Ethnomathematics: Cultural Assertions and Challenges Towards Pedagogical Action

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Abstract
In this article, the authors discuss ethnomathematical concepts that were found useful in the interpretation of assertions and challenges faced by the Ethnomathematics Program for teacher professional development, as described by D'Ambrosio. The authors share the student's teaching-learning process, and for mathematics education in our ongoing work in Brazil and the United States. The discussion begins with a brief examination of where ethnomathematics stands today in respect to the process of teaching and learning of mathematics.

Resumo
Neste artigo, os autores discutem alguns conceitos etnomatemáticos que podem ser considerados úteis para a interpretação das asserções e desafios enfrentados pelo Programa Etnomatemática, para o desenvolvimento profissional dos professores, para o processo de ensino-aprendizagem dos alunos, e para a educação matemática; conforme descrito por D'Ambrosio; em nosso contínuo trabalho realizado no Brasil e nos Estados Unidos. Esta discussão começa com um breve exame sobre o posicionamento atual do Programa Etnomatemática em relação ao processo de ensino e a prendizagem em matemática.

Introduction

We begin with the assumption that those who study and use mathematics academically

operate from a unique paradigm. That is, as mathematicians, we see the world from a certain

point of view, and most importantly, we operate from within a certain cultural perspective.

Modern Western academic mathematics[1] has come to represent a grammar and language that

originated when p a whole, "we hope that, in this phase of the evolution of our species, that

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[1] The "scientific way of thinking."

the respect for diverse peoples will not be replaced by our arrogance, envy, prepotency, and great power and so that when people began to work with quantity, measure, shape, and modeling in the Mediterranean. Like many of the other cultural vehicles, that have come to dominate the planet, the Western mathematical way of thinking spread and grew along with these civilizations. At the same time, this particular form of mathematics also came into contact with other ways of thinking and interpreting the world. The conquest and domination of the planet, along with and through the use of modern mathematics by European-North American colonizers was not without its consequences. Arrogance coupled with a not so very subtle sense of entitlement and a scientific cultural hegemony has spread faster than it has sought to understand or come to terms with the thousands of traditions and time honored forms of thinking, calculating, and problem solving. D'Ambrosio (1997) has stated that as individuals become integrated into humankind as solidarity, we will be able to contribute to the preservation of a common inheritance" (p.12).

Many people, the authors included, have been attracted to Western-academic mathematics for its elegant, yet powerful sense of logic, form, as well as its scientific, cultural, and artistic qualities. It goes without saying that the mathematics of the 21st century has allowed impressive scientific achievements to immerge in all parts of the planet, yet this came with incalculable costs to the millions of people, their cultures and civilizations as European/North American ideas, morality, and science have come to dominate and control, and capture our imagination. It has, as well, enabled some of the most horrific, social, scientific, ecological and cultural disasters in the history of the planet. The Ethnomathematics Program considers a concept of mathematics which includes a critical, moral, holistic, and global perspective. That is, a mathematics curriculum that "walks the mystical way with practical feet[2]".

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[2] Attributed to Former President of Stanford University D. S. Jordan, quoted in *Bahá'í World*, VI, p.480. and found at: http://bahai-library.com/books/quest/index.html

D'Ambrosio's Approach to Ethnomathematics

The authors have chosen D'Ambrosio's approach of ethnomathematics as our philosophical

basis to our work in ethnomathematics and school mathematics. However, other researchers

and educators have used a diversity of approaches to demonstrate the dualistic concepts

between both approaches in mathematics education. For example, Gerdes (1997b) stated that

these concepts were indigenous mathematics (Gay & Cole, 1967; Lancy, 1976);

sociomathematics (Zaslavsky, 1973); informal mathematics (Posner, 1978); spontaneous

mathematics (D'Ambrosio, 1982); oral mathematics (Carraher et al., 1982); oppressed

mathematics (Gerdes, 1982); hidden or frozen mathematics (Gerdes, 1982); folk mathematics

(Mellin-Olsen, 1986); non-standard mathematics (Carraher et al. 1982, Gerdes, 1982; Harris,

1987); and mathematics codified in know-how (Ferreira, 1991). Gerdes (1997) also stated

that these "concepts have been gradually united under the more general "common

denominator" of D'Ambrosio's ethnomathematics" (p. 339).

In this context, we feel that D'Ambrosio's (1993) approach is broader in concepts, ideas, and

objectives. It considers mathematical modeling as a methodology that may be used as a tool

in the ethnomathematics program. The authors also consider this perspective as a new trend

for the pedagogical actions of the ethnomathematics program for its agenda for the 21st

century.

Ethnomathematics

Ethnomathematics is the application of mathematical ideas and practices to problems that

confronted people in the past or are encountered in present contemporary culture

(D'Ambrosio, 2001). Much of what we call *modern* mathematics came about as diverse

cultural groups sought to resolve unique problems such as exploration, colonization,

communications, and construction of railroads, census data, space travel, and other problems-

solving techniques that arose from specific communities. More than ten years ago, the

National Academy of Sciences (1994) reported that cultural variables have strongly

influenced how students consider themselves as human beings, how they came to understand

the world, and interpret their own and others experiences. Simply put, culture affects the

ways we acquire and use our own mathematical knowledge.

In attempting to create and integrate mathematical materials related to different cultures that

draw on students' own experiences in an instructional mathematics curriculum, we believe

that it is possible to apply ethnomathematical strategies in teaching and learning mathematics.

These strategies include, but are not limited to, the:

…historical development of mathematics in different cultures (e.g. the Mayan numeration system). Another aspect could be prominent people in different cultures that use mathematics (e.g. an African-American biologist, an Asian-American athlete). Mathematical applications can be made in cultural contexts (e.g. using fractions in food recipes from different cultures). Social issues can be addressed via mathematics applications (e.g. use statistics to analyze demographic data (ICME-7, 1992, WG-10, Multicultural Mathematics, p.3 - 4).

Seen in the above context, Gilmer (1990) stated "…there is an urgent need to multiculturalize

the mathematics curriculum" (p.4). A growing body of literature on ethnomathematics has

been stimulated by concerns for equity, equality, and excellence in a context of diversity.

Many teachers worldwide have come to realize that students become motivated when they

are involved in their own learning. This is especially true when dealing directly with issues

of greatest concern to themselves (Freire, 1970).

The challenge that many societies face today is to determine how to shape a modernized,

national culture integrating selected aspects of traditional culture that coexist in an often

delicate balance with those of westernized globalization. An increased cultural, ethnic, and

racial diversity provides both an opportunity and challenge to societies and institutions, with

many questions related to schooling forming an integral part of this question.

Ethnomathematics as a Program

The inclusion of moral consequences to mathematical-scientific thinking, mathematical ideas

and experiences from different cultures around the world, the acknowledgment of

contributions that individuals from diverse cultural groups make to mathematical

understanding, the recognition and identification of diverse practices of a mathematical

nature in varied cultural procedural contexts, and the link between academic mathematics and

student experiences should become a central aspect to a complete study of mathematics. This

is one of the most important objectives of an ethnomathematics perspective in mathematics

curriculum development. Within this context, D'Ambrosio (1990) describes

ethnomathematics as:

The prefix ethno is today accepted as a very broad term that refers to the social-cultural
context, and therefore includes language, jargon, and codes of behavior, myths, and symbols.
The derivation of mathema is difficult, but tends to mean to explain, to know, to understand,
and to do activities such as ciphering, measuring, classifying, ordering, inferring, and
modeling. The suffix tics is derived from techne, and has the same root as art and technique
(p.81).

In this case, ethno refers to groups that are identified by cultural traditions, codes, symbols,

myths and specific ways used to reason and to infer. Mathematics is therefore more than

counting, measuring, classifying, inferring, and modeling. Ethnomathematics forms the

intersection set between cultural anthropology and institutional mathematics and utilizes

mathematical modeling to solve real-world problems, and translate them into modern

mathematical language systems. Eglash (2002) stated that mathematical modeling is a tool,

which "provides a translation from indigenous knowledge systems to Western mathematics.

This perspective is crucial to give minority students a sense of cultural ownership of math,

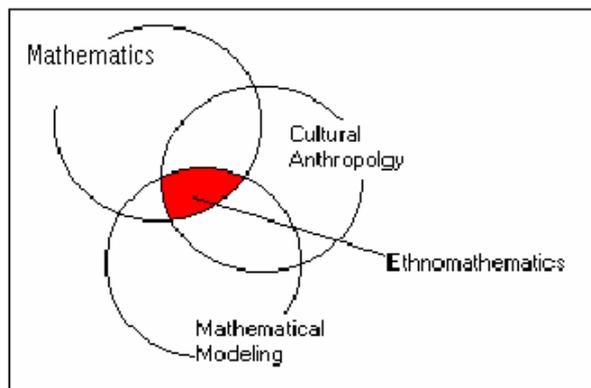rather than an empty gesture toward inclusiveness" (p. 4).

Figure 1: Ethnomathematics as an intersection of three disciplines

An essential aspect of the program includes an ongoing critical analysis of the generation and production of mathematical knowledge and the intellectual processes of this production (D'Ambrosio, 1993; Rosa, 2000). This process also includes the social mechanisms of the institutionalization of knowledge (academics), and its transmission (education).

A General Assertion

Ethnomathematics is a contemporary global pedagogical trend in education (Scientific American-Brasil, Edição Especial, 2005). This approach has allowed a number of mathematicians and educators to criticize (Greene, 2000; Ravitch, 2005) ethnomathematics and express fears that this trend may represent a pulling away from certain cultural norms, even though some social realities underlie the need for many multicultural efforts to reform curricula.

The world's economy is globalized; yet, traditional mathematics curricula neglects, indeed often rejects, the contributions made by the world's non-dominant cultures. Given these conditions, an ethnomathematical perspective in the curriculum may be seen as giving new, and expanded, often extremely complicated definitions of a given society's unique scientific contributions. This context allows school mathematics to be seen "as the process of inducting young people into mathematical aspects of their culture" (Gilmer, 1990, p. 4).

Ethnomathematics can reshape our greater cultural identity in a positive way (D'Ambrosio, 1995; Zaslavsky, 1996) by requiring the inclusion of a greater representation of the true mathematical practices and problems of a student's own community (D'Ambrosio, 1998; Zaslavsky, 1993, 1996). It helps both educators and students alike to understand the universality of mathematics, in the context of mathematical practices of day-to-day life, preliterate cultures, professional practitioners, workers, and academic or school mathematics. It can do this by taking into account the historical evolution, and the recognition of natural, social and cultural factors that shape human development (D'Ambrosio, 1995).

A Brief Summary of Assertions

There are numerous favorable arguments as related to the implementation of ethnomathematics as a program towards pedagogical action. We summarize these arguments in the following categories:

Education

The Ethnomathematics Program promotes the rights of all people, no matter their sexual orientation, gender, ethnicity, race, and socio-economic status. It does this in order to allow learners to understand the issues and problems of all the members of our increasingly globalized society (D'Ambrosio, 1990, 1995; Croom, 1997; Fasheh 1982; Zaslavsky, 1991, 1996, 1998). The students will learn to make contributions and learn to appreciate the achievements of their own and other cultures (D'Ambrosio, 1990, Joseph, 1991, Zaslavsky, 1996).

Mathematics

The Ethnomathematics Program deals with both the content and the process of curriculum, classroom management, teacher expectations, professional development, and relationships among teachers, administrators, students, and the community (Borba, 1990; D'Ambrosio, 1985, 1990, 1995, 1998; Zaslavsky, 1998). This approach allows students to make

connections with historical developments of mathematics ideas, practices, and the contributions made by diverse cultural groups and individuals.

Ethnomathematics posses important characteristics of being able to help develop the concept of mathematics. In other words, ethnomathematics may be seen as a transformational endeavor because it transforms what mathematics really is. Thus a possible purpose of the analysis of an ethnomathematical perspective as an addition the school curriculum could be tracing the developments or transformations of mathematical ideas and practices throughout history.

Ethnomathematics also develops the study of mathematical ideas and practices of socio-cultural groups, but how this is realized in the classroom is still problematic because much of ethnomathematical research and investigations identify ethnomathematical forms of mathematics but do not continue to develop the pedagogical actions for this program. Classrooms research about ethnomathematics and its role is a crucial aspect of this perspective because this program should be implemented in classrooms (D'Ambrosio, 1993). Ethnomathematics emphasizes the communal and tends to connect mathematics with its contexts. If these two components are to be brought together then ethnomathematics may be conceived as an overarching aspect of the curriculum because mathematics may be humanized, that is, ethnomathematics may be viewed as a philosophical, contextual, affective, and attitudinal approach to the curriculum.

From a perspective of using mathematical modeling towards pedagogical action for the ethnomathematics program, teaching is much more than the transference of knowledge because teaching becomes an activity that introduces the creation of knowledge (Freire, 1998). This approach in mathematics education is the antithesis of turning containers to be filled with information (Freire, 1970). Bassanezi (2002) characterizes this process as "ethno-modeling" (p. 208), and defines ethnomathematics as "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" (p. 208).

Students

Students need to develop skills in critical thinking and analysis that can best be applied to all areas of life. These skills include vital issues involving health, environment, race, gender, and socioeconomic class (D'Ambrosio, 1990, 1998; Freire, 1970; Zaslavsky, 1998). Bassanezi (1990, 1994), Borba (1990), D'Ambrosio (1990, 1998), and Zaslavsky (1998) agree that ongoing contact of students with diverse and different ways of thinking and practicing mathematics, will raise interest in learning the necessary and required content, by having students apply mathematical concepts to future professional contexts and by facilitating student performance (Bassanezi, 1990, 1994; NCTM, 1989; Zaslavsky, 1990). In an Ethnomathematics Program, students develop abilities, increased creativity, and a sound set of research habits, as they learn the required mathematics. They develop the capacity to create a hypothesis (Bassanezi, 1990, 1994; D'Ambrosio, 1990, 1993; Biembengut, 1999; Hogson, 1995). Ethnomathematics contributes to the development of student capacity by selecting data and the subsequent adaptation to their needs (Biembengut, 1999, Croom, 1997; Hodgson, 1995), by encouraging contact with biology, chemistry, physics, geography, history, and language (Bassanezi, 1990, 1994; D'Ambrosio, 1995; Zaslavsky, 1991, 1993, 1996, 1998), and by developing work in groups, sharing tasks, learning how to appreciate both criticism and alternate opinions, respecting the decisions of others and of the group, and by facilitating student interactions in a globalized society, students share global and interactive visions necessary to develop successful mathematical content (D'Ambrosio, 1993; Bassanezi. 1990, 1994; Freire, 1970, Gerdes, 1988a, 1988; Zaslavsky, 1998). In our opinion, a major objective of ethnomathematics as a program can be to raise student self-confidence,

to enhance creativity, and to promote cultural dignity (D'Ambrosio 1990; Rosa, 2000).

These factors are essential for students to learn all school subjects.

Teachers and Educators

As societies become increasingly urbanized, diverse and globalized, the application of an

ethnomathematical perspective in the curriculum encourages further and ongoing intellectual

and professional development of teachers. It also encourages long-term learning through a

diversity of experiences. Teachers are characterized as facilitators, advisers, and mediators of

the mathematics learning process (Bassanezi, 1990, 1994; Biembengut, 1999; Hogson, 1995).

Biembengut (1999), Hogson (1995), Orey (2001), and Rosa (2000) all have shown that

teachers and students can discover a process of understanding mathematics together if given

proper support and encouragement. This alternative allows students to learn mathematics

content through varied experiences that are related to the cultural, historical, and scientific

evolution of mathematics.

School Mathematics

Ethnomathematics turns perceived conceptual poverty into conceptual richness. This process

can go wrong, for example when non-Western knowledge systems are idealized, or when

educational processes trap students in old ways of thinking. However the process is likely to

be positive provided that ethnomathematics:

- looks forward, not backward; that is ethnomathematics as an expression of
  contemporary thought, is not just a recording of historical ideas and practices;
- assumes a sophisticated knowledge system because it is not just mathematical skills
  and drills.

When a mathematical system is actively used as a system based on theory that can solve real

problems, this can be described as modeling. In such modeling activity, both conventional

mathematics and the mathematical system of the cultural group are used. The point of this

activity as ethnomathematics is not just to solve problems, nor just so that people understand alternative mathematical systems, but also it is so that people understand more about the role that mathematics play in a societal context (Orey, 2000). It can enable a better understanding of mathematical systems through the use of mathematical modeling.

According to D'Ambrosio (2000), mathematical modeling is a process of translation and elaboration of problems and questions growing from any real situation (system), that forms an image or sense of an idealized version of the system. By analyzing their role in the contextual reality as a whole, this holistic context allows those engaged in the modeling process to study the systems of reality in which there is an equal effort made by them to create an understand of all components of the system as well as the interrelationships among them (D'Ambrosio, 1985, 1989, 1990, 1993).

In 2002, D'Ambrosio commented about an ethnomathematical example that naturally comes across as a mathematical modeling methodology. For example, a group of Brazilian teachers (1989-1990) studied the cultivation of vines brought to Southern Brazil by Italian immigrants in the early twentieth century. They chose to investigate this theme because, in their opinion, the problem to be analyzed should be linked with the culture of the people in that region. Both Bassanezi (2002) and D'Ambrosio (2002) have sited this is an excellent example of the connection betwen ethnomathematics and modeling.

Teachers started their project by interviewing wine producers and doing an ethnographical and historical research about their theme. One of the producers of wine was also involved in the building of their own barrels. The barrel used to store the wine formed a truncated cone. The teachers realized that the process used by the producer to find the volume of the barrel was different from the process used in academic mathematics, but worked perfectly well, and had been used for centuries in Italy. The producer's process was based on techniques that were learned from his father and transmitted to the members of his family through

generations by his ancestors long before arriving in Brazil. The teachers in this study used mathematical modeling techniques (academic mathematics) to model the process used by the producer (ethnomathematical practice).

Through modeling (Rosa, 2000; Rosa & Orey, 2003), it is possible to mix school mathematics and ethnomathematics. Hence, students practice academic mathematics while learning to model situations which are generated by ethnomathematics (D'Ambrosio, 1993). This is especially true when they are encouraged to solve problems that are related to their own communities. Mathematical modeling acts as a bridge between ethnomathematics and Western-academic mathematics which will be required for the student's success in today's globalized technological society.

A General Challenge

The traditional mathematical curriculum may not allow implementation by ethnomathematical perspectives. This challenge depends on how ethnomathematics aspects are selected from student experiences or from their own environment and community, because as a paradigm, it is culturally rooted, and often there is no traditional *syllabus* or assessment standards. The selection of mathematical content is dependent on situations that are interesting to students themselves because motivation and creativity are key components in the teaching and learning process in mathematics. In this curriculum model, teachers must learn to be both flexible and knowledgeable in the content because they be the ones who select cases which are related to student cultural background and their environment.

Seen in this context, part of this challenge is to adopt a methodology that deals with ethnomathematical perspectives in the mathematics curriculum. It is feasible to believe that one methodology that is adequate to this perspective is the use of mathematical modeling strategies. The selection of mathematical content can be directed to cover specific topics, standards or benchmarks in required mathematics content. However, many teachers are not

trusted or allowed to work away from required texts and curriculum, nor are they sufficently prepared or supported to be able to connect mathematical modeling and ethnomathematics. This most certainly limits the possibility for an ethnomathematics perspective to enter in classrooms in the United States and other countries.

To work with this perspective it is necessary that a school and community have an open curriculum where by the mathematics content that must be covered depends on the development of the class and how students become motivated. In this context, mathematical modeling becomes a methodology which is intrinsic to the Ethnomathematics Program. A careful look into the history of mathematics reveals that mathematical modeling is the root out of which much of modern mathematics has developed, often from a process of abstraction, which represents the real world. This can also be true in traditional school and academic mathematics.

A Summary of the Challenges to Ethnomathematics

There are numerous unfavorable arguments as related to the implementation of ethnomathematics as a program. We outline some of these challenges in the following categories:

Education

For several years it has been argued that traditional uses of the school curriculum do not foster a genuine disposition for realistic mathematics in students (Davis, 1989). Yet the same argument can be used against many attempts to make ethnomathematics useful to educators and students. Other concerns are related to the lack of enough time to develop content that enables teachers to execute pre-established pedagogical plans. Concerns related to the application of ethnomathematics as pedagogical action generally include:

- Few, if any, textbooks and other pedagogical materials about ethnomathematics are in use in classrooms, this is especially true in regards to materials in English.

- A scarcity of university ethnomathematics courses leaves teachers and researchers unprepared to argue this issue, and leaves the door open to further criticism of the field.

- Most research being done in ethnomathematics is being published in languages other than English (the most recent example being the 2005-Scientific American-Brasil Special Edition on Ethnomathematics).

- Few, if any, assessment instruments are appropriate to this new curriculum model; this is especially true in the United States.

- There is a real danger of ethnomathematics being taught as folkloristic and "primitivist" (Eglash, 2002) introductions to "real" or academic mathematics.

- Much of the published ethnomathematics activities represent a shallow, superficial understanding of the field with a sense of "multicultural experiences" based only upon "exposure to diversity", and an inability to look at the deeper mathematics present.

Students

Many students have difficulty with working in groups or in cooperative learning styles. Many teachers and parents are unsure about how their children should work without traditional classroom structures. Because of the traditional, often passive aspect of schooling, many students and teachers have not developed the habit of formulating questions and mathematizing[3] ideas and hypotheses, and have difficulty assimilating several subjects simultaneously (Burak, 1994; Pedroso, 1998), or seeing mathematics outside of the traditional classroom context.

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[3] Mathematization is the development of a given problem, that is, the transformation of the problem into mathematical language. This can be accomplished by the formulation of the hypotheses; classification of the data and information as important and non-important to the hypotheses, selection of important variables, selection of symbols adapted for these variables and description of those relationships in mathematical terms.

Teachers and Educators

Often because of the lack of their own personal experiences, and their inability to comprehend languages other than English, many educators in the United States and other countries are reticent to try cross-cultural methods in their academic training or professional growth in mathematics. Many educators are reticent to de-emphasize their traditional authority in favor of group work (Burak, 1994; Cross & Moscardini, 1985; Pedroso, 1998). Other reasons may relate to issues of time for planning lessons (Burak, 1994; Pedroso, 1998; Zaslavsky, 1998). Many educators are not familiar with the interface between mathematics and other subjects, that is, the interdisciplinary fashion of the mathematics curriculum, which is required when teachers work in this perspective. In a generally mathematics phobic culture, certainly the reverse is equally true. As well, many mathematics educators are not always prepared to employ practices that will enable underserved and underrepresented groups to learn, understand, and comprehend mathematics (Burak, 1994, Zaslavsky, 1994).

School Mathematics

It has been extremely difficult to mix the goals and philosophy of ethnomathematics, academic benchmarks, standards, and goals related to passing of standardized exams that are based in traditional school mathematics (Rosa, 2000). Many teachers and educators feel that their students will not learn mathematics if they use an ethnomathematical approach in school curricula. They believe that this perspective makes students and teachers accountability in standardized examinations extremely problematic.

We believe that one way for ethnomathematics to be taken seriously in North America and other countries, is for ethnomathematicians to develop rigorous research in regards to linking ethnomathematics and modeling activities to the mandated mathematics curriculum as being undertaken in places such as Brazil. Like it or not, educators are less likely to use

ethnomathematics if they cannot see at this time how this would allow them to succeed in improving overall student achievement.

Challenges towards Pedagogical Action

The pedagogical action of the ethnomathematical program underscores the importance of doing the ethnomathematical work first. In this context, coming to a good understanding of the mathematical aspects of culture and having a clear purpose to the educational activity are vital aspects of this perspective. The consequence of these ideas is that ethnomathematical work in the schools is not a simplistic presentation of cultural examples or simply situating mathematics in cultural contexts. Rather it requires considerable background work, complete understanding, and pedagogical sophistication. This is a complex task, takes time, and is difficult to get right. For example, it is convenient to state that teachers may interpret an ethnomathematical approach by starting with the students' outside socio-cultural-economic realities, but the students may refuse to study their own realities because they consider them oppressive. In this case, they may not identify this contextualization as mathematics because they already have a grounded mathematical conception as a previous knowledge. In this case, one possibility is to start with the students' existing mathematical conceptions, even if they are traditional, because this is another way to develop the mathematical contents followed by a critical examination of these conceptions. The consequence of this educational aspect for teacher education is significant. It means that teachers must know more about mathematics and additional pedagogical skills in order to help students undertake a critical examination of the mathematical contents.

Final Considerations

An eventual inclusion of ethnomathematics in the school curriculum could happen simply because current trends in many urban schools (on-growing migration, immigration and the increasing complex, urban diversity of our populations) will demand it. However,

ethnomathematics can be considered negative when it restricts ethnic groups to stereotypes and leaves them unprepared to participate in greater academic endeavors. It can be considered equally negative if it is seen to "water down" the necessary mathematics content in general. Ongoing work needs be undertaken by ethnomathematicians that shows that we can and do integrate rigorous mathematics such as modeling, into the curriculum.

As stated earlier, ethnomathematics seeks to recognize the contributions, values, rights, and the equality of opportunities of all cultural groups that compose any given society. Educators can begin to develop an ideal equality among students and build a foundation for promoting academic excellence for all their students (Croom, 1997) by implementing ethnomathematics and modeling.

Ethnomathematics may come to exert some influence on mathematics education in the United States, as it has in other countries (most notably Brazil) if researchers develop rigorous activities that are linked to standards and curriculum that makes mathematics a living subject for both teachers and students. Traditional mathematics education aims at transmitting a certain amount of content and uses it in artificial situations presented as problems. The problems are artificially formulated, in such a way that they can only help memorization skills, at best. These techniques and problems are usually boring, uninteresting, obsolete, and unrelated to the modern reality of students. These characteristics of traditional mathematics education are responsible for downgrading of school satisfaction and achievement in many countries. Ethnomathematics through modeling may restore a sense of pleasure in the doing of mathematics.

The use of calculators and computers must be integrated into the concept of ethnomathematics and mathematical modeling curriculum (D'Ambrosio, 2001). The emphasis in ethnomathematics can be considered conceptual while the emphasis in modeling

can be thought of as performance. And both, concepts and performance are aided in significant ways by advanced technology (D'Ambrosio, 2000; Rosa, 2000).

In relation to the ongoing development and implementation of ethnomathematics and modeling in the Untied States and other countries, debate should continue as part of ongoing development and research that creates inclusive paths for the learning and teaching of mathematics in schools, communities, and societies. Sociological questions about the relationships between institutionally dominant majority and minority cultures needs be reflected by ethnomathematics research in this, our increasingly interconnected and globalized, world.

In closing, since the vast amount of research in the field is being published outside of the United States, it is necessary for more research to be translated and published into English. A recent special of Scientific American - Brasil was published in Portuguese with out any plans what so ever for Scientific American to do the same in English. NASGEm might consider assisting researchers in other countries to translate and publish their work in journals in the United States in order to establish a better reputation for our own work the field.

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