BEYOND EUROCENTRISM: SITUATING ETHNOMATHEMATICS WITHIN THE HISTORY OF MATHEMATICS NARRATIVE

Iman Chafik Chahine[1]
Georgia State University

ABSTRACT

The purpose of this paper is to provide a brief background on the history of mathematics as debated from a sociopolitical stance. This paper sheds light on the role of ethnomathematics and culturally relevant mathematics in advancing the teaching and learning of mathematics for learners from diverse backgrounds. The author reviews efforts to integrate the history of mathematics in the mathematics classroom and introduces potential artifacts and culturally-designed materials inspired by ethnomathematical research that can potentially enhance students' engagement and interest in mathematics. Finally, the paper explores current debate on the role of ethnomathematics as pedagogy revolutionizing mathematics teaching and learning.

Keywords: Ethnomathematics, History of mathematics, Eurocentrism, Teaching Mathematics.

[1] ichahine@gsu.edu

INTRODUCTION

The date is July 2007; the place is University of Dakar; the event is French president Nicolas Sarkozy's infamous speech, which was directed to the elite young African college students at the university:

> Le drame de l'Afrique, c'est que l'homme Africain n'est pas assez entré dans l'histoire. Le paysan Africain, qui depuis des millénaires, vit avex les saisons, dont l'idéal de vie est d'être en harmonie avec la nature, ne connaît que l'éternel recommencement du temps rythmé par la répétition sans fin des mêmes gestes et des mêmes paroles.
>
> [The tragedy of Africa is that the African man has not fully entered into history. The African peasant, who for thousands of years has lived according to the seasons, whose life ideal was to be in harmony with nature, only knew the eternal renewal of time, in rhythm with the endless repetition of the same gestures and the same words.] (Ba, 2007)

Sarkozy's speech is reminiscent of a longstanding portrayal of the civilizing role that European colonialism has assumed in Africa and Asia, a true positioning of the non-Western world on the threshold of history and on the periphery of modernity. The spirit of Anglo/Euro-centric modernity that continues to recur in prominent political discourses brings back memories not only of intentional racist positioning but of a persistent devaluation of other, less "affluent" societies' contributions to history, development, and progress. Such a prejudiced representation reflects an intentional calibration of intellectual superiority that privileges the historical contributions of some cultures and civilizations while undervaluing those of others. These Eurocentric biases are wider than Africa and deeper than any fleeting political fad. Because Europe has monopolized the production and dissemination of scientific knowledge for at least 300 years, many paradigms of *all* other cultures are endlessly compromised. A more striking illustration of Eurocentric influence on the scrupulous characterization and appropriation of scientific knowledge is vividly portrayed in the histories of mathematics.

The purpose of this paper is to present a systemic account of the underlying directionality in the general history of mathematics, particularly as portrayed in the traditional Eurocentric trajectory. We will argue that the resistance to acknowledging the contributions of other cultures and civilizations in the production and dissemination of rigorous mathematical knowledge, though deliberate, nonetheless emanates from a state of unawareness of the value and complexity of others' knowledge.

A GLIMPSE AT THE HISTORY OF MATHEMATICS

The most mentally charged debate in the history of mathematics revolves around the nature of mathematical knowledge. While some historians, such as Florian Cajori (1859-1930), adopted a positivistic view of the nature of mathematical knowledge (Furinghetti & Radford, 2008), others believed that knowledge in general and mathematical knowledge in particular are far from being unproblematic, static concepts (Furinghetti & Radford, 2002). In an introduction to his book *A History of Mathematics*, Cajori (1919) stated, "The contemplation of the various steps by which mankind has come into possession of the cast stock of mathematical knowledge can hardly fail to interest the mathematician. He takes pride in the fact that his science, more than any other is an exact science" (p. ix). In positivists' view, knowledge is considered as an objective entity in the form of generalizations that are always true irrespective of time and place (Lincoln & Cuba, 1985). As such mathematics is seen as a body of infallible and objective truth rooted in the belief in the essential certainty and neutrality. That is why positivists' discourse in the history of mathematics is seen as that of unfolding *process*, which is assumed to follow the Enlightenment philosophy of rationalism and progress, a philosophy from which modern thought arose (Furinghetti & Radford, 2002).

On the other hand, a nonpositivist perspective assumes that there is no single knowledge but rather multiple knowledges that evolved as series of bursts and discontinuities under certain epistemological conditions (Furinghetti & Radford, 2002). In this paradigm, it is believed that as humans change, the knowledge they produce also changes. As a result of this view, knowledge is seen as continually created and recreated as people act and reflect on the world.

With the political momentum of events that prevailed during the 19th century, particularly the outburst of the Great Revolution in France and the alliance of the old colonial powers--Britain, Russia, Portugal, Spain, The Netherlands, and later Belgium and Germany--to conquer, colonize, and exploit the world, the furious debate on the nature of knowledge has inflated into what Foucault calls a “power-knowledge” nexus. Foucault (1977) proposed that "there is no power relation without the correlative constitution of a field of knowledge, nor any knowledge that does not presuppose and constitute at the same time power relations" (p. 27). When examining multiple forms of knowledge in relation to "science,” Foucault implied a *status quo* that invests "discourses and those who uphold them with the effects of a power which the West since Medieval times has attributed to science and has reserved for those engaged in scientific discourse" (p. 85).

Supporters of Foucault’s ideology tear apart traditional perspectives on the history of mathematics to reveal how this body evolved as a result of various strategies of power and knowledge in the modern period. Consequently, the dispute around the nature of knowledge moved from describing various structural forms of knowledge to a rather politically charged notion of a “hegemonic knowledge” owned by the colonizer and the product of power relations that repress and eradicate “subjugated knowledges” of the colonized (Powell & Frankenstein, 1997).

A critical look at the traditional histories of mathematics discloses a devaluation of the mathematics developed and expanded by non-Greek civilizations (Selin, 2000). In his famous book *A short account of the history of mathematics*, Rouse Ball (1960) stated, “The history of mathematics cannot be traced back to any school or period before that of the Ionian Greeks” (p. 1). Also, Rudman (2007) declared, “The mathematics developed by about 200BCE in Egypt and Babylon was the inheritance of the Greeks” (p.17). In a similar vein, many books on the traditional history of mathematics describe mathematics as a discipline absolutely integrated with Western civilization, which is portrayed as conquering and dominating the entire world. From a sociopolitical stance of the colonization era, mathematics is considered as solely Eurocentric and the sheer cultivation of Western elite thought. Bishop (1990) described Western mathematics as “one of the most powerful weapons in the imposition of Western culture” (p. 52). Similarly, D’Ambrosio (1996) explained, “[when talking about Western mathematics] especially in relation to Aboriginals or Afro-Americans or other non-European peoples, to oppressed workers and marginalized classes, this brings the memory of the conqueror, the slave-owner, in other words, the dominator; it also refers to a form of knowledge that was built by him, the dominator, and that he used and still uses to exercise his dominance" (p. 113).

Notwithstanding the fact that early Europeans and ancient Greeks acknowledged the mathematical contribution of the Egyptians, some contemporary Euro-American historians still refute this reality and consider it a myth (Selin, 2000). For instance and when speaking of Al-Khwarizmi's contributions to the field, Burton (2007) contended, "In speaking of Al-Khwarizmi, we do not mean that he personally was the inventor of algebra, he was only the representative of an old Persian school who preserved its methods for posterity through his books. . . . This early Arabic algebra was still at the primitive rhetorical phase--a phase characterized by mathematical symbols. . . . Algebraic rules of procedure were proclaimed as if they were divine revelations, which the reader was to accept and follow as true believer" (pp. 241-242). Devaluing the contributions of the Egyptians, Chinese, Indians, and Arabs and denying inventions of indigenous and tribal societies in the development of mathematical knowledge and in science in general are facets of an ideological prejudice adducing the conviction that the "European mind and its cultural products are superior to those of other peoples and races" (Ernest, 2009, p. 198).

There is an extensive corpus of literature providing evidence that mathematics, throughout history has been commonly represented in a Eurocentric way (Joseph, 2011; Powell & Frankenstein, 1997, Pearce, n.d.). Eurocentric views claim that before the emergence of Greek mathematics, mathematical activities used in Egypt and Mesopotamia were strictly utilitarian and, thereof, lacking in robustness and rigor (Ernest, 2009; Joseph, 1997). When discussing the foundations of Eurocentrism in mathematics, Joseph (1993) asserts that naming some mathematical results after the Greeks and Europeans is "misleading" and represents a clear expression of domination and exploitation. He illustrates, "For example, the earliest known demonstrations of the theorem of Pythagoras are found in an ancient Chinese text, *Chou Pei*, conservatively dated around the latter half of the first millennium BC and in the *Sulbasutras* (c. 800-500 BC) from India. Antecedents of Pascal's triangle, Gregory's series or the Ruffini-Horner method are all found outside Europe" (pp. 13-14).

However, new prospects on the history of mathematics that challenge the traditional Eurocentric views have recently emerged. Such perspectives acknowledge and emphasize the contributions of non-Western, indigenous cultures, including those of the Pacific, African, and American continents, to the development of science and mathematics.

As a reaction to traditional Eurocentric views, Joseph (2011), Pearce (as cited in Ernest, 2009), and others suggested an alternative, unbiased trail to the history of mathematical development. This new trajectory shifted the attribution of mathematical knowledge from Western Europe to a recognized contribution of different cultures, particularly emphasizing the role of Arabs and that of the Indians in the refinement and diffusion of mathematical knowledge. However, efforts fall short in acknowledging the vibrant body of mathematical knowledge implicit in traditional or small-scale surviving cultures, lesser known to the mathematical community. Ascher (2002) indicates that there 6,000 cultures that existed within the past 500 years and capitalizes on the riches that can be cultivated from studying cultural practices and heritage. Cultures such as the Inuit, Iroquois, and Navajo of North America; the Incas of South America; the Bushoong, Kpelle and Tshokwe of Africa; and the Caroline Islanders, Malekula, Maori, Warlpiri, and Trobriand Islanders of Oceania, Ascher (2002) explained, enrich and add nuances to mathematical knowledge.

In this context, various mathematical knowledges have been proposed and were given different names, such as *Indigenous mathematics*; *Sociomathematics* (of Africa); *Informal mathematics*; *Spontaneous mathematics*; *Oral mathematics*; *Oppressed mathematics* (of the Third World during the colonial occupation, that was not *recognized* as mathematics by the dominant ideology and which was inspired from works of Freire, 1972); and *Non-standard mathematics* (Carraher, Carraher, & Schliemann, 1985; Jurdak & Shahin, 1999), in which other mathematical forms have developed in the "streets," outside the school context.

THE ROLE OF ETHNOMATHEMATICS

D’Ambrosio (1999), who coined the term, defined ethnomathematics as “a program in history and epistemology with an intrinsic pedagogical action [that] responds to a broader conception of mathematics, taking into account the cultural differences that have determined the cultural evolution of human mankind and political dimensions of mathematics” (p. 150). Drawing on the belief that, from prehistoric ages, humans have been accumulating knowledges to respond to their drives and needs, ethnomathematics promotes the belief that all people are capable of doing mathematics using their own unique and personal perspectives. In this vein, ethnomathematics is seen as emerging from within individuals while interacting with their cultural and physical environments. Nunes, Schliemann, and Carraher (1993) argue that ethnomathematics develops when there is a discrepancy between people's need for problem solving and the amount of mathematics they have learned in school (i.e., when people become involved in tasks requiring problem solving skills that are not learned in school). In this argument, ethnomathematics is believed to be closely tied to issues of access and equity (Anderson, 1997).

D’Ambrosio (1985) also proposed a broader conceptualization of mathematics which encompasses mathematical knowledge of diverse cultural groups that sustain democratic access of knowledge by all students irrespective of their sociocultural backgrounds. Additionally, Ascher (1991) explained that broadening the perspective to encompass other cultures extends the contribution of all classes of societies and not only the elite.

USE OF CULTURALLY-RELEVANT MATERIALS

There is ample evidence in literature that supports the claim that culture can be implemented in the mathematics classroom in various ways and utilizing a wide range of varying resources. Kim (2000) proposed two ways to integrate ethnomathematics in the process of teaching and learning in the mathematics classroom: first through the use of inventive ideas inspired from one’s own culture and second by the exploration of new ideas in other cultures. Kim also emphasized the role that ethnomathematics materials play in the enculturation and acculturation processes within and across diverse cultures. Research on the ethnomathematics of different cultures has provided a wealth of creative and thought-provoking materials, such as number systems, folk games and puzzles, kinship relations, divination systems, and symmetric strip decorations that can be actively explored by students in the classroom to enhance their learning and appreciation of mathematical structures. Ascher (2002) argued that what makes culturally derived mathematical ideas so powerful is their embeddedness in socio-cultural contexts that invoke their emergence as inherent part of the complex of ideas around them. Such contexts include *divination*, *calendrics*, *religion*, *social relations, decoration* and many others.

Artifacts most powerful in unfolding creativity and rigor of cultural heritages are indigenous games. Kim (2000) cited more than 200 games that were inspired from the history of mathematics across many cultures. The power of games in teaching lies in their ability to raise students' interest and provide a tool that brings into play many thought-provoking strategies that hone their mathematical skills.

Other forms of folk games have been documented in the literature that relate to the teaching and learning of mathematics in many different ways. Sizer (2000) cited several games of chance and of strategy as well as puzzles which were developed and used by the Pacific cultures and which can serve as tools to represent basic notions of probability, expectation, and fairness. These include the Hawaiian game of *lu-lu*; the *Zambales* dice game; the Hawaiian game of *Konane*; the *Main Machan* board game, which was played by the Iban tribe of Borneo; and the Hawaiian *Pu-waa-pa* cord and block puzzle.

Other sources of knowledge that can enrich and invigorate the learning of mathematics include mathematical ideas inspired by the logic underlying kinship relations. In examining the logical structure of the kinship system of Warlpiri native Australian tribe, Ascher (1991) describes a highly sophisticated dihedral mathematical group of order 8 with specific matricycles as well as patricycles that guide interpersonal relationships. When using such a logical system and in order to unbutton its peculiarities, the author draws heavily on ideas from graph theory as well as group theory.

Additionally, Eglash (1997) investigated the most mathematically significant aspect of doubling in African religion that occurs in the divination ("fortune-telling") techniques of Vodun, Ifa, and Bamana. He described the technique of Ifa as purely *stochastic* (i.e., operating by pure chance) and that of Bamana as systematic, highly compact oracles which follow laws of recursion. Asher (2002) described a twin of the Bamana technique 5,000 miles to the east in Malagasy Sikidy. The rich available literature presents ample evidence that these major African divination systems were all transformations of the Arabic system of 'Sand Science' (*ilm al-raml*) or 'Sand Calligraphy' (*khatt al-raml*), which spread from Abbasid Iraq all over the Islamic world, the Indian Ocean region, and Africa from the late first millennia CE onwards (Van Binsbergen, 1999).

There is no doubt that various uses of materials represent invaluable clues to cultural connections and continuities through space and time. Besides the more obvious advantages concerning the possibility for providing a better understanding of tools and resources of civilizations, use of culturally relevant materials contain within it the keys to concepts which are believed to be at the heart of some sophisticated mathematical notions. This presents an open invitation to educators to bring unconventional mathematics into the classrooms and to build on the mathematical ideas that students bring from their experiences in their homes and in their communities.

The importance of integrating cultural practices that resonate with students' ethnic background experiences in the mathematics classroom have been extensively documented in the literature. In a final report of The National Council of Teachers of Mathematics (NCTM) Achievement Gap Task Force (October 2004), the committee recognized that "the achievement gap is *not* a result of membership in any group, but rather *is* the result of the systematic mistreatment of learners caused by racial and class bias—conscious and unconscious, blatant and subtle, personal and institutionalized. There is plentiful evidence of deep structural injustices in how the U.S. school system distributes opportunities to learn mathematics" (pp. 2-3). One of the committee's recommendations was to expand efforts to examine research areas that integrate race, ethnicity, social class, and language issues pertinent to closing the mathematics achievement gap. The claim that has been forwarded is that children from diverse ethnic groups have different modes of thinking, possess diverse perceptual abilities, and spend differential efforts on tasks depending on personal criteria of perceived usefulness (Lamon, 2003).

In his book, the *Geography of Thought*, Nisbett (2003) expands the view that people coming from different ecologies and social structures hold different cognitive and affective systems. In striking a comparison between Easterners and Westerners, Nisbett explains,

> *The collective or interdependent nature of Asian society is consistent with Asians' broad, contextual view of the world and their belief that events are highly complex and determined by many factors. The individualistic or independent nature of Western society seem consistent with the Western focus on particular objects in isolation from their context and with their Westerners' belief that they can know the rules governing objects and therefore can control the objects' behaviour. (p. 17)*

With such diversity in modes of thinking and in abilities, such views support the notion that there is no universal way to teach mathematics for all children. More interesting is the belief that even mathematics has no generally agreed upon definition. The only truth is that "the category 'mathematics' is Western and so is not to be found in traditional cultures" (Ascher, 1991, p. 3).

INTEGRATING THE HISTORY OF MATHEMATICS IN TEACHING MATHEMATICS

There has been an outburst of demands calling for integrating the history of mathematics in the teaching of mathematics and teacher education in schools worldwide. The most compelling reason cited in support of this movement is a push toward humanizing the field by fostering *cultural understanding* (Furinghetti, 2007) and deliberately replacing the "usual with something different" (Tymoczko, 1994, p. 335).

Calls to include the history of mathematics into the daily practice of teaching mathematics were raised in the Tenth International Congress on Mathematical Education conference in Copenhagen (July 2004). Major recommendations of the conference include invitations to schools to incorporate the history of mathematics in elementary, secondary and postsecondary classrooms as a way of making connections as well as adding meaning to students' experiences while engaged in learning mathematics. The essence of the message propagated by the History of Mathematics Study Group is captured in the following statement:

> *History of mathematics is not to be regarded as a panacea to all pedagogical issues in mathematics education, just as mathematics, though important, is not the only subject worth studying. It is the harmony of mathematics with other intellectual and cultural pursuits that makes the subject even more worth studying. (Siu & Tzanakis, 2004, p. 367)*

CONCLUDING REMARKS

Throughout history, mathematics has been viewed as a catalyst fueling the debate on the knowledge power nexus and contributing to the production of a number of social and political conflicts (Vithal & Valero, 2003). A closer look at the history of mathematics provides a rationale for the role that mathematics has played in the process of globalization. Racism, sexism, and social/ideological injustices that have been long ascribed to colonial prejudices denying communities and cultures their history and intellectual heritage are gradually confronted by a critical awareness in the legitimate systems of knowledge that are inherent in many cultural practices and which have been exposed by ethnomathematical research that transcends past and present politicized discourses. In another sense, replacing the narrow and traditional notion of history of mathematics with the dynamic and *anachronical* notion of *historicity* (De Lissovoy, 2008) opens up the space of possibility to redefine mathematical knowledge as the collective, epistemological expressions and human experiences of diverse cultures and civilizations.

If we accept the premise that mathematics is a ticket for aspiring individuals and countries for technological and thereof economic development, then we should demand that all peoples have the right and proper means to access it. Furthermore, if we believe in what it means to be mathematically literate, then perhaps we need an inclusive vision of what counts as mathematics, a pedagogy built around a set of core human values that enhance life and protect humanity. We have witnessed and are still witnessing the sociopolitical power of mathematics in driving nations' progress toward economic and technological development. Concurrently, we are gazing at how our humanity is regrettably slipping away under the rhetoric of globalization and capitalistic appropriation of societies and under the "drums of triumphant technology at the expense of ecology, culture, and peoples" (Fasheh, 1997).

Indeed, there is a sense of urgency now to engage in a mathematics education that advances an epistemological shift away from reductionist perspectives on how we perceive future citizenry toward a radical education that encourages critical pedagogies which revolutionize space, content, and approaches to teaching and learning; pedagogies that transform the classroom into democratic spaces for reconfiguring history, empowering students as well as teachers toward the pursuit of truth; and pedagogies that reclaim our cultural spaces by

> *developing more than just mathematicians in the very strict sense of the word, [but] critical intellectuals who are scientists, who are not only apt in their discipline, but also see the work that they are doing as connected to the society they're in, and see their society as connected to other societies on the planet. (Powell & Frankenstein as cited by Greene, 2000, p. 7)*

Could ethnomathematics live up to such pedagogies? And if so, who decides?

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