturally relevant materials cannot completely eliminate cultural dissonance and in order to minimize its effects, school leaders need to constantly monitor and review aspects of both the formal and informal curricula (Rosa, 2010). In so doing, learning contexts must also allow for differences in the values, knowledge, skills, and learning styles that students bring to the classroom (Gordon & Yowell, 1999).

Culturally relevant leadership is considered as a relational and ethical process that occurs when leaders lead the school community to work together to accomplish positive changes (Rosa, 2010). This suggests that if given support, all stakeholders will work toward resolving differences among the members of the school community, finding a common direction, and building a shared vision to improve schools. In this regard, leadership is culturally relevant and inclusive when members of the school community understand, value, and actively engage diversity in views, approaches, styles, and aspects of individuality such as culture that add multiple perspectives to a group's activity (Komives, Lucas, & McMahon, 2007).

Because school leaders attend to values and personal beliefs as well as intellectual percepts in matters of culturally relevant leadership, culturally relevant school leaders are also considered moral leaders (Sergiovanni, 1992). It is necessary to emphasize the concepts of moral and transformational leadership because the relationship between the leader and the staff must be genuine. In other words, moral leaders' behaviors must be consistent and aligned with the needs and values of their followers (Burns, 1978). Other characteristics of moral leaders include those of assuming responsibility for their actions and commitments made to their followers, keeping promises made by personally leading the change, and understanding that alternatives exist and having a willingness to switch direction if needed.

It is necessary that school leaders refine their educational programs in order to meet the pedagogical necessities of their students. For example, English Language Learners (ELL) student achievement only occurs when school leaders maintain literacy and matheracy of all students as

[3]Cultural dissonance may be considered as a sense of discord, disharmony, and conflict experienced by students in the midst of change in their cultural environment (Allan, 2002).

high priorities, motivating all teachers to participate in the improvement of the pedagogy of the schools (Goldenberg & Sullivan, 1994). In this culturally relevant leadership, school leaders have to provide supervision in order to move their faculty forward to best meet the needs of their minority students' population by implementing best practices such as culturally relevant pedagogy. Thus, culturally relevant school leaders need to work with the school community to develop and provide adequate professional development opportunities for teachers so that they are able to learn about students' *cultural backgrounds*. These school leaders also need to ensure that teachers are culturally competent enough to develop and initiate appropriate curriculum for minority students (Demmert, 2001).

Culturally relevant school leaders must lead change efforts as agents who transform the teaching and learning culture of their schools and communities (Fullan, 2002). It is important to note that these leaders operate within a larger culture, the culture of the school district, which must respond to state and federal mandates and policies (Bridgeland & Duane, 1987). How school leaders respond to these mandates and policies influences students' achievement. Thus, the role of culturally relevant school leaders is challenging and complex because they have to acquire knowledge, skills, abilities, competencies, and attributes that constitute their cultural competence (Fullan, 2002). In this regard, school leaders need to reflect on their own leadership practice in order to understand the cultural dynamics that occur in their schools. This is a very daunting standard of excellence, which few school leaders are able to fully embrace because it is related to the value of diversity in schools as well as the preservation of the cultural dignity of students. Finally, culturally relevant leadership enables principals and vice-principals to create an inclusive and instructionally powerful learning environment in their schools (Fullan, 2002; Rosa, 2010).

5. A Culturally Relevant Pedagogy

Scholars have developed a theory of culturally relevant pedagogy, which examines the teaching and learning process within a more critical paradigm by making a more explicit connection between students' home culture and school subject matter (Ladson-Billings, 1995). In this regard, "culturally responsive teaching 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" (Gay, 2000, p. 29).

Culturally relevant pedagogy builds upon research in educational anthropology that examines cultural congruence between home and school (Ladson-Billings, 1995). Cultural congruence indicates school leaders and teachers' respect for the culture of their students. In order for school leaders and teachers to implement the principle of cultural congruence, they must have knowledge of and respect for the various cultural background, traditions, and languages of students in their schools. They need a base of general sociocultural knowledge about child and adolescent development; second language acquisition; and the ways in which socioeconomic circumstances, language, and culture shape students' school performance. School leaders and teachers 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. This will help school leaders to understand how their own cultural biases may influence their judgments about students' performance and obstruct students' ability to learn (Zeichner, 1996).

In a culturally relevant pedagogy approach, teachers need to understand and value the diverse cultures of their students and allows them to explicitly address their understanding of it in the classroom. They also need to teach subject matter in a culturally appropriate manner that is situated within students' *funds of knowledge*[4] they bring to school. In this regard, students need to be educated within an understanding of the historical legacy of racism in society and its current impact upon 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 then use them to scaffold students' learning (Gay, 2000). These features of culturally relevant pedagogy assist educators in developing greater specificity in the knowledge needed for school leaders to provide their schools with culturally relevant leadership.

Culturally relevant pedagogy is a teaching style that validates and incorporates the cultural background, ethnic history, and current societal interests into teachers' daily instruction of all students. It addresses students' socio-emotional needs and uses ethnically and culturally diverse materials for pedagogical action. As an educational approach, culturally relevant pedagogy empowers students intellectually, socially, and politically by helping them to make use of cultural and historical references to convey knowledge and acquire academic skills with the objective of changing students' attitudes towards academic instruction (Ladson-Billings, 1995). In this point of view, 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" (Scheurich & Skrla, 2003, p.48).

This kind of pedagogy delineates and promotes the 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 achievement (Richards, Brown, & Forde, 2000 *apud* Rosa 2010). The academic achievement of students who come from minority students with diverse backgrounds improve if school leaders and teachers ensure that classroom instruction is conducted in a manner that is relevant to students' home and the culture of their community (Banks, 1991). For example, Moll, Amanti, Neff, and Gonzalez (1992) studied ethnic minority students in Mexican-American communities in Tucson, Arizona as a means to empower and support their academic achievement. They examined the effects of teachers as co-learners, that is, learning students' home culture, practicing reciprocal teaching, and in turn connecting to 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 quasi-experimental study was to determine the effectiveness of a culturally based unit of instruction on mathematics that dealt with the learning of perimeter and area by sixth grade

[4]*Funds of knowledge* refer "to the historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being" (Moll, Amanti, Neff, & Gonzalez, 1992, p. 133). This means that when teachers shed their role of teacher and expert and instead take on a new role as a learner, they can come to know students and their families in new and distinct ways. With this new knowledge, teachers may be able to see that the households of their students contain rich cultural and cognitive resources. These resources can and should be used in classrooms in order to provide culturally responsive and meaningful lessons to tap students' interest and prior knowledge.

students. In their study, they examined two independent variables such as treatment versus control condition as well as urban versus rural settings. A total group of 97 percent Yup'ik students from both the rural and urban schools was assigned to either the treatment or control group by randomly assigning teachers and their intact classes to one or the other condition. From this population, four subgroups were created, consisting of five classes and 109 students in the urban-treatment group, three classes and 71 students in the urban-control group, four classes and 51 students in the rural-treatment group, and 27 students in the rural-control group.

The outcome measure was a locally constructed achievement test on mathematical concepts of perimeter and area. Lipka and Adams (2001) applied both pretest and posttest versions, which consisted of 17 multiple choices and constructed response items. For the purposes of data analysis, students' scores on the pretest and posttest were converted into percentages measuring percent correct. A series of *t* tests were conducted on the pretest scores, and it was found that there were no differences between the treatment and control groups across urban-rural. However, there was a significant difference between urban and rural across treatment-control, in favor of the urban group. Gain in scores, in percentage, was used for primary analysis, and it was found that the percentage gain score for the treatment groups, across rural and urban, was significant favoring the treatment group over the control. The percentage gain for the rural-treatment group exceeded the percentage gain for the rural-control group. Their conclusions of the study were in favor of the effectiveness of the culturally relevant based curriculum treatment as implemented in their study.

In line with this perspective, in order to promote the academic achievement of students, it is necessary to establish and implement culturally relevant pedagogy through the use of connection between culture and curriculum as well as connection between home and school. Furthermore, in order to establish and implement a culturally relevant pedagogy, reforms must occur in the overall organization of the school (Little, 1993). These reforms included the administrative structure and the ways it relates to diversity by adequately using physical space in planning schools and arranging classrooms. Reforms also include school policies, procedures, and practices that influence the delivery of services to students from diverse cultural backgrounds as well as the involvement of the community within the school, including the institutional approach to community involvement in which families and communities are expected to find ways to become involved in the school (Rosa, 2010).

For example, Kawagley and Barnhardt (1999) conducted a case study in which they examined the school improvement process undertaken at Yupiit School District (YSD), which consisted of three Yupiaq villages in southwest Alaska that joined in 1984 to form the Yupiit Nation in order to run their own schools. In 1992, a district-level leadership team, trained in the Alaska Onward to Excellence school improvement process, called the first community wide meeting to discuss the values and beliefs that should be passed on to the next generation. The district team then compiled community values and beliefs, drew up a draft mission statement, and listed tentative goals for students.

After extensive community feedback, the YSD school board adopted the following students' goals such as knowledge of Yup'ik values, culture, and subsistence skills; preparation for work and further education; respect and positive attitudes toward life, learning, and community; development as law-abiding citizens; and ability to communicate in Yup'ik and English languages.

Local leadership teams then identified the goal of greatest concern in each community and developed specific actions to advance that goal. By the end of the third year of this process, results included improved student attendance, increased parent and elder participation in the school community, provision of curricular training, and closer school-community cooperation. Through this curriculum, everyone in the school community becomes a teacher, every place is a potential classroom, and every activity constitutes a learning opportunity.

In a similar study, Agbo (2001) conducted participatory research at Potsdam, New York with the Mohawk Nation by involving communities in discussion groups to establish the needs for bicultural education for students. Participants discussed the use of Mohawk culture as the arena for curriculum development as well as for the development of Mohawk cultural standards and teacher training in Mohawk culture. It was concluded that learning-teaching environments of Native American students must foster self-esteem, reflect increased academic standards, and provide access to cultural resources, particularly at the local community level.

Culturally relevant pedagogy allows teachers to provide and use meaningful learning materials, create classroom environments that include cultures, customs, and traditions that are different from their own, and include lessons that assist students in making meaningful connections between their daily experiences and school-related activities (Irvine & Armento, 2001). In other words, participating in culturally relevant teaching means that teachers create a bridge between students' home and school lives, while they still meet the expectations of the school district, state, and federal curricular requirements. The purpose of this instructional pedagogy is to utilize student cultural and linguistic backgrounds, knowledge, and experiences to inform teacher lesson planning, methodology, and pedagogy. Culturally relevant pedagogy provides a way for students to maintain cultural identity while succeeding academically (Ogbu, 1992). In other words, it is important for teachers to contextualize instruction and schooling by applying culturally relevant pedagogy in their pedagogical practices as well as by embodying relevance and rigor to the educational process.

Finally, teachers working from a culturally relevant pedagogy 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 now, and exhibit in-depth knowledge of students as well as subject matter (Ladson-Billings, 1995).

6. Culturally Relevant Pedagogy and Ethnomathematics: Curricular Implications

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. 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 (Torres-Velasquez & Lobo, 2004).

The guidelines of both the National Council of Teacher of Mathematics (NCTM, 1991) and the Brazilian Ministry of Education and Culture (Brasil, 1997) highlighted the importance of building connections between mathematics and students' personal lives and cultures. Along with this line,

"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" (Rosa & Orey, 2006, p. 34). 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) such as mathematics.

According to this context, curricular activities developed according to the principles of a culturally relevant pedagogy focus on the role of mathematics in a sociocultural context that involves the ideas and concepts associated with an ethnomathematical perspective to solve problems. In other words, mathematics knowledge in the culturally relevant pedagogy is perceived as a version of ethnomathematics because *ethno* is defined as culturally identifiable groups with their jargons, codes, symbols, myths, and even specific ways of reasoning and inferring; *mathema* is defined as categories of analysis; and *tics* is defined as methods or techniques for solving problems faced daily. In a culturally relevant mathematics classroom, teachers build from students' previous knowledge (*ethno*) and direct the lessons toward their culture and experiences (*mathema*) while developing their critical thinking skills (*tics*) (Rosa, 2010).

The inclusion of cultural aspects in the mathematics curriculum have long-term benefits for student mathematical attainment because cultural aspects contribute to recognizing mathematics as part of daily life, enhancing the ability to make meaningful connections, and deepening the understanding of mathematics (Rosa, 2010). In this regard, 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. In this regard, the pedagogical elements necessary to develop the mathematics curriculum are found in the school community (Chieus, 2004; Damazio, 2004). In this direction, the field of ethnomathematics presents some possibilities for educational initiatives that help to reach this goal because it is a research program that guides educational pedagogical practices (D'Ambrosio, 1990). However, 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 (Monteiro, Orey, & Domite, 2004).

The trend towards ethnomathematical approaches to mathematics curriculum and culturally relevant pedagogy reflects a comprehensive development in mathematics education. Ethnomathematical approaches are intended to make school mathematics more relevant and meaningful to students in order to promote the overall quality of education. In so doing, it is necessary to plead for a more culturally relevant view of mathematics to be incorporated into the school curriculum. For example, it is necessary to elaborate 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 (Powell & Frankenstein, 1997). This pedagogical approach can be achieved through dialogue between teachers and students to discuss mathematical themes that help them to reflect about problems that affect society. In this context, students investigate conceptions, traditions, and mathematical practices developed by the members of distinct cultural groups in order to incorporate them into the mathematics curriculum. In so

doing, 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.

A culturally relevant mathematics curriculum based on an ethnomathematical perspective infuses the students' cultural backgrounds in the learning environment in a holistic. In this learning environment, students are given opportunities to relate their new learning experiences to knowledge and skills they have previously learned manner (Rosa & Orey, 2006). In this regard, it is particularly important that the mathematical learning experiences of students acknowledge their cultural backgrounds and experiences in the learning of mathematics by working with activities that are culturally relevant. This mathematical approach is presented as a cultural response to students' needs by making connections between their cultural background and mathematics (Rosa, 2010).

Culturally relevant pedagogy supports the view that "mathematics is conceived as a cultural product which has developed as a result of various activities" (Bishop, 1988, p. 182). The objective of this approach is to make mathematics more relevant to students because every culture is assumed to have mathematical responses to problems faced daily and these responses are valid content for the development of mathematics lessons. Teachers using this kind of curriculum would be full of examples that are drawn on the students' own experiences that are found in their sociocultural environment. In other words, 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).

7. Symmetrical Freedom Quilts: A Culturally Relevant Activity based on an Ethnomathematical Perspective

Quilts may be considered as cultural, artistic, and mathematical expressions and manifestations of mental models that represent a specific cultural activity. One example of this representation was related to the life of slaves in the United States, who formed part of a particular cultural group. In this activity we explored the symmetrical patterns found in specific kinds of quilts called *symmetrical freedom quilts* as well as the connections between culturally relevant pedagogy, ethnomathematics, and the tactile craft and art of quilting of this resilient group of people (Rosa & Orey, 2012).

The study of quilts made by people who endured slavery in the United States provides an opportunity to study the history of slavery in the United States from perspectives that are not well represented in history books. Fabrics used, designs constructed, and stitches made tell stories about oppression, suffering, and resilience of African-Americans living in that time period. Symmetrical freedom quilts were the physical traces (cultural artifacts) of people who made community around the creation of the quilts that expressed their shared values. In this sense, quilt making was a collective response to their human experience (Rosa & Orey, 2009).

The story of symmetrical freedom quilts offers a mixture of fact and myth. Its oral tradition may not give us absolutely accurate information but it reflects a greater truth inherent in the pride of

the members of this specific cultural group (former slaves) and their hopes for the future. Maybe there was no special role symmetrical freedom quilts played in the Underground Railroad during slavery in the United States while there are some debates related to if quilts were used as directional codes in helping slaves to run to freedom. Whether or not the story of the symmetrical freedom quilts is true, it is an appealing story and has touched the hearts of many. In our opinion, these quilts may have played a key role in the ending of slavery in the United States, however we do understand that there is no corroborating scientific evidences that may support these ideas. Throughout time, quilts have been created as a vehicle for sharing family history, a moral message, or as a reflection of historical and cultural events. In other words, quilts may be considered as cultural artifacts (Rosa & Orey, 2012).

The focus of this activity is on one important form of communication as used on the *Underground Railroad* by African-Americans escaping slavery. The term *Underground Railroad* has come to us from a story of a farmer chasing a runaway who testified that this slave vanished on some kind of underground railroad. It was "used to describe the network of abolitionists and safe houses that helped slaves escape to Ohio and Canada. Safe houses along the way were known as *stations*, those who guided the escapees were called *conductors* and the runaways themselves were called *passengers* (Burns & Bouchard, 2003, p. 32).

What we do know is that the *Underground Railroad* was organized by former slaves, freed blacks, and sympathetic whites for the slaves to find shelter, food, drinking water, safe hiding places, and safe paths to follow as they moved to the free states of the north and into Canada. The quilts are referred to as *Freedom Quilts* and they were often hung over a clothes line, porches, or balconies to signal what to do or where to go by using different designs that indicated safety, danger, clues, and landmarks to guide the slaves to freedom. The quilts were sewn to serve as a coded map for runaway slaves to memorize. Slaves followed symbols on *Freedom Quilts* that were hung out during the day to give guidance, directions or dangers that lay ahead. This method of communication was very effective, because bounty hunters apparently never caught onto the quilts and their messages (Rosa & Orey, 2009). Figure 1 shows a freedom quilt displayed on window-sill.

Figure 1: Freedom Quilt displayed on window-sill
(Photographed by Raymond G. Dobard)

In so doing, quilts were hung with other items to be aired out so most people believed that quilts were just a kind of bed-covering that needed to be aired. However, to those people who knew how

to identify the secret codes in the quilt pattern, this meant the difference between slavery and freedom. Since slaves were not taught to read or write in English, they developed an intricate system of secret codes, signs, and signals to communicate with one another along the routes of the Underground Railroad. In order to memorize the whole code, a sampler quilt was used. The sampler quilt included all necessary patterns that were arranged in the order of the code. Freed slaves traveled from one plantation to another to teach to other slaves the translation of the codes of the sampler quilt patterns (Wilson, 2002). Figure 2 shows one of the underground railroad quilts, which is a variation of Jacob's ladder.

Figure 2: One of the underground railroad quilts: a variation of Jacob's ladder

Knot-making was a practice that has interesting historical background in Africa. In this regard, in the slave practices, knots were tied to encode objects with meaning, messages, and protective power. This means that symmetrical freedom quilts contained ties with knots that were often used to indicate the date slaves were to run away from their working plantation. For example, five knots in the cord meant that they should escape on the 5^{th} day of the 5^{th} month. If a quilt showed a house with smoke coming out of the chimney, it meant that the house was safe (Wilson, 2002). In other words, symmetrical freedom quilts present an ingenious, indeed highly creative and complex way in which to communicate between slaves and safe houses because they did not show any overt connection to slavery (Rosa & Orey, 2012).

Figure 3: Ozella's Underground Railroad Symmetrical Freedom Quilt

The ethnomathematical perspective of this context is to study the mathematical practices of this specific cultural group in the course of dealing with problems faced in their daily lives (D'Ambrosio, 1990). The quilt codes may be considered as mathematical techniques (tics) used by the slaves (ethno) who were trying to manage problems and activities that arose in their own

social-political environments (mathema). These codes were transmitted to the members of the slave's families by their ancestors through generations (Rosa & Orey, 2009).

On the other hand, in the context of culturally relevant pedagogy, students "can be successful in mathematics when their understanding of it is linked to meaningful cultural referents" (Ladson-Billings, 1995, p. 41). According to this perspective, Shoo Fly is one the simplest traditional Symmetrical Freedom Quilts. Although Shoo Fly is a basic pattern, its versatility provides quilters with some wonderful opportunities for creative use of colors, fabrics, and stitching. Figure 4 shows the Shoo Fly quilt design.

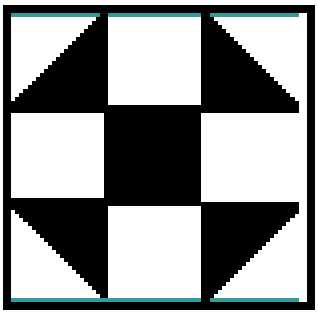

Figure 4: The Shoo Fly quilt design

Shoo Fly may be adapted to a variety of sizes. For example, blocks often measure 9 x 9, but variations such as 10 x 10 and 12 x 12 may also be used. Below is an example of the Shoo Fly 10 x 10 symmetrical quilt block. Figure 5 shows the Shoo Fly quilt block.

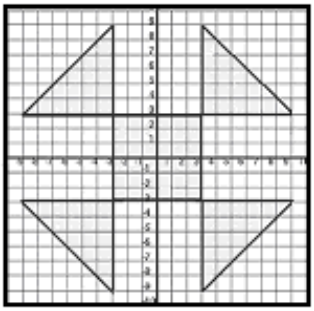

Figure 5: The Shoo Fly quilt block

The use of culturally relevant pedagogy values the previous knowledge of the members of a given community such as former slaves by developing the process of elaborating mathematical models in its different contexts such as political, social, economic, and environmental. In this kind of activity, the "mathematics practiced and elaborated by different cultural groups, and involves the mathematical practices that are present in diverse situations in the daily lives of members of these diverse groups" (Bassanezi, 2002, p. 208).

Mathematizing ideas involves connecting the informal mathematics developed in a given cultural group to formal mathematical concepts by using ideas, procedures, and mathematical practices that are used by a specific cultural group. In this regard, symmetrical freedom quilt designs contain geometric concepts like symmetry, similarity, congruence, translations, rotations, and reflections

(Rosa & Orey, 2009). For example, students mathematize a point of reflection of the Shoo Fly Quilt block.

In this context, a point of reflection is determined when a figure is built around a single point called *center*. In other words, for every point in the figure, there is another point that is found directly opposite on the other side of the figure. While any point in the x-y coordinate system may be used as a point of reflection, the most commonly point used is the origin. In the *Shoo Fly* quilt block, the point of reflection is at the origin of the *x-y* coordinate system.

By applying the general mapping of transformations $P(x, y) \rightarrow P'(-x,-y)$ in the three points of reflection in the triangle below it is possible to find their images, which are $A(9,3) \rightarrow A'(-9,-3), B(3,9) \rightarrow B(-3,-9)$ and $C(3,3) \rightarrow C'(-3,-3)$. In this specific case, triangle *A'B'C'* is the image of triangle *ABC* after a reflection on the origin of the Cartesian coordinate system. Figure 6 shows the point of reflection of the Shoo Fly quilt block at the origin of the *x-y* coordinate system.

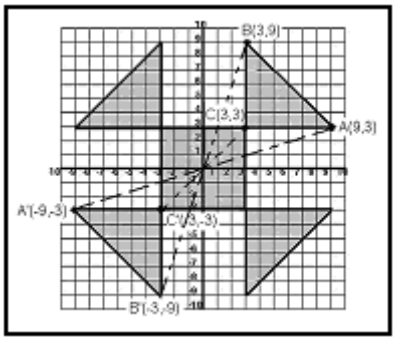

Figure 6: Point of Reflection of the Shoo Fly quilt block at the origin of the *x-y* coordinate system

The point of reflection is also called point of symmetry. In a point of symmetry, the center point is a midpoint to every segment formed by joining a point to its image. The three straight dashed lines that connect *A* to *A'*, *B* to *B'*, and *C* to *C'* pass through the origin, which is the midpoint of rotation.

It important to emphasize 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. For example, Duarte (2004) investigated the uniqueness of mathematical knowledge produced by workers in home construction industry through the study of mathematical ideas and practices that they develop in the construction sites. In this study, there was a reflection on the mathematical knowledge possessed by the members of this working class in order to academically legitimate their knowledge in order to determine the pedagogical and curricular implications that are inferred in the process of production 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. This kind of 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, 2007). Students also value and appreciate their 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. An ethnomathematical curriculum helps students understand the nature of mathematics because it is an effective tool that contributes to improve the learning of mathematics of minority students (Rosa & Orey, 2006).

The integration of ethnomathematics and culturally relevant pedagogy into the mathematics curriculum focuses on the development of this research area as a process, rather than a collection of facts because it is based on the idea that mathematics is a human creation that emerges as people attempt to understand and comprehend the world around them. Therefore, mathematics can be seen as a process as well as a human activity rather than just as a set of academic content (Rosa, 2010). The implication of this kind of 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. Thus formal mathematics is better understood, appreciated, and made more meaningful to its learners.

8. Final Considerations

Culturally Relevant Education was developed out of concern for serious academic achievement gaps experienced by many low-income students, students of color, and students from linguistically and culturally diverse environments. It 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, 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 culturally relevant schools, school leaders, teachers, and staff members are enabled to both recognize and build upon the diversity and strengths of students by applying culturally relevant instructional strategies. These professionals are also able to identify and remove obstacles that may have been inadvertently placed in the path of students through their prior schooling. In culturally relevant schools, all leaders, teachers, and staff members have unified and high expectations for all students and are held accountable to high standards. In culturally relevant schools, the teaching and learning process must be relevant and meaningful to all students, specifically to students from different linguistic and cultural backgrounds.

The need for culturally relevant leadership reflects the influence that culture has on the learning process. According to this perspective, culturally relevant leadership is one of the most important roles for contemporary school leaders because it is rooted in culturally relevant education theory, which is grounded in the beliefs that culturally and linguistically diverse students are able to excel in academic endeavors. However, 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 facilitate the acquisition of their knowledge, skills, and attitudes.

A culturally relevant pedagogy and ethnomathematics provide ways for students to maintain their cultural identity while succeeding academically. They are teaching methodologies designed to fit school culture to students' cultural backgrounds to form a firm basis for helping them to understand themselves and their peers, develop and structure social interactions, and conceptualize knowledge. 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. Both 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 success of student educational experience.

Mathematics knowledge in the context of culturally relevant can be perceived as an ethnomathematical perspective because in the culturally relevant schools and mathematics classrooms, school leaders and teachers build from the students' ethno or informal mathematics and orients the lesson toward their culture and experiences, while developing the students' critical thinking skills (Gutstein, Lipman, Hernandez, & de los Reyes, 1997). In other words, students are considered as a culturally identifiable group with their own jargons, codes, symbols, myths, and specific ways of reasoning and inferring (ethno) who develop their own categories of analysis (mathema) and apply specific methods or techniques to solve problems faced daily (D'Ambrosio, 1990).

Since ethnomathematics studies the cultural aspects of mathematics and presents the mathematical concepts of the school curriculum in a way that is related to the students' cultural backgrounds by enhancing their ability to make meaningful connections and deepening their understanding of mathematics. This perspective matches teaching styles to the "culture and home backgrounds of their students" (Ladson-Billings, 2001, p. 75), which is one of the most important principles of culturally relevant pedagogy.

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 (Rosa, 2010). It is a program that includes curricular relevance that builds a curriculum around the local interests and culture of the learners (D'Ambrosio, 1990; Ladson-Billing, 2001). 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 mathematical content and approaches that enable them to successfully master academic mathematics. In our opinion, an ethnomathematics approach to the mathematics curriculum is considered a pedagogical vehicle for achieving such a goal.

9. References

Agbo, S. (2001). Enhancing success in American Indian students: participatory research at Akwesasne as part of the development of a culturally relevant curriculum. *Journal of American Indian Education, 40*(1), 31–56.

Agbo, S. (2002). Unstated features of cultural deprivation or discontinuity: culture standards for administrators and teachers of aboriginal students. *Journal of Educational Administration and Foundations, 16*(2), 10–36.

Allan, M. J. (2002). Cultural borderlands. *International Schools Journal, 21*(2), 42–53.
Atkinson D. R., Morten G., & Sue, D. (1993). *Counseling American minorities*: a cross-cultural perspective. Madison, WI: Brown & Benchmark.

Banks, J. (1991). A curriculum for empowerment, action, and change. In C. E. Sleeter (Ed.), *Empowerment through multicultural education* (pp. 125-141). Albany, NY: SUNY Press.
Bassanezi, R. C. (2002). *Ensino-aprendizagem com modelagem* matemática [Teaching and learning with mathematical modeling]. São Paulo, SP: Editora Contexto.

Bazron, B.; Osher, D.; & Fleischman, S. (2005). Creating culturally responsive schools. *Educational Leadership, 63*(1), 83-84.

Beauboeuf-Lafontant, T. (1999). A movement against and beyond boundaries: politically relevant teaching among African American teachers. *Teachers College Record, 100*, 702-718.

Bishop, A. J. (1988). *Mathematics enculturation*: a cultural perspective on mathematics education. Dordrecht, The Netherlands: Kluwer.

Bridgeland, W. M., & Duane, E. A. (1987). Elementary school principals and their political settings. *Urban Review, 19*, 191–200.

Brasil (1998). *Parâmetros curriculares nacionais***:** matemática. Brasília, DF: MEC/SEF.

Burns, J. M. (1978). *Leadership*. New York, NY: Harper & Row Publishers.

Burns, E.; Bouchard, S. (2003). *Underground railroad*: sampler. San Marcos, CA: Quilt in a Day, Inc.

Burns, R., Keyes, M., & Kusimo, P. (2005). *Closing achievement gaps by creating culturally responsive schools*. Charleston, WV: Edvantia, Inc.

Carter, T. P., & Segura, R. D. (1979). *Mexican Americans in school*: a decade of change. New York, NY: College Entrance Examination Board.

Chieus, G. J. (2004). Etnomatemática: reflexões sobre a prática docente. In J. P. M. Ribeiro, M. C. S. Domite, & R. Ferreira (Eds.), *Etnomatemática:* papel, valor e significado (pp. 185-202). São Paulo, SP, Brazil: ZOUK.

D'Ambrosio, U. (1990). *Etnomatemática*. São Paulo, SP, Brazil: Editora Ática.

Damazio, A. (2004). *Especifidades conceituais da matemática da atividade extrativa do carvão*. Coleção Introdução à Etnomatemática. Natal. RN, Brazil: UFRN.

Darling-Hammond, L. (1997). *Doing what matters most*: investing in quality teaching. New York, NY: National Commission on Teaching & America's Future.

Davis, D. M. (2002). Toward democratic education: the importance of culturally responsive leadership in 21st century schools. In P. S. Hart (Ed.), *Race, ethnicity and public education* (pp. 5-16). Boston, MA: The Trotter Review.

Demmert, W. J. Jr. (2001). *Improving academic performance among native American students*: a review of the research literature. Charleston, WV: ERIC Clearinghouse on Rural Education and Small Schools.

Duarte, C. G. (2004). *Implicações curriculares a partir de um olhar sobre o mundo da construção civil*. In G. Knijnik, F. Wanderer, & C. J. Oliveira (Eds.), *Etnomatemática*: currículo e formação de professores (pp. 195-215). Santa Cruz do Sul, RS, Brazil: EDUNISC.

Education Trust (2004). *Education watch*: the nation. Key education facts and figures: achievement, attainment and opportunity from elementary school through college. Washington, DC: The Education Trust.

Farmer, T. A., & Higham, J. R., III (2007). *Culturally responsive leadership*: graduate program egalitarianism. Paper presented at the Annual Meeting of the University Council of Educational Administration in Alexandria, Virginia.

Fullan, M. (2001). *Leading in a culture of change*. San Francisco, CA: Jossey-Bass.

Gándara, P., Maxwell-Jolly, J., & Rumberger, R. (2008). *Resources need for English learners*: getting down to policy recommendations. Davis, CA: UCDavis.

Gay, G. (2000). *Culturally responsive teaching*: theory, research, and practice. New York, NY: Teachers College Press.

Gerdes, P. (1996). Ethnomathematics and Mathematics Education. A. Bishop et al. (Eds.). *International Handbook of Mathematics Education* (pp. 909-943). Utrecht, The Netherlands: Kluwer Academic Publishers.

Goldenberg, C., & Sullivan, J. (1994). *Making change happen in a language minority school*: a search for coherence. Santa Cruz, CA: National Center for Research on Cultural Diversity and Second Language Learning.

Gordon, E., & Yowell, C. (1999). Cultural dissonance as a risk factor in the development of students. In E. Gordon (Ed.), *Education and justice*: a view from the back of the bus (pp. 34-51). New York, NY: Teachers College Press.

Gutstein, E., Lipman, P., Hernandez, P., & de los Reyes, R. (1997). Culturally relevant mathematics teaching in a Mexican American context. *Journal for Research in Mathematics Education, 28*(6), 709–737.

Hart L. E. (2003). Some directions for research on equity and justice in mathematics education. In L. Burton (Eds.). *Which way social justice in mathematics education?* International Perspectives on Mathematics Education (pp.25-50). Westport, CT: Praeger Publishers.

Irvine, J. J., & Armento, B. J. (2001). *Culturally responsive teaching*: lesson planning for elementary and middle grades. New York, NY: McGraw-Hill.

Katz, J. H. (1985). The sociopolitical nature of counseling. *The Counseling Psychologist, 13*, 615-624.

Kawagley, A. O., & Barnhardt, R. (1999). *A long journey*: Alaska onward to excellence in Yupiit/Tuluksak schools. Fairbanks, AK: University of Alaska.

Keddie, N. (1973). *Tinker, tailor*: the myth of cultural deprivation. Harmondsworth, England: Penguin Education.

Kretovics, J., & Nussel, E. (1994). *Transforming urban education*. Boston, MA: Allyn & Bacon.

Klingner, J., Artiles, A. J., & Barletta, L. M. (2006). English language learners who struggle with reading: Language acquisition or LD? *Journal of Learning Disabilities, 39*(2), 108–128.

Klotz, M. B. (2006). Culturally competent schools: guidelines for secondary school principals. *Principal Leadership*, 11-14. Retrieved from http://www.nasponline.org/resources/principals/Culturally%20Competent%20Schools%20NASSP.pdf.

Komives, S. R., Lucas, N., & McMahon, T. R. (2007). *Exploring leadership*: for college students who want to make a difference. San Francisco, CA: Jossey-Bass.

Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal, 32*(3), 465-491.

Ladson-Billings, G. (2001). The power of pedagogy: Does teaching matter? In W. H. Watkins, J. H. Lewis, & V. Chou (Eds.), *Race and education*: the roles of history and society in educating African American students (pp. 73–88). Boston: Allyn & Bacon.

Lee, O. (2003). Equity for linguistically and culturally diverse students in science education: a research agenda. *Teachers College* Record, *105*(3)465–489.

Lindsey, R. B., Robins, K. N., & Terrell, R. D. (2003). *Cultural proficiency:* a manual for school leaders. Thousand Oaks, CA: Corwin Press.

Lipka, J., & Adams, B. (2001*). Improving rural and urban students' mathematical understanding of perimeter and area*. Fairbanks, AK: University of Alaska, Fairbanks.

Lipka, J., & McCarty, T. L. (1994). Changing the culture of schooling: Navajo and Yup'ik cases. *Anthropology & Education Quarterly, 25*(3), 266–284.

Little, J. W. (1993). Teachers' professional development in a climate of education reform. *Education Evaluation and Policy Analysis, 15*,129-151.

Maddahian, E. (2004). *Evaluation of the implementation of culturally relevant and responsive education. Publication No. 218*. Los Angeles, CA: L.A. Unified School District.

Marion, R. (2002). *Leadership in education*: organizational theory for the practitioner. Long Grove, IL: Waveland Press Inc.

Moll, L. C., Amanti, C., Neff, D., & Gonzalez, N. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory Into Practice, 31*(2), 132-141.

Monteiro, A.; Orey, D. C.; & Domite, M. C. Etnomatemática: Papel, valor e significad. In J. P. M. Ribeiro, M. C. S. Domite, R. Ferreira (Eds.), *Etnomatemática*: papel, valor e significado (pp. 13-37). São Paulo, SP, Brazil: ZOUK.

NCEE (1983). *A nation a risk*: the imperative for educational reform. Washington, D.C.: U. S. Government Printing Office.

NCLB (2002). No Child Left Behind Act of 2001, Pub. L. No. 107-110, 115 Stat. 1425.

NCTM (1991). *Professional standards for teaching mathematics.* Reston,VA: National Council of Teachers of Mathematics.

Nieto, S. (1999). *The light in their eyes*: creating multicultural learning communities. New York, NY: Teachers College Press.

Norton, S. (2005). *Executive leadership for effective administration*. New York, NY: Pearson Education Inc.

Ogbu, J. U. (1992). Understanding cultural diversity and learning. *Educational Researcher, 21*(8), 5-14.

Persell, C. H. (1977). *Education and equality*. New York, NY: Collier Macmillian Publishers.

Powell, A. B. & Frankenstein, M. (1997). Ethnomathematics praxis in the curriculum. In A. B. Powell & M. Frankenstein (Eds.), *Challenging Eurocentrism in mathematics education* (pp. 249-259). New York, NY: SUNY.

Rosa, M. (2010). *A mixed-methods study to understand the perceptions of high school leader about English language learners (ELL):* the case of mathematics. Doctorate dissertation. College of Education. California State University, Sacramento.

Rosa, M., & Orey, D. C. (2006). Abordagens atuais do programa etnomatemática: delinenando-se um caminho para a ação pedagógica. *Bolema, 19*(26), 19-48.

Rosa, M., & Orey, D. C. (2007). Cultural assertions and challenges towards pedagogical action of an ethnomathematics program. *For the Learning of Mathematics, 27*(1), 10-16.

Rosa, M., & Orey, D. C. (2008). Ethnomathematics and cultural representations: teaching in highly diverse contexts. *Acta Scientiae, 10*, 27-46.

Rosa, M. and Orey, D. (2009). Symmetrical freedom quilts: the ethnomathematics of ways of communication, liberation, and art. *Revista Latinoamericana de Etnomatemática, 2*(2). 52-75.

Rosa, M.; Orey, D.C. (2012). An ethnomathematical study of the symmetrical freedom quilts. *Symmetry: Culture and Science, 23*(2), 191-220.

Scheurich, J. J.; & Skrla, L. (2003). *Leadership for equity and excellence*: creating high-achievement classrooms, schools, and districts. Thousand Oaks, CA: Corwin Press, Inc.

Sergiovanni, T. J. (1992). *Moral leadership*: getting to the heart of school improvement. New York, NY: Jossey-Bass Publishers.

Sowers, J. (2004). *Creating a community of learners*: solving the puzzle of classroom management. Portland, OR: Northwest Regional Educational Laboratory.

Torres-Velasquez, D., & Lobo, G. (2004). Culturally responsive mathematics teaching and English language learners. *Teaching Children Mathematics, 11*, 249-255.

Trueba, E. T., & Bartolomé, L. I. (1997). The education of Latino students: Is school reform enough? *ERIC Clearinghouse on Urban Education, 123*, 1-10.

Valencia, R. R. (1991). *Chicano school failure and success*: research and policy agendas for the 1990s. London, England: Burgess Science Press.

Wibbeke, E. S. (2009). *Global business leadership*. Oxford, England: Elsevier, Inc.

Wilson, S. S. (2002). The Secret Quilt Code. *Traditional Quiltworks, 79*, 6 – 9.

Ybarra, R. (2001). Cultural dissonance in basic writing courses. *Journal of Basic Writing, 20*(1), 37-52.

Zeichner, K. (1996). Educating teachers to close the achievement gap: issues of pedagogy, knowledge, and teacher preparation. In B. Williams (Ed.), *Closing the achievement gap*: a vision

to guide change in beliefs and practice (pp.55-77). Alexandria, VA: Association for Supervision and Curriculum Development.