12

ETHNOMATHEMATICS IN THE GLOBAL EPISTEME: QUO VADIS?

Ferdinand Rivera and Joanne Rossi Becker
San José State University, USA

Abstract: This chapter discusses scholarly work in the field of ethnomathematics from three perspectives that seem to encompass much of the current work in the field: challenging Eurocentrism in mathematics; ethnomathematics praxis in the curriculum; and ethnomathematics as a field of research. We identify what we perceive to be strengths and weaknesses of these three perspectives for today's learners who are faced with forces of a global nature. We propose a less traditional view of ethnomathematics that is compatible with postnational, global identities, and exemplify this approach through a professional development program in California. Finally, we raise several issues for future discussions relative to ethnomathematical theory and practice

Keywords: ethnomathematics

According to Habermas (2001), globalisation is still in its emergent state. Currently, we witness various physical and nonmaterial changes in our societies as a consequence of "the increasing scope and intensity of commercial, communicative, and exchange relations beyond national borders" (Habermas, 2001, p. 66). Giddens (1999) also makes sense when he insists that no one group can claim ownership to all the various global forces that are currently influencing the emerging social landscape. As a matter of fact, control takes place at the level of networks that enable globalisation to maintain its multidimensional character. Our intent in this chapter is to confront conceptual and practical difficulties with ethnomathematics and its nuances (herein collectively referred to as "the ethnomathematics program") so that their strengths are articulated and their limitations are surfaced and overcome. Today's learners, irrespective of community and affiliation, are living out the tensions brought about by the reality of globalisation. This social condition implies that various operations, transactions, and interactions that are currently taking place employ disciplinary relations that are not state-specific in the classical sense. They

B. Atweh et al. (eds.), Internationalisation and Globalisation in Mathematics and Science Education, 209–225.

are increasingly performed within a distinctively post-state perspective that has been forged by cosmopolitan solidarity (Habermas, 1998). It is a solidarity that seems to have traversed particular cultures and social filiations or groups and, at the same time, has successfully reconciled the specificity of cultural practices with the generality and universality of lived relations across cultures.

As social theorists of difference, we see some ironies and contradictions that are developing between global and multicultural societies insofar as cultural identities matter. *At the local stage*, immigration has tremendously changed the landscape of nation-states. All prosperous nations that deal with migrants in large numbers experience unanticipated transformations in their societies. Habermas (2001) points out that the "path toward a multicultural society" is a challenge for these nation-states that are confronted with the plurality of lived relationships. A significant issue in education in these multicultural contexts is how to develop good practices of inclusion. Here we note that if by inclusion we mean "a collective political existence [that] keeps itself open for the inclusion of citizens of every background, without enclosing these others into the uniformity of a homogenous community" (ibid, p. 73), what remains unresolved to this day deals with processes and mechanisms that can be effectively institutionalised in schools and in the wider communities so that a more meaningful, harmonious, and productive political integration of different relationships is achieved. According to Habermas,

> (m)ulticultural societies require a "politics of recognition" because the identity of each individual citizen is woven together with collective identities, and must be stabilized in a network of mutual recognition. (Habermas, 2001, p. 74)

Thus, inclusive practices must take into account ways in which different cultural communities with their particular shared traditions and practices can be made to co-exist so that the practices do not produce difficult situations of subcultural formation and marginalisation.

At the global stage, people from around the world develop a shared need or a mass culture for goods, fashion, films, programs, music, books, and other forms of aesthetic expression. The Western influence seems to have produced, Habermas writes,

> [a] "commodified, homogenous culture [that] doesn't just impose itself on distant lands, of course; in the West, too, it levels out even the strongest national differences, and weakens even the strongest local traditions. (Habermas, 2001, p. 75)

Thus, while some critical commentators have pointed out how global forces are driving indigenous cultures to states of moribundity, irrelevance, and homogenisation, they are, as a matter of fact, producing new constellations, new differences, new worldviews, or cosmopolitan identities that celebrate "a new multiplicity of hybridised forms" (ibid, p. 75). In effect, hybridity promotes "new modes of belonging[ness and] new subcultures and lifestyles [that involve] a process [that is] kept in motion through intercultural contacts and multiethnic connections" (p.75). What we now perceive to be the most significant problematic in our schools that are situated in the global cultural economy is not one of inclusion in the worried ethnocentric sense. Rather, it involves finding ways of dealing with new collective experiences, including processes that encourage new individual experiences (ibid, p. 76; Rivera, 2004) and that operate within a sensibility that is compatible with new solidarities or cosmopolitan structures (Habermas, 1998) brought about by emerging global identities.

The chapter is divided into four sections. In section 1, we characterize important aspects of the global episteme that bear on ethnomathematical practices. In section 2, we identify and discuss with some depth three prevailing perspectives (i.e., theory, practice, and research) raised about ethnomathematics. Following Hardt and Negri (2000), since we believe that the construction of a conceptual program is both an epistemological and ontological project – in the sense that the production of knowledge and the construction and deployment of reality are mutually constitutive – we articulate what we perceive to be strengths and weaknesses of the various perspectives that have been proposed and developed about the ethnomathematics program. In section 3, we discuss problems with both the theory and practice of ethnomathematics. Also, we propose a less traditional view of ethnomathematics and propose a hybrid version that is compatible with postnational, global identities. In this section, we draw on insights and tellings from the English Language Development Institute in Algebra, a grant-funded professional development program for in-service mathematics teachers of minority students in California. In Section 4, the conclusion, we raise several issues that are worth considering in future discussions involving ethnomathematical theory and practice.

1. The Global Order Of Things

Hardt and Negri (2000) claim that in the now that is the postmodern, a global concept rules by the name of Empire. Empire deploys a new form of logic that has emerged as a consequence of the globalisation of economic and cultural relations. Further, it produces new modes and conditions of social production. Empire draws its strength from being in control of global capital that is run mainly by networks of transnational corporations and united national and supranational organisms. Networks function around a world market that continues to threaten boundaries and limits imposed by individual nation-states. At the very least, the Empire is "both system and hierarchy, centralized construction of norms and far-reaching production of legitimacy, spread out over world space" (p. 13). Thus, the global market is the site whereby certain binary divisions, generated mostly by nation-states, can no longer be justified since the "new free space" harbours "a myriad of differences" (p. 151) and certain forms of hybridity that enable the market to stay fluid and flexible. Henceforth, individual citizens who live in particular locations witness the decline of the power of their respective countries when confronted with the decentred and deterritorialising rule of the Empire.

At least from the perspective of those of us that are privileged to live in affluent societies and benefit from membership in the top ladder in the global order, today's nation-states have been and, in some cases are being, phased into the postmodern episteme. Hardt and Negri point out that both modernisation and industrialisation represent one and the same economic phenomenon, and that the transition to postmodernisation marks a shift towards an informational economy that "emphasise[s] different kinds of service and different relations between services and manufacturing" (p. 286). Needless to say, such a postmodern condition causes the development of "new mode(s) of becoming human" because advances in "cybernetic intelligence of information and communication technologies" change the manner in which labour is performed in the new global order (p. 289). For instance, individuals are now forced to perform "immaterial labour" by way of manipulating and producing information and knowledge more intensely than ever before. Progress in technological tools has also modified social dynamics as advances in cybernetics have been successful in abstracting important aspects of material, concrete, physical, and bodily labour ("abstract labour") resulting in the further deskilling of work and encouraging "abstract cooperation" in virtual contexts. Consequently, new relations in the division of labour have also taken shape, between creative individuals who are capable of "symbolic-analytic services," that is, "problem-solving, problem-identifying, and strategic brokering activities" (Reich, 1991), and those who can (merely) perform "routine symbolic manipulation" such as data entry and word processing (ibid.).

Analysing the history of the nation-state, Habermas (1998) traces its origin from attempts to organize individuals and communities at a time when the old European feudal order was being phased out, and that nation-states emerged in the period of modernisation and democratisation. For Habermas, traditional notions associated with the nation-state are becoming irrelevant in the global order. Nationality in the usual sense as pertaining to "ethnicity, a common language, or a shared history" (Cronin & De Greiff, 1998, p. xxii) is now being disputed in favour of republicanism that is "founded on the ideals of voluntary association and universal human rights" (ibid.). Further, while loyalties and kinships played an important role in forming national identities in early history, politics and legal institutions also contributed significantly to the constructive process. Thus, a distinction has to be made "between a *civic* and *ethnic* sense of the nation" and "between a *political* and a *majority* culture" (Cronin & De Greiff, 1998, p. xxiii). Cronin and De Greiff capture the differential essence astutely in the following manner:

> Citizens do not have to agree on a mutually acceptable set of cultural practices but must come to a more modest thought still demanding agreement concerning abstract constitutional principles. As with national identity within pluralistic states, Habermas thinks that a supranational identity might evolve around an agreement about political principles and procedures rather than about culture more generally. (Cronin & De Greiff, 1998, p. xxiv)

In summary, the emerging global condition influences the cultural experiences and, consequently, the mathematical education of learners in ways no one can easily predict. As Giddens (1999) has clearly emphasized, we are only at the initial stage of the globalisation process, "at the beginning of a fundamental shake-out of world society, which comes from numerous sources, not from a single source." For some, globalisation is seen in positive terms, while for others, it carries with it some negative elements. A negative instance is worth discussing briefly. While international studies in areas such as school science and mathematics (for example, the Third International Mathematics and Science Study (TIMSS), the International Evaluation of Educational Achievement) drive schools from around the globe to attempt to develop a quality and competitive curriculum, they also create new situations and other externally-induced conditions, such as learned helplessness and relative deprivation, that affect the nature and context of their learners' educational experiences. The TIMSS, including various state-funded examinations that have been informed by results from international assessments, seem to put pressure on schools to develop uniform, standardized, and homogenizing practices without considering their effects on particular cultures. Addressing a positive instance, globalisation has provided the impetus for increased democratisation of life in many countries and, thus, has permitted discussions involving gender, race, and equity, in general. Suffice it to say, globalisation allows individuals to produce new ways of reworking their identities, enabling them to "revolt against traditional forms and styles" and "to create new, more emancipatory ones" (Cvetkovich & Kellner, 1997, p. 10). This observation needs to be articulated considering the fact that many learners from particular cultures show a tendency to value practices other than what their own cultures allow or suggest for them. We tend to view them as comprising the new group of cosmopolites (in Habermas's sense) that value global skills necessary for accomplishing global innovations and activities (Carnoy, 1998).

2. Three Prevailing Perspectives On Ethnomathematics

Ethnomathematics as a field of study has a number of definitions and interpretations. It has evolved significantly from the early, rather narrow definition of Marcia Ascher and Robert Ascher (1997) as "the study of mathematical ideas of non-literate peoples" (p. 26). Powell & Frankenstein (1997) use a broader definition provided by D'Ambrosio, a Brazilian mathematician and mathematics educator whom many consider the intellectual progenitor of the field, that is, ethnomathematics as the mathematics in which all cultural groups engage (D'Ambrosio, 1985). For D'Ambrosio, each group, including "national tribal societies, labour groups, children of a certain age bracket" (pp. 16) has its own mathematics, in contrast to the academic mathematics that is taught in schools. From D'Ambrosio's perspective, ethnomathematics exists at the convergence of the history of mathematics and cultural anthropology.

Eglash (1997) provides a more comprehensive characterization of ethnomathematics. Ethnomathematics is the mathematics of "small-scale or indigenous cultures" (p. 79). It is distinguished from: *non-Western mathematics* (with a focus on contributions from "state empires such as the ancient Chinese, Hindu, and Muslim civilizations" (p. 80) that have developed mathematical methods and theories similar to those of Western mathematics); *mathematical anthropology* (with a focus on "material and cognitive patterns" that are the "structural basis of underlying social forces, or as epiphenomena resulting unintentionally from the nature of the activity itself" (ibid.)); *sociology of mathematics* (with a focus on how mathematics itself is seen as a social construction resulting from the work of professional mathematicians, including the community that validates certain practices), and; *vernacular mathematics* (with a focus on street, situated, folk, informal, and non-standard mathematical practices of individuals that appear not to fall under any of the above categories). An ethnomathematical program strives to see how the mathematical practices and/or social or everyday patterns of minority cultural groups can be shown to be similar or as rigorous and sophisticated as those that have been developed in both Western and non-Western traditions. Further, such practices are not necessarily primitive (i.e., concrete and drawn from nature) and pure (i.e., unsullied by influences from other cultures).

But from its beginnings ethnomathematics has had a decidedly political stance that is not apparent in these definitions. We discuss scholarly work in the field of ethnomathematics from three perspectives that seem to encompass much of the current work in the field: challenging Eurocentrism in mathematics; ethnomathematics praxis in the curriculum; and ethnomathematics as a field of research. By focusing on these conceptions of ethnomathematics, we do not imply discrete categories of work; in fact, various contributions often fit into more than one category. But the categorization does help sort the major points of view represented in the literature.

2.1 Critiques of Eurocentrism

One of the themes of ethnomathematical scholarship is a critique of prevailing views of the history of mathematics as frequently represented as a two-stage development in which the Greeks ($\approx$600 BC to 300 AD) and post-Renaissance Europe and Europeanised countries like the US (16th century to present) were primarily responsible for the development of mathematics. For example, Joseph (1997, 1993) provides an alternative look at the Dark Ages by highlighting the role of Arabs in the history of mathematics, arguing that an Arab renaissance in mathematics between the 8th and 12th centuries provided for a flow of mathematical knowledge *into* western Europe that helped shape the pace of developments for the next five hundred years. Joseph (1997) also stresses that most of the topics taught in school mathematics today are derived from outside Western Europe before the 15th century. So one purpose of this perspective of ethnomathematics is to challenge the Eurocentric foundations of mathematics that ethnomathematics scholars find in many historical treatments of the subject (see, for example, Powell & Frankenstein, 1997).

While colonialism played a critical role in denying the contributions of Arabs and other non-European people of colour to the development of mathematics, the ideology of European superiority arose as an outcome of European political control over vast areas of Africa and Asia. "The contributions of the colonized were ignored or devalued as part of the rationale for subjugation and dominance" (Joseph, 1997, pp. 63). As Walkerdine (1997) points out, the European aristocratic male became the model to which others were compared; all others became inferior. By analysing the mathematics of traditional cultures or others marginalized in mathematics, such as women, scholars have attempted to provide some balance into the historical record (e.g. Gerdes, 1997; Gilmer, 2001 ; Hancock, 2001; Harris, 1997; Zaslavsky, 1973).

2.2 Ethnomathematics Praxis in the Classroom

This perspective on ethnomathematics has perhaps engendered the most controversy recently (Adam, Alangui & Barton, 2003; Rowlands & Carson, 2002; Vithal & Skovsmose, 1997). The main goals of proponents of an ethnomathematical approach to curriculum are: to reveal to students the role that mathematics has played throughout human civilization (Gerdes, 1997); to validate students' lived experiences and culture (Zaslavsky, 1997); to capitalize on students' interests and knowledge (Borba, 1997); and to empower students to understand power and oppression more critically (Powell & Frankenstein, 1997). The ultimate aim of an ethnomathematics praxis in the classroom is one of equity. What might such curricular approaches look like?

In their critique of ethnomathematics, Rowlands and Carson (2002) pose four possibilities for an ethnomathematics curriculum and its role relative to formal academic mathematics: replacement for academic mathematics; supplement to academic mathematics; springboard for academic mathematics; or, motivation for academic mathematics. It is clear that supporters of ethnomathematics are promoting much more than cultural adjuncts to lessons: "However, we also stress that we are not advocating the curricular use of other people's ethnomathematical knowledge in a simplistic way, as a kind of 'folkloristic' five-minute introduction to the 'real' mathematics lesson" (Powell & Frankenstein, 1997, p. 254). In their response to Rowlands and Carson, Adam, Alangui, and Barton (2003) propose an "integration of the mathematical concepts and practices originating in the learners' culture with those of conventional academic mathematics" (p. 332). However, their example of perimeter, area and volume within Maldivian culture is so scanty that the reader cannot judge how it answers Rowlands' and Carson's concerns. And despite many fine ethnomathematics articles documenting interesting mathematics arising from real life contexts (for example, Barbie dolls (Kitchen & Lear, 2000); braiding of African American hair (Gilmer, 2001); the mathematics of seamstresses (Hancock, 2001); and the mathematics of carpenters (Millroy, 1992)), we still have few examples of ethnomathematics as educational practice that can serve as stepping stones to formal academic mathematics (Kitchen & Becker, 1998 ; Rowlands and Carson, 2002; Vithal & Skovsmose, 1997).

A further challenge to ethnomathematics and its impact on the school mathematics curriculum is raised by Vithal & Skovsmose (1997) in the South African experience in which ethnomathematics was subverted to provide a justification for apartheid education. Mathematics based on knowledge that students bring from outside school and related to their own situations and culture was used to help justify continued separation of students by racial classification and all the concomitant differences in resources, curricula, and outcomes that would result. So while proponents of ethnomathematics in western countries such as the US consider it as promoting equity (Gilmer, 2001; Secada, 2000), in South Africa during apartheid it helped enable the opposite (Vithal & Skovsmose, 1997).

2.3 Research in Ethnomathematics

Ethnomathematical research seeks to uncover information about various people's mathematical knowledge in both western and non-western contexts, and how that knowledge has been created. This research probes deep epistemological questions, such as what counts as mathematical knowledge? Or, in Eglash's (1997) words: "Once we step outside the acknowledged, professional mathematical community of the west, how will we recognize mathematics when we run into it?" (p. 79). In a western context, Hancock (2001) studied four women seamstresses and the mathematics they used and created while sewing. The four women used mathematics for estimation, problem solving, measurement, spatial visualization, reasoning, geometry, and cost effectiveness. But, according to Hancock (2001), "[b]ecause of their different tools, resources, goals, and thinking, their mathematics rarely resembled school mathematics" (p. 70). The seamstresses not only invented their own language and processes, but created a type of coordinate system on the plane of a fabric that appeared to be different from known, standard systems.

In a non-western context, Knijnik (1997) worked with the Landless People's Movement in Brazil, researching the conceptions, traditions, and mathematical practices of that specific social group and how they codified and interpreted their knowledge in order to solve problems. Gerdes (1995, 1997) has conducted ethnomathematical research in Mozambique starting in the late 1970s, with an aim to ascertain the hidden mathematics of daily life that survived colonization. Gerdes has discovered many examples of use of geometry in daily life in Mozambique, and argues that without colonialism it is possible Mozambicans might have been credited, for example, with the so-called Pythagorean Theorem.

Pinxten (1997) provides an example of how ethnomathematical research might have curricular impact in schools. An anthropologist who studied the Navajo conception of space, Pinxten found that Navajo notions of space are dynamic rather than static, with the emphasis on continuous changes rather than an atomistic structure. This fundamental approach to spatial knowledge creates essential differences in how Navajos approach many concepts, including geometric ones in school. Pinxten proposes an explicit treatment of the Navajo spatial knowledge in geometry courses and in other parts of the curriculum, integrating it with the Western outlook, to improve Navajo children's understandings of spatial concepts.

3. Issues with Theory and Practice, and the English Language Development Institute in Algebra

3.1 Issues with Theory

Researchers who claim Western hegemony in the way mathematics is constructed in our schools today have done quite well in surfacing the contributions of other cultures in the history of mathematics. Equity researchers who advocate widening the space in which to do mathematics by drawing on the cultural practices of learners have as well raised the problematic of contexts in learning mathematics in a more meaningful manner. Various research studies on ethnomathematics (Joseph, 1997; Stapleton, 1996) also show that other early cultures were already familiar with notable mathematical theories such as the Pythagorean Theorem, which only demonstrates the universality of certain mathematical concepts. The question, "What counts as mathematical knowledge?" will remain open and unresolved. Suffice it to say, any response we make to such a foundational question necessitates foregrounding and articulating our favoured paradigms that significantly influence the way we perceive and construct mathematical objects and relationships. Further, what may be nonmathematical to some cultural groups or practitioners may be mathematical to others, and what constitutes the divide between what is and what is not mathematical will remain tied to subscribed epistemes that provide the very "conditions of possibility" (Foucault, 1970).

While we acknowledge the significance of the ethnomathematics program as providing "corrective measures" that may lead to the "redemption of [non-mainstream mathematical] cultures" (D'Ambrosio, 1999, p. 50) we find ourselves echoing Eglash's (1997) predicament: How do we develop alternative ways of thinking about the ethnomathematical practices of small-scale, indigenous groups without imposing the framework of Western mathematics? How might such othered forms of mathematics look if their logic of sense were to remain sophisticated and generally or universally unreasonably effective without being dismissed as primitive? As it were, current conceptualisations of ethnomathematics – as a "history 'from below,' " as the "cultures of the periphery," as "other ways of doing mathematics, proper to different cultures," and as driven by differing cosmovisions that appear opposed to the Western version (D'Ambrosio, 1999) – seem to suggest the view that the mathematical practices of minority groups are culturally-situated and context-dependent.

Barton's (1999) proposal to develop a relativist philosophy further reinforces tensions in ethnomathematical theory. He also suggests renaming ethnomathematics as a QRS system (quantity, relationship, space) to distinguish it from Western mathematics. However, we find that such a philosophy exhibits an epistemo-ontological symptom that Eglash (1997) has described as "western romantic diversions," that is, "illusions of cultural purity and organic innocence [that] are too easily projected onto these traditional cultures" (p. 83). Further, Barton suggests that we view mathematics "as a way of talking" rather than "characterizing mathematical knowledge" (p. 56). Enacting a Wittgenstein move, Barton insists that such talk enables mathematicians to load mathematical objects with real properties. For Barton, however, mathematics "is just a convenient figure of speech – literally" (p. 56). He then articulates that the "real" is at best a human construction that justifies his view that we can set aside judging for correctness (p. 57). While we agree that "talked into existence" is a good thing, however, such an action does not fully take into account how it needs to be evaluated for general and universal effectiveness and usability if at least to assure intergenerational continuity. Also, Barton's QRS system begs the question of a basis for looking at QRS in a way that projects a form or structure that is totally other to Western mathematics. For instance, our current understanding of the weaving patterns of certain indigenous cultures still reflects the use of Western mathematical concepts and processes (e.g., group theory, transformation geometry) in explaining and understanding the patterns. But, how can we begin to understand the patterns in ways that encourage us to look at mathematics differently against/beyond the Western lens?

3.2 Issues with Practice

Despite critiques of assimilation, and anticipating the needs in global times, what is lacking in conversations about ethnomathematics concerns how researchers address the complex issue of ways in which students develop mathematical identities. If certain minority groups in our schools today are known to employ particular ethnomathematical practices, in which case *ethnomathematical practices are viewed as cultural*, should individuals in such groups be bound by those practices? Are those practices too solidified and institutionalised so as not to permit changes that result from developments in their respective societies? Are indigenous mathematical practices not allowed to evolve and expand based on newer forms of social and cultural lives of peoples who engage with others outside their own cultures? From a different lens, if *ethnomathematical practices are seen as socioconstructivist*, should members allow themselves to be continually constructed by those practices that might in effect preclude any consideration of being reconstructed in some other ways? Are members not permitted to improvise based on social, cultural, economic, historical, and material transformations and developments that occur within and outside their societies? Such improvisations are necessary actions especially in situations when traditional practices of the past come into conflict with present needs and circumstances. They are "the openings by which change comes about from generation to generation" (Holland, Lachicotte Jr., Skinner, & Cain, 1998, p. 18).

From our point of view, reconceptualising ethnomathematics involves situating the talk where it is at stake, that is, the formation of students' mathematical identities that go far beyond the confines of traditional conceptualisations (i.e., culturalist, constructivist) oftentimes associated with ethnomathematics. Limiting the scope of the nature of ethnomathematics to those seemingly indigenous practices that define a community tend to essentialise members in ways that effectively close the possibility of multiple and evolving "political" processes relevant to their ways of mathematising. While we acknowledge the benefits that minority groups may acquire from learning more about the mathematical practices of their communities, we also see advantages in broadening their sense of "ethno" to include changes that take place outside their cultures. Moreover, we find it necessary for ethnomathematical researchers who construct what they perceive to be authentic, indigenous mathematical practices of a certain culture to carefully scrutinize the extent to which such practices apply to all individual members that comprise the culture. While a certain cultural community may have developed common practices, it does not simply imply that every member in the group supports the same practices. The formalization of those indigenous practices as an ethnomathematical discourse can in many cases be naively interpreted as applicable to all members despite possible differences in individual, personal, social, and environmental contexts. In other words, we need to be wary of essentialist-driven ethnomathematical programs since there is a possible unintended consequence of categorizing people and their practices in ways that may constrain the manner in which they learn mathematics, and all for the sake of preservation. Similar to Appiah's (1994) cautionary remarks about "tightly scripted identities," it is likely that certain tightly-scripted ethnomathematical practices that have been drawn from a particular culture might curtail individual and personal practices and even prevent members in the same culture from learning a different approach because of the equality assumption that cultural membership also implies shared cultural practices.

3.3 Forging a Hybrid Version of Ethnomathematics

Situating the mathematical education of those minority groups in our classrooms in the positive space of globalisation means providing them with an appropriate mix of past and present mathematical practices that will prepare them to have a better sense of the order in which their immediate and outside worlds are being reorganized in contemporary times. This is "ethno" expanded as a concept that includes all the appropriate "jargons, codes, symbols, myths, and even specific ways of reasoning and inferring" in global times (D'Ambrosio, 1985, p. 45). We emphasise that it does not mean doing away with mathematical practices that learners in particular cultures have come to know by tradition and that have constructed them in some way. However, it does mean reconciling the old with the new and, better still, forging newer practices that enable learners to cope with current modes of living. What we deem to be contemporary ethnomathematical practices involve the development of a hybrid set of altered practices and an assemblage of new collective mathematical registers that enable minority learners to cope with the global imaginary. Such practices and meaning systems should bridge the divide between the abstract, universal, and decontextualised nature of Western mathematics and the situated, local, and contextualised nature of ethnomathematics.

In 2001–2002, data from the U.S. Department of Education shows that close to 4 million students in public schools throughout the country obtained some level of assistance to learn English, with about three quarters of the students speaking Spanish as their first language. In the state of California, there has been a steady growth of English learners from 1995 to 2003. California has a "higher concentration of English learners than anywhere else in the US" (Gándara, Maxwell-Jolly, & Driscoll, 2005). In the 2003–2004 Language Census, data from the California Department of Education reveals that 85% of English learners spoke Spanish, while the remaining ones spoke any one of fifty-five different languages. Efforts have been established to assist these students to acquire proficiency in the official language (i.e., English) at both conversational and academic levels. The English Language Development Institute in Algebra (ELDI-A) was one of several efforts. It has both ethno- and Western-mathematical components integrated in its program for in-service and certified middle school and high school teachers. ELDI-A works within a premise that English learners' mathematical identities are never pregiven to them. That is, while it is true that they come to American classrooms after having been already exposed to levels of ethnomathematical practices in their respective home countries, they are still capable of acquiring knowledge about (Western) mathematics. What the ELDI-A seeks to accomplish is for teachers to provide a hybrid space in which English learners acquire Western mathematics by grounding their knowledge on what they know about their ethnomathematical practices. This perspective shadows Cummins's (1994) common underlying proficiency thesis whereby linguistic elements in a student's native academic language share syntactical, semantical, and structural commonalities with the elements in the new academic language. In the case of school mathematics, using the mathematical knowledge that students bring with them and then connecting that knowledge with the appropriate mathematical knowledge in English will enable learners to achieve some level of success in learning academic, formal mathematics.

Because the ELDI-A focuses on implementing a mathematical discourse that is drawn from activities from various traditions, what is constructed for learners is a discourse in which various frames of reference for meaning have not been drawn from a single source (i.e., Western). Further, the pedagogical strategies appropriate for English learners, called Specially Designed Academic Instruction in English (SDAIE), are sensitive to similarities and differences in cultural practices. Thus, English learners' knowledge of concepts, skills, and processes has been generated from a diverse set of mathematical practices. Because the ELDI-A Program represents a collective discourse from several cultures, students' mathematical practices evolve out of such a hybrid condition.

Barton (1999) provides some evidence about a possible relationship between the manner in which cultural groups use and practice mathematical language and their conceptions of quantity. For instance, the traditional Maoris in New Zealand and some American Indian groups consider "number words [as] action words, they act like verbs" (p. 57; see, also, Denny (1986)). Barton laments that such linguistic practices have "been talked out of existence, or, at the least, [they have] been talked out of existence as mathematics" (ibid.). In the ELDI-A, every effort is made to bridge such differences in mathematical practice. What mathematics teachers acquire is that an understanding of English and relevant discourse and linguistic patterns reflect cultural traditions and practices. Further, it is generally acknowledged that the English language relevant to mathematics has a structure that is not shared by other cultures. In other terms, there are variations in the manner in which language is used and practiced by, say, American Indians, Native Hawaiians, Puerto Ricans, and African Americans, which tend to significantly influence the way mathematics is learned. Also, Fillmore & Snow (2000) point out that if teachers are aware of the grammatical and extra-linguistic (cultural) structures that different minority groups employ to convey their thoughts and processes, then they can at least "see the logic behind [their students'] errors" (p. 15). Thus, in ELDI-A, it is not the case that certain ethnomathematical practices are effaced or talked out of existence. In fact, they serve as the basis for assisting students to acquire competence in the academic, formal language in which mathematics is represented (which happens to be English in the case of the U.S.). Various SDAIE strategies attempt to integrate ethnomathematical practices with those used in the mainstream.

4. Provisional Closure

D'Ambrosio (1985) claims that the field of ethnomathematics is about acknowledging how "different modes of thought may lead to different forms of mathematics" (p. 44). We are fortunate that there is now a strong research base that shows the mathematical capabilities of quite a number of cultural groups that have developed particular "quantitative and qualitative practices, such as counting, weighing and measuring, comparing, sorting, and classifying" (D'Ambrosio, 1999, p. 51). D'Ambrosio (1999) points out as well how tellings in cognitive theories suggest a strong connection between culture and cognition. While his early views are worth considering in our efforts to theorize mathematical practice based on cultural specificities and necessities, there is also a need to consider how promoting such differences in thought and context will benefit minority learners in the long haul. While we possess a wealth of information about the mathematical systems and discursive and symbolic representations of different cultural groups, the most significant question for ethnomathematical theory and practice is: What now? Restivo (1983) has astutely articulated how transformations "in the social, economic, and political conditions of [and relationships in] our lives" would inevitably necessitate transformations in "the material bases and social structure of mathematics" (p. 178). Considering the global episteme, how can teachers use ethnomathematical knowledge that will enable their students, especially those individuals that come from "cultures of the periphery" (D'Ambrosio, 1999, p. 51), to meet the demands of a changing global society?

Bracketing unresolved conceptual issues with the ethnomathematics program, we believe that all learners' mathematical experiences will be enriched if every effort is made to reconcile the traditions of both Western mathematics and ethnomathematics, including other types of mathematical systems such as non-Western and vernacular mathematics (see Eglash's (1997)). Drawing on Habermas (2001, 1998), this reconciliatory view stems from our belief that it is possible to have shared mathematical practices in spite of cultural differences. Western mathematics for us represents those corpora of disembodied, universal, and institutionalised mathematical knowledge and practices that continue to impose its hegemony as a result of centuries of shared thinking across cultures. For instance, contemporary school algebra reflects an interesting history of shared knowledge as a result of early mathematicians who have engaged in trade and commerce, and at the same time, have acquired knowledge of mathematical systems in other cultures. In Section 3, we briefly discussed how the ELDI-A program that we offer our in-service mathematics teachers in California was an attempt to resolve certain linguistic and extra-linguistic (cultural, social) differences and difficulties. Thus, we see a complementary relationship between Western mathematics, the mainstream discourse that is implemented in almost all schools around the globe, and the contextual nature of ethnomathematics.

Ethnomathematics researchers are also not exempt from criticisms that in effect claim they are imposing ethnomathematical traditions onto learners who may favour or benefit from other ways of learning mathematics. We believe that a more powerful ethnomathematics program in contemporary times involves understanding the structure of complexity of cultures in ways that explain how members in such cultures are able to preserve valuable mathematical practices and might overcome those that constrain them from fully participating globally. Holland, Lachicotte Jr., Skinner, and Cain cogently capture what we envision to be the next phase in the ethnomathematics agenda in the sentences below.

> The very conceptions of culture have changed drastically. Anthropology no longer endeavours to describe cultures as though they were coherent, integrated, timeless wholes. … Anthropology is much less willing to treat the cultural discourses and practices of a group of people as indicative of one underlying cultural logic or essence equally compelling to all members of the group. Instead, contest, struggle, and power have been brought to the foreground. *The objects of cultural study are now particular, circumscribed, historically and socially situated "texts" or "forms" and the processes through which they are negotiated, resisted, institutionalised, and internalised.*
> (Holland, Lachicotte Jr., Skinner, & Cain, 1998, pp. 25–26; emphasis added).

Below we raise four issues that need to be addressed in future discussions on ethnomathematics.

(1) In constructing knowledge about the ethnomathematical practices of indigenous groups, how were those practices institutionalised? What were the social, economic, and political conditions that have allowed those practices to be taken as shared? Are those conditions still evident in their societies?
(2) To what extent do individual members within indigenous groups subscribe to the same ethnomathematical practices? How do they negotiate and internalise such practices?

(3) Are there members within indigenous groups who do not subscribe to the same ethnomathematical practices? Why do they resist the practices?
(4) Considering the fact that the ethnomathematical practices of minority groups have been developed and influenced by specific cosmovisions, epistemologies, and ontologies, how can teachers and learners be assisted in reconciling possible conceptual and praxiological differences between mainstream and minoritarian views and practices?

References

Adam, S., Alangui, W., & Barton, B. (2003). A comment on Rowlands' and Carson's "Where would formal, academic mathematics stand in a curriculum informed by ethnomathematics? A critical review." *Educational Studies in Mathematics, 56*(3), 327–335.

Appiah, A. (1994). Identity, authenticity, survival: Multicultural societies and social reproduction. In A. Gutman (Ed.), *Multiculturalism: Examining the politics of recognition* (pp. 149–163). Princeton, NJ: Princeton University Press.

Ascher, M., & Ascher, R. (1997). Ethnomathematics. In A. Powell & M. Frankenstein, (Eds.), *Ethnomathematics: Challenging Eurocentrism in mathematics education* (pp. 25–50). New York: SUNY Press.

Barton, B. (1999). Ethnomathematics and philosophy. *Zentralblatt für Didaktik der Mathematik, 31*(2), 54–58.

Borba, M. (1997). Ethnomathematics and education. In A. Powell & M. Frankenstein, (Eds.), *Ethnomathematics: Challenging eurocentrism in mathematics education* (pp. 261–272). New York: SUNY Press.

Carnoy, M. (1998). The changing world of work in the information age. *New Political Economy, 3*(1), 123–128.

Cronin, C., & De Greiff, P. D. (1998). Introduction. In J. Habermas, (Ed.), *The inclusion of the other: Studies in political theory* (pp. vii–xxxiv). Cambridge, MA: MIT Press.

Cummins, J. (1994). Primary language instruction and the education of language minority students. *Schooling and language minority students: A theoretical framework* (pp. 3–46). Los Angeles, CA: Evaluation, Dissemination, and Assessment Centre of the California State Department of Education.

Cvetkovich, A., & Kellner, D. (Eds.). (1997). *Articulating the global and the local: Globalisation and Cultural Studies*. Boulder, CO: Westview Press.

D'Ambrosio, U. (1985). Ethnomathematics and its place in the history and pedagogy of mathematics. *For the Learning of Mathematics, 5*(1), 44–50.

D'Ambrosio, U. (1999). Ethnomathematics and its first international congress. *Zentralblatt für Didaktik der Mathematik, 31*(2), 50–53.

Denny, P. (1986). Cultural ecology of mathematics: Ojibway and Inuit hunters. In M. P. Closs (Ed.), *Native American Mathematics* (pp. 129–180). Austin, TX: University of Texas Press.

Eglash, R. (1997). When math worlds collide: Intention and invention in ethnomathematics. *Science, Technology, and Human values*, *22*(1), 79–97.

Fillmore, L.W., & Snow, C. (2000). What teachers need to know about language. *ERIC Clearinghouse on Language and Linguistics: Special Report.* http://faculty.tamu-commerce.edu/jthompson/Resources/FillmoreSnow2000.pdf

Foucault, M. (1970). *The order of things: An archaeology of the human sciences.* New York: Random House-Vintage.

Gandara, P., Maxwell-Jolly, J., & Driscoll, A. (2005). *Listening to teachers of English language learners.* Santa Cruz, CA: Centre for the Future of Teaching and Learning.

Gerdes, P. (1995). *Ethnomathematics and education in Africa.* Stockholm: University of Stockholm Institute of International Education.

Gerdes, P. (1997). Survey of current work in ethnomathematics. In A. Powell & M. Frankenstein, (Eds.), *Ethnomathematics: Challenging eurocentrism in mathematics education* (pp. 331–372). New York: SUNY Press.

Giddens, A. (1999). Excerpts from a keynote address at the UNRISD conference on globalisation and citizenship. *UNRISD News* #15.

Gilmer, G.F. (2001). Ethnomathematics: A promising approach for developing mathematical knowledge among African American women. In J. E. Jacobs, J. R. Becker, & G. F. Gilmer (Eds.), *Changing the faces of mathematics: Perspectives on gender* (pp. 79–88). Reston, VA: National Council of Teachers of Mathematics.

Habermas, J. (1998). *The inclusion of the other: Studies in political theory* (C. Cronin & P. D. Greiff, Eds.). Cambridge, MA: MIT Press.

Habermas, J. (2001). *The postnational constellation: Political essays* (M. Pensky, trans. & ed.). Cambridge, MA: MIT Press.

Hancock, S. J. C. (2001). The mathematics and mathematical thinking of four women seamstresses. In J. E. Jacobs, J. R. Becker, & G. F. Gilmer (Eds.), *Changing the faces of mathematics: Perspectives on gender* (pp. 67–78). Reston, VA: National Council of Teachers of Mathematics.

Hardt, M., & Negri, A. (2000). *Empire.* Cambridge, MA: Harvard University Press.

Harris, M. (1997). An example of traditional women's work as a mathematics resource. In A. Powell & M. Frankenstein, (Eds.), *Ethnomathematics: Challenging eurocentrism in mathematics education* (pp. 2215–222). New York: SUNY Press.

Holland, D., Lachicotte Jr. W., Skinner, D., & Cain, C. (1998). *Identity and agency in cultural worlds.* Cambridge, MA: Harvard University Press.

Joseph, G. G. (1993). A rationale for a multicultural approach to mathematics. In D. Nelson, G. G. Joseph, & J. Williams (Eds.), *Multicultural mathematics: Teaching mathematics from a global perspective* (pp. 1–24). Oxford: Oxford University Press.

Joseph, G. G. (1997). Foundations of eurocentrism in mathematics. In A. Powell & M. Frankenstein, *Ethnomathematics: Challenging eurocentrism in mathematics education* (pp. 61–82). New York: SUNY Press.

Kitchen, R. S., & Becker, J. R. (1998). Mathematics, culture, and power–A review of "Ethnomathematics: Challenging eurocentrism in mathematics education." *Journal for Research in Mathematics Education, 29*(3): 357–363.

Kitchen, R. S., & Lear, J. M. (2000). Mathematising Barbie: Using measurement as a means for girls to analyse their sense of body image. In W. G. Secada (Ed.), *Changing the faces of mathematics: Perspectives on multiculturalism and gender equity* (pp. 67–74). Reston, VA: National Council of Teachers of Mathematics.

Knijnik, G. (1997). An ethnomathematical approach in mathematical education: A matter of political power. In A. Powell & M. Frankenstein, (Eds.), *Ethnomathematics: Challenging eurocentrism in mathematics education* (pp. 403–410). New York: SUNY Press.

Millroy, W. L. (1992). *An ethnographic study of the mathematical ideas of a group of carpenters.* Reston, VA: National Council of Teachers of Mathematics.

Pinxten, R. (1997). Applications in the teaching of mathematics and the sciences. In A. Powell & M. Frankenstein, (Eds.), *Ethnomathematics: Challenging eurocentrism in mathematics education* (pp. 373–402). New York: SUNY Press.

Powell, A., & Frankenstein, M. (1997). (Eds.). *Ethnomathematics: Challenging eurocentrism in mathematics education.* New York: SUNY Press.

Reich, R. (1991). *The work of nations: Preparing ourselves for 21st century capitalism*. New York: Knopf.

Restivo, S. (1983). *The social relations of physics, mysticism, and mathematics*. Boston, MA: D. Reidel Publishing Company.

Rivera, F. (2004). In Southeast Asia (Philippines, Malaysia, and Thailand): Conjunctions and collisions in the global cultural economy. In W. Pinar (Ed.), *International handbook of curriculum research* (pp. 553–574). Mahwah, NJ: Erlbaum.

Rowlands, S., & Carson, R. (2002). Where would formal, academic mathematics stand in a curriculum informed by ethnomathematics? A critical review of ethnomathematics. *Educational Studies in Mathematics, 50*(1), 79–102.

Secada. W. G. (Ed.). (2000). *Changing the faces of mathematics: Perspectives on multiculturalism and gender equity.* Reston, VA: National Council of Teachers of Mathematics.

Stapleton, R. (1996). *Ancient Chinese Mathematics.* Ethnomathematics Digital Library. Available online: http://www.unisanet.unisa.edu.au/07305/chinese.htm.

Vithal, R., & Skovsmose, O. (1997). The end of innocence: A critique of ethnomathematics. *Educational Studies in Mathematics, 34*(2), 131–157.

Walkerdine, V. (1997). Difference, cognition, and mathematics education. In A. Powell & M. Frankenstein, (Eds.), *Ethnomathematics: Challenging eurocentrism in mathematics education* (pp. 201–214). New York: SUNY Press.

Zaslavsky, C. (1973). *Africa Counts: Number and pattern in African culture.* Boston: Prindle, Weber & Schmidt.

Zaslavsky, C. (1997). World cultures in the mathematics class. In A. Powell & M. Frankenstein, (Eds.), *Ethnomathematics: Challenging eurocentrism in mathematics education* (pp. 207–320). New York: SUNY Press.